Determining tourism climate change mitigation and adaptation strategies at a selected private game reserve in South Africa

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Declaration

I, Zinzi Eugene Sibitane, student number 216030374, declare that the study titled: "Determining tourism climate change mitigation and adaptation strategies at a selected private game reserve in South Africa" is my work which has never been submitted anywhere for examination. This dissertation is the result of my own independent work except where otherwise stated. The sources are acknowledged by giving explicit references. A list of references is included in the dissertation.

Signature:

Date: 06/12/2021

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Dedication

This dissertation is dedicated to all my family members, especially my mother, grandfather, and late grandmother, who always supported me with prayers and encouraging words throughout this journey.

Abstract

Background

Climate change is a significant threat that affects the natural environment and the industries dependent on it for their livelihoods, such as coastal and nature-based tourism. Regardless of this knowledge, vast knowledge gaps still exist regarding how climate variability and change affect nature tourism operations and response strategies.

Aim

This study aims to determine tourism climate change mitigation and adaptation strategies at one of the leading private game reserves in South Africa, Phinda Private Game Reserve.

Methodology

The study adopted the pragmatism philosophy, which informed the use of the mixed methods research design. Data collection was conducted at Phinda Private Game Reserve in May 2021. The data was collected through field observations, in-depth interviews with Phinda Private Game Reserve staff, archival and secondary data analysis. Primary data were analysed using qualitative data techniques, which followed an interactive content and thematic analysis process. Secondary data was analysed using content analysis, whereas trend analysis was applied to archival data (climate data). Using Mann Kendall Trend Analysis, trend analysis was analysed to track climatic trends such as climate variability and change and test their significance.

Results and discussion

The study identified several vital climatic challenges attributed to climate variability and change, increasing temperature, and extreme rainfall, resulting in localised flooding and droughts. These climatic threats have resulted in challenges for tourism operations ranging from disturbed sleep for tourism employees, dying off birds due to extreme heat, destruction of infrastructure, loss of biodiversity, water shortages and other such challenges over the last couple of years. The lodge has responded by adopting climate change mitigation adaption strategies to address carbon risk and extreme weather events. Measures adopted by the reserve include adopting measures aimed at reducing

the company's carbon footprint and protecting tourism infrastructure from the damaging impacts of extreme weather events.

Recommendations

The study recommends adopting additional measures to deal with its carbon footprint, such as investing in renewable energy as part of its mitigation strategy and continuing its research in biodiversity conservation, which can offer a solution to species protection in the context of climate change. The study also recommends continued research and monitoring of climate change impacts and tourism response, given the continued shift in the climate in the region.

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Chapter 1:   Background and Introduction to the Study

1.1   Introduction

There are growing concerns and attention that climate change results in severe negative impacts on the sensitive tourism sector around the world, such as coastal tourism and nature-based tourism (Rossello & Waqas 2015:4). Excessive changes in the climate of a region result in significant challenges (intense and more frequent drought, storms, heat waves and rising sea level), which affect the global economies and South Africa in particular (Rossello & Waqas 2015:5). The Southern African region is part of the regions which are more exposed to climate change-induced impacts (Rogerson 2016:322). Novella, Ghiotti, Bruschi and Bariani (2015:222) noted that as a consequence of climate change, achieving and managing a sustainable tourism industry becomes a challenge. Floods, droughts, storms, and natural hazards caused by climate change make it difficult for the tourism sector to respond to and reduce the costs of adaptation and mitigation measures (Kajan, Tervo-Kankare & Saarinen 2015:311).

The tourism industry, especially nature-based tourism (public and private game reserves), is vulnerable to the negative impacts posed by climate change and extreme weather events, which undermines natural resources (environment) to promote tourism (Becken 2015:53). The reliance of game reserves in the natural environment increases the vulnerability to being fundamentally undermined by the impacts of climate change (Kilungu, Leemans, Munishi, Nicholls & Amuleng 2019:235). The impacts of climate change such as increasing average temperatures, intense drought and flooding are major threats to game reserves, thereby compromising biodiversity conservation, tourism infrastructure and tourism operations (David-Reddy and Vincent 2017:30).

The negative impacts of climate change are declared to disturb tourism services and operations, damage infrastructure, alter tourist destination geography and minimise the comfort of tourists (Dube & Nhamo 2018:114). A recent example in South Africa was the droughts in Cape Town from 2016 to 2018, which made world headlines, where the daily water supply was severely restricted, compromising tourism in the area (Otto, Wolski, Lehner, Tebaldi, Van Odenborch, Hagesteeger, Singh, Holden, Fuckar

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& Oldoulami 2018:2; Sousa, Blamey, Reason, Ramos & Trigo 2018:1). The restrictions anticipated during the prolonged period of drought in Cape Town from 2015 to 2016 affected the region and the promotion of tourism activities, especially nature-based tourism (Swemmer, Bond, Donaldson, Hempson, Malherbe & Smit 2018:1).

Consequently, the tourism industry is a contributor and a casualty of climate change through the emission of greenhouse gases (GHGs) that result in global warming, which causes climate change (Michailidou, Vlachokostas & Moussiopoulos 2016:2). Dube and Nhamo (2019a:2025) stated that climate change would cause destruction and damage to infrastructure, undermining tourism operations, destination's attractiveness and destructions in tourism components (tourist boards, travel services, accommodation services, conference and events, and attractions and tourism services). Dawson (2015:2) argues that an increase in the occurrence of extreme weather events such as floods results in continuous damage to tourism infrastructure. The impacts of climate change (floods, droughts and storms) cause considerable damage to buildings, traffic, and transport infrastructure (Bergmüller, Schwarz & Tischler 2018:1). Also, these climate change impacts affect energy and food supplies, affecting tourism operations and services (Bergmüller *et al.* 2018:1).

According to Ziervogel, New, Archer Van Garderen, Midgley, Taylor, Hamann, Stuart-Hills, Myers and Warburton (2014:606), climate change poses considerable threats to South Africa's natural resources, health, infrastructure, ecosystem services and biodiversity. Therefore, there is a need to take action and deal with climate change. Gössling, Schroder, Spath and Freytag (2015:203) argue that as a solution, the tourism sector needs to reduce carbon emissions by 40% by 2030 to avoid dangerous climate change, which might undermine adaptation efforts.

The carbon footprint reduction for tourism should aim at carbon produced directly from tourism activities consumed or purchased by the tourists (Lenzen, Sun, Faturay, Ting, Geschke & Malik 2018:522). The carbon footprint reduction can be achieved by implementing adaptation and mitigation measures to combat climate change. Climate change mitigation is explained by Elum, Modise and Marr (2017:249) as an advent process of making efforts to minimise or eliminate the production of GHG emissions to stop global warming. Furthermore, Climate change mitigation involves decreasing GHG outpouring and expanding carbon-neutral (Joyce, Brisket, Brown, Polley &

McCarl 2018:514). On the other hand, climate change adaptation is defined as the measures taken to strengthen the resilience of individuals and systems to adapt and respond to climate variability and change (Elum *et al*. 2017:248).

1.2 Rationale and motivation

Nature-based tourism, including the game reserves, is more sensitive to climate change-induced impacts (Preston-Whyte & Watson 2005:132; Pandy & Rogerson 2018:104). Dube and Nhamo (2020a:88) documented the adverse effects of floods, drought and increasing temperature on Kruger National Park (KNP). Two studies conducted in South Africa by Dube and Nhamo (2020b:2) and Smith and Fitchett (2020:108) have shown devastating effects of climate change on private game reserves in the country, for example, droughts and bushfires. However, a knowledge gap exists on how private game reserves adapt and mitigate climate change impacts.

The realisation of the significant challenges produced by climate change has led national officials across the world to focus on developing, promoting and implementing adaptation measures in their policies to avoid mal adaptation (Rauken, Mydske & Winsvold 2015:408). According to Hoogendoorn and Fitchett (2016:1), a call made for more research focused on the evidence and implications of climate change on tourism as the sector is vulnerable and lacking necessary adaptation capacity. Therefore, the study aims to fill the knowledge gap on how private game reserves adapt and mitigate climate change impacts.

According to Van Wilgen, Goodall, Holness, Chown and McGeoch (2016:707), high anthropogenic temperature increases due to global warming and persistent aridity, including natural areas such as parks and game reserves, thus, threatening the plants and animals. The Intergovernmental Platform on Biodiversity and Ecosystems-IPBEs (2019:257) reported that severe threats to species extinction face the world due to the global change mainly driven by climate change. This increases the demand for the tourism sector to reduce and adapt to climate change to ensure a sustainable tourism industry in the future (see Figure 1.1).
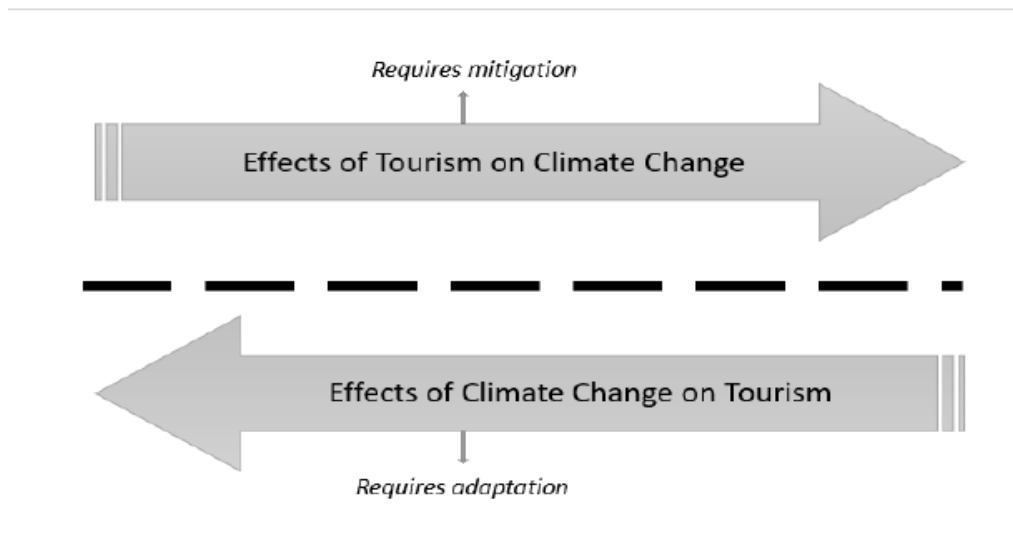
Figure 1.1: Dual relation between tourism and climate change: Source (Patterson, Bastianoni & Simpson 2006:341).

Tourism is one of the significant sources of climate change and is also suffering from climate change. Consequently, there is a need for the industry to devise measures to reduce and adapt to climate change to ensure sustainable business and global sustainability (Dube & Nhamo 2018:40; Mjimba & Nhamo 2019:201). Climate change needs people to adopt or shift to new measures and change resources, their knowledge and alter entrance to and control resources (Eriksen, Nightingale & Eakin 2015:523).

1.3   Problem statement

The tourism industry is vulnerable to climate variability and change as the impacts of climate change on infrastructure and the natural environment has the ability to affect the tourism operations and services (Department of tourism 2017:2). Private nature reserves in South Africa are no exception to being fundamentally affected by climate change variability and change due to its reliance on the natural environment and ecosystem services for their livelihood (Diaz-Reviriego, Turnhout & Beck 2016:457).

The need for private nature reserves to adapt to and mitigate climate change cannot be overemphasised (Eriksen *et al.* 2015:523). Numerous studies have been conducted on climate variability and change impacts on nature-based tourism and tourism vulnerability to climate change in the Southern African region, for example, Dube and Nhamo 2018, 2020, and 2021; Smith and Fitchett 2020; Hoogendoorn and

Fitchett 2020; Dube, Nhamo and Chikodzi 2020; and Kupika, Gandiwa, Kativu and Nhamo 2017.

However, there is still a knowledge gap of scientific understanding of how private game reserves are performing regarding climate change adaptation and mitigation. Nevertheless, this understanding is key to crafting policies and strategies for bolstering the resilience of nature reserves to climate change. National policy dictates a situation that might threaten industry sustainability, and there is a need to respond to this knowledge gap (DEA 2018:34). Therefore, this study aims to investigate how the tourism industry, particularly private game reserves, are responding to climate change to ensure a climate-smart and climate-resilient future. Through climate change adaptation and mitigation, the tourism industry can decrease related threats and make use of the new opportunities that come with mitigation and adaptation strategies (United Nations World Tourism Organisation-UNWTO 2018:7).

1.4   Research aim and objectives

1.4.1   Research aim
The primary aim of the study is to determine tourism climate change mitigation and adaptation strategies at Phinda Private Game Reserve in KwaZulu-Natal, South Africa.

1.4.2   Research objectives

The study is guided by the following objectives:

- To determine the trends of temperature, rainfall, sea-level rise and lightning at Phinda Private Game Reserve.
- To determine the impacts of climate change and variability at Phinda Private Game Reserve.
- To explore the climate change mitigation measures at Phinda Private Game Reserve.
- To explore the climate change adaptation strategies at Phinda Private Game Reserve.

1.5 Research questions

The primary research question is: How is the selected Phinda Private Game Reserve in South Africa mitigating and adapting its tourism operations to climate change?

Secondary research questions are as follows:

- What are the trends of temperature, rainfall, sea-level rise and lightning at Phinda private game reserve?
- What are the impacts of climate change on tourism operations at Phinda Private Game Reserve?
- What climate change mitigation strategies are adopted by Phinda Private Game Reserve's tourism business operations' value chain?
- Which adaptation strategies are being adopted by Phinda Private Game Reserve in responding to climate change impacts?

1.6 Limitations of the study

The study was limited because the data was only collected from a private game reserve in KwaZulu-Natal, while it can be expanded to public nature reserves in other locations. The study only used two data collection methods (in-depth interviews and field observation). The duration for data collection was limited to a few days with the participants. The reliance on human subjects as the source of information may vary depending on the person interviewing them and the mood of the day.

1.7 Outline of the study

Chapter 1: Background and introduction of the study

This chapter provides an introduction and background to the study. This chapter also highlights the gap that caused the study to be conducted and explains the problem statement as well as the rationale and motivation of the study. Besides, it provides aims and objectives together with research questions.

Chapter 2: Literature review

This chapter covers all theories and contextualisation of the research, highlighting existing knowledge practices and gaps in climate change mitigation and adaptation

strategies in the South African context. This chapter also covers an overview of the tourism industry the relationship between tourism and climate change. It presents empirical knowledge in tourism and climate change in protected areas, the role of tourism and contribution to climate change and provides more information on climate change mitigation and adaptation strategies by the tourism industry.

Chapter 3: Research methodology

This chapter elaborates the research design, study area, study population, sampling and description of the sample, pre-testing, data collection methods, data analysis, ethical considerations and data management used to conduct the study.

Chapter 4: Interpretation and presentation of results

This chapter provides the findings on the evidence of climate variability and change impacts at Phinda Private Game Reserve. This chapter also provides evidence of temperature increase, sea-level rise, rainfall and lightning and storms. These findings are represented in graphs and tables for quantitative data. Qualitative data the data is represented in a narrative form, photographs and tables to display the themes.

Chapter 5: Climate change mitigation and adaptation

This chapter aims to discuss various climatic actions adopted at Phinda Private Game Reserve to deal with the adverse impacts of climate variability and change. The first section of the chapter deals with ways in which the tourism industry is trying to reduce the impact of tourism operations on the environment through climate change mitigation measures. The second section of the chapter covers ways in which the reserve is trying to live with the impacts of climate change.

Chapter 6: Conclusion and recommendations

The purpose of this chapter is to provide the conclusion to the research and to make necessary recommendations. In this chapter, conclusions are drawn based on the study results, and the study's shortcomings are mentioned. Recommendations are made regarding the tourism climate change mitigation and adaptation strategies for private nature reserves. Limitations and the value of the study are highlighted. Suggestions for future research based on the findings concludes this chapter.

1.8 Chapter summary

This chapter introduced the background of the study and provided motivation for conducting the study. The problem statement and a clear overview of the research aim and objectives are elaborated with the outline of the study. Therefore, the following chapter will provide more information in the literature review that guides the study.

Chapter 2:   Literature review

2.1   Introduction

This chapter provides the theoretical background of the research and places the study into the global, regional and contextual framework. Amongst other things, the chapter highlights existing knowledge, practices and knowledge gaps in tourism and climate change mitigation and adaptation in protected areas. The chapter assumes a global overview, narrowing down to regional and local levels (South African). It presents empirical knowledge in tourism and climate change in protected areas, the role of tourism and contribution to climate change and provides more information on climate change mitigation and adaptation strategies by the tourism industry.

2.2   An overview of the tourism industry

Prior to the COVID-19 pandemic, the tourism industry was one of the fastest-growing economic sectors across the world (Nhamo, Dube & Chikodzi 2020a:353). Before the pandemic, the tourism sector was growing faster than the global economic growth rates (World Travel and Tourism Council-WTTC 2019:1). The UNWTO (2019:55) defines tourism "as a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business or professional purposes". As far back as the 1950s, the tourism sector was acknowledged as a significant profitable sector, and it has emerged and spread all over the world (Pulido-Femandez & Sanchez-Lopez 2018:268).

Tourism serves as a crucial economic sector that provides jobs and remuneration to individuals (Pandy 2017:1). According to Butgereit and Martinus (2018:38), the tourism industry plays an essential role in the Southern African region; it is seen as a significant contributor to the Gross Domestic Product (GDP) across many Southern African countries. In South Africa, the sector patrons 3% of the GDP of the country (Department of Tourism 2017:1). For many decades, the tourism sector has been the leading profit-making sector and the most significant contributor to the GDP (Department of Tourism 2018:1).

Besides, the tourism sector acts as a tool for reducing poverty and inequality in both rich and developing countries (Meyer & Meyer 2015:198). It contributes to the

diversification of the local economy, attracting foreign exchange investment that leads to the improvement of the country's balance of payments and the generation of jobs and income (Meyer & Meyer 2015:198). In 2017, the total spending of domestic and international tourists was about R227 billion (Statistics South Africa 2019:2). As of 2018, about 5% of the employed population worked in the tourism sector (Statistics South Africa 2018:1).

The tourism industry in South Africa also allows communities with abundant culture (cultural heritage) and history to turn their special assets for economic development (Sibisi & Abrahams 2018:190). Additionally, it contributes towards the non-economic benefits for the improvement of communities as well as helping in poverty reduction through employment creation (Mowforth & Munt 2016:20). Likewise, the sector contributes to conserving our diverse natural resources and promoting the South African diverse cultures (Rogerson 2016:322). However, some researcher argues that tourism promotes crime and encourages the exploitation of local indigenous people in cultural tourism (Canavan 2016:53).

Apart from the centrality of the industry to the region together with the Southern African economy in particular, recent studies point to the climate vulnerability of this sensitive economic sector (Dube, Nhamo & Chikodzi 2020:1). The predominance of nature-based tourism (responsible tourism that emerged as an alternative to the negative impacts of tourism activities on the natural environment (Oktay, Islek & Yasar 2016:47) on mountains, oceans, national parks, private game reserves, rivers and waterfalls means that the sector is exposed to harsh weather events, including floods, heatwaves and droughts (Dube, Mearns, Mini & Chapungu 2018:2).

2.3   The relationship between tourism and climate change
Human-induced (anthropogenic) climate change has emerged as a global threat to the global economy, particularly tourism, given its reliance on nature. Climate change refers to a change in the condition of the climate that can be recognised by alterations in the mean and/ or the variability of its properties and that persists for an extended period, commonly decades or centuries (IPCC 2017:1). The Intergovernmental Panel on Climate Change- IPCC's (2018:1) Special Report on 1.5°C noted that Sub-Saharan Africa falls with the places that are more exposed to the vagaries and effects of anthropogenic driven climate change. There is growing evidence of the impacts of

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climate harsh climatic events on Southern Africa's tourism economy (Hoogendoorn & Fitchett 2018b:742).

As a consequence, tourists (Dube & Nhamo 2020a:5), businesses (Dube & Nhamo 2020b:2), academics and other stakeholders (Pandy & Rogerson 2018b:1) have been raising serious concerns about the effects of climate change on tourists attractions across the Southern African Development Community (SADC) region. Climate change adversely affects tourism in Southern Africa by degrading natural resources that are used as tourist attractions in the region, such as national parks, conservation areas, fauna and flora, and water resources (Rogerson 2016:1). Previous studies have shown that droughts and floods are some of the biggest threats to tourism, especially wildlife tourism (Serdeczny, Adams & Baarsch 2016:1585).

According to Ma and Kirilenko (2019:3), tourism has a twin correlation with climate and weather. Climate, together with weather, is an essential factor in tourism that influences the operation of tourism businesses (Gössling, Abegg & Steiger 2016:1). Dube and Nhamo (2020f:28) pointed out that tourism has an impact on and is affected by the climate change on facilities, activities and the environment in which tourism takes place. Climate influences tourism as well, as it serves as an essential factor for motivating tourists about a specific tourism destination (Sifolo & Henama 2018:191).

For tourism, especially nature-based tourism, to thrive, absolute climate conditions are needed for activities and tourists to experience an enjoyable holiday (Dube & Nhamo 2020b:29). Many tourist attractions depend on the ideal climatic conditions and natural resources such as water, wildlife and ecological diversity (Becken 2015:59). To support this, nature-based and adventure tourism highly depends on ideal climate (favourable weather conditions that allow tourists to undertake tourism and participate in tourism activities) and weather, with activities such as skiing, hiking, water rafting, game viewing and bird watching largely depend on prevailing weather conditions (Fitchett 2018:1).

Climate variability and change are predicted to undermine or fundamentally change the raw materials (natural resource base) on which various types of tourism depend (Pandy 2017:1). Climate variability is the discrepancies in the mean condition and

other climate statistics at all spatial and temporal scales beyond weather events (IPCC 2016:557).

According to Dubois, Geron, Gösslings and Hall (2016:339), the correlation between tourism and climate change is quite complicated. Tourism contributes to climate change and is a victim of climate change through the emission of Greenhouse Gases-GHGs (Michailidou *et al.* 2016:2). Pandy (2017:5) stated that it is vital to recognise that beyond the increasing levels of risks and impacts caused by climate change on tourism, the sector is also a culprit of climate change. The tourism sector serves as a significant individual donor to climate change as it contributes about 8% to global carbon emissions (Lenzen *et al.* 2018:1). The tourism sector has been ranked or placed as a donor sector and suffers from climate change worldwide (Pang, MaCkercher & Prideaux 2015:4). "Tourism is often described as an industry that both add to climate change and impacted upon by climate change" (Dube & Nhamo 2018:113).

According to Pandy (2017:2), the observed temperature in the Southern African countries is higher than temperatures of other areas globally, with estimates for 3.4 Degrees Celsius in the overall yearly temperature when we compare to the period of 1980-1999 with 2080-2099. The impacts as a result of climate change on the southern African region, even as predicted by the climate scientists, are the increase in rainfall variability, late occurrence rain period and early occurrence of harsh climatic events such as floods, droughts, storms and wildfires (Rogerson 2016:322).

The occurrence of extreme weather events related to climate change indicates a critical threat to wildlife and tourism in southern Africa (Midgely & Bond 2015:823). The effects of climate change include increased water shortage, threatening wildlife resources (wild animals, wild plants and their habitat), and wildlife-dependant livelihoods (Sifolo & Henama 2016:192). Fundamentally, the tourism sector is within sectors that are severely affected by climate change in the world (Su, Hall & Ozanne 2018:92).

Climate change is a crucial component affecting localised economic growth futures connected to tourism. South Africa is one of the places more vulnerable to climate change-induced impacts across the world (Hoogerndoorn, Grant & Fitchett 2016:59;

Rogerson 2016b:322). The consequences of climate change on the economy of South Africa are becoming significantly harsh (Steyn & Spencer 2015:1). From 2015 to 2018, South Africa's iconic destination area, Cape Town, suffered the worst drought with ramifications such as water restrictions for the city's accommodation sector and tourism (Dube, Nhamo & Chikodzi 2018:5). The drought led to the infamous Day Zero, a day in the taps of Cape Town that were predicted to run dry (Dube *et al.* 2016:5). The daily water supply was severely restricted, compromising tourism in the area (Otto *et al.* 2018:1). The restrictions anticipated during the prolonged period of drought in Cape Town from 2015 to 2016 affected the region and the promotion of tourism activities, especially nature-based tourism (Swemmer *et al.* 2018:1).

There are growing concerns that tourism has negative impacts on the natural environment by producing GHGs, which are the main drivers of global warming a critical driver of the climate change phenomenon through travel, accommodation and activities that produce greenhouse gas emissions (Dube & Nhamo 2019c:1). The tourism industry is the fastest growing industry globally, which is projected to grow on an exponential level in the future with its carbon footprint (Dube & Nhamo 2020d:94).

According to Schwirplies and Ziegler (2017:1278), coastal and marine tourism are especially exposed to climate change. As a result of climate change, harsh climatic events cause sea levels to rise, resulting in the destruction and degradation of coastal tourism assets (Gössling, Hall & Scott 2018:773). A South African example of rising sea levels resulting from climate change is the sea level rise induced flood risk to two coastal towns in the Eastern Cape province (Fitchett, Grant & Hoogendoorn 2016a:3). The mentioned climate change impacts affect tourism in many countries around the world (Hoogendoorn & Fitchett 2018b:752). The negative impacts of climate change, including the high frequency of floods, droughts, wildfires with high intensity of tropical cyclones, have major consequences on the vulnerable tourism sector (Fitchett 2018:1).

2.4   Tourism and climate change in protected areas

Tourism in the Southern African region is mostly nature-based, together with flora and fauna, including other essential attractions as the primary contributor to its growth. Moreover, the sector is affected by climate-induced extreme weather events (Dube & Nhamo 2020a:1; Dube & Nhamo 2020c:1). Studies by several scholars have

demonstrated how the sector, particularly nature-based tourism, remains susceptible to the impacts of climate change. The impacts of climate change such as extreme weather events, droughts, floods and heatwaves put pressure on wildlife in many protected areas, including national parks around the world (Midgley & Bond 2015:2). The International Union for Conservation of Nature-IUCN (2016:3) define protected areas as areas of land or sea that is particularly reserved for the conservation of biodiversity and ecosystem, of the natural environment and the correlated cultural resources and is managed by legal means

Kilungu, Leemans, Munishi and Amelung (2017:375) observed that animal migration patterns in the Serengeti national park are changing due to climate changes, consequently threatening some species and undermining seasonal tourism operations. Dube and Nhamo's (2019a:10) study shows climate change in South African national parks, Kruger National Park (KNP). They found that KNP is negatively affected by climate change and extreme climatic events such as floods and droughts. Increased incidence of droughts in KNP, as observed by Dube and Nhamo (2019a:8), results in an increased death rate among animals and disrupts the natural ecosystems.

Van Wilgen (2016:5) stated that the high heat intensity in protected areas is a considerable challenge to the animals including the natural environment. Further, Dube and Nhamo (2019a:9) observed that extreme weather events threaten and undermine the operations and services of tourism and infrastructure because they have enduring impacts on the natural environment. The extreme weather events affect the development and sustainability of nature-based tourism (Dube & Nhamo 2019a:9). As a result of climate change and extreme weather events, bush encroachment will occur in many protected areas in semi-arid environments (Midgley & Bond 2015:5).

Besides national parks, private nature reserves, which are crucial tourism establishments in the region and the country, are also suffering the fate. Private nature reserves in the semi-arid areas are significantly at risk of climatic variations and harsh climatic phenomena since the natural area is the principal tourism place in these establishments (Nyaupane & Chhetri 2015:95). The climatic variations on nature-based tourism are severe because the sector is vulnerable to climate change and operates on the natural environment (Preston-Whyte & Watson 2015:130). Climate change drastically affects the climate suitability of nature-based tourism destinations

and their capacity to undertake tourism (La Jeunesse, Cirelli, Aubin & Larrue 2016:981; Jeffrey & Bleasdale 2017:191).

As a result of the multifaceted impacts of droughts, tourism operations get affected in terms of water usage, wildlife behaviour and distribution, and the quality of the natural environment due to severe drought (Hoogendoorn, Mentjies, Kelso & Fitchett 2019:309). The impacts of droughts on the natural environment tend last longer than the climatic impacts (Swemmer *et al.* 2018:1). According to Dube and Nhamo (2020a:1), climate change and variability have caused considerable challenges to the natural (biophysical) environment, affecting and compromising the natural environment including flora and fauna.

2.5   The role of tourism and its contribution to climate change

As already seen, the tourism industry is the primary driver of global warming that causes climate change; therefore, it is necessary to understand how tourism contributes to climate change to devise mitigation measures (Dube & Nhamo 2019a:5; Dube & Nhamo 2020f:3). The contribution of tourism to climate change is a relevant aspect because tourism contributes about 8% of total GHG emissions globally (Lenzen *et al.* 2018:522). Tourism contributes to climate change in several ways. Transport as a part of the tourism industry provides accessibility and it plays a crucial role as an influencer for tourism promotion and development (Campa, Lopez-lambas & Guirao 2016:44). Together, the aviation and tourism sectors contribute over five percent of total global carbon emissions, with the aviation industry contributing three percent alone (Schäfer & Waitz 2014:1).

The relationship between tourism and transport is evident because the former cannot operate or exist without the latter (Cavallaro, Galati & Nocera 2020:2). The travel sector is a massive donor to GHG emissions produced by the tourism industry, accounting for 75% of the net emission and is anticipated to grow more in the future (Peeters, Higham, Kutzner, Cohen & Gössling 2016:30). Transport within destination areas causes negative impacts on the environment such as air pollution, environmental degradation and GHG emission (Cavallaro *et al.* 2020:2). In particular, the tourism industry strongly depends on the aviation sector, which is a significant contributor to GHG emissions that cause global warming, the main driver of climate

change (Dube & Nhamo 2019a:6). The aviation sector alone accounts for 3% of the total GHG emission attributed to tourism (Dube & Nhamo 2019a:6).

There is mounting evidence indicating that tourism negatively impacts the natural environment through the production of GHG emissions, which are the main drivers of climate change and extreme weather conditions, through travel, accommodation, and activities (Dube & Nhamo 2020c:1). A study by Dube and Nhamo (2020f:7) observed that "one other main source of GHG emission comes from the hospitality sector through lighting, heating, cooling and cooking in establishments that use electricity produced from coal". Moreover, as the tourism industry continues to grow exponentially in the future, so is the carbon footprint produced by the industry (Dube & Nhamo 2020b:94).

Consequently, the impacts of climate change are not evenly spread. This emphasises the need for tourism operators to implement different approaches to deal with climatic change and its impacts on tourism (Scott, Hall & Gössling 2016:933). The way with which the effects of climate change manifest into the environment makes it difficult for the tourism industry to plan for ways to tackle these impacts (Becken, Zammit & Hendrikx 2015:430; Craig & Feng 2018:351). However, it is within the benefit of the tourism industry, which is both suffering and a contributor to climate change, to include mitigation together with adaptions strategies in their planning framework to tackle climate change, not only for ethical reasons but for the preserving and sustaining the natural environment in which tourism depends on (Mackay & Spencer 2017:45).

2.6   Climate change mitigation and adaptation strategies

As observed above, the tourism industry donates heavily to global warming and climate change (Hoogendoorn & Fitchett 2018a:7). Therefore, it is within the interest of the sector to reduce and adapt to climate change to limit the harmful impacts to be reached (Csete & Szecsi 2015:477). Shakeela and Becken (2015:65) argue that the recent truth of climate change is inevitable, it continues to grow due to unrestricted past environmental impacts and emissions. They further point out that the tourism industry needs to infuse in applying adaptive and mitigation strategies that seek to improve and maintain the wellbeing of the environment upon which the tourism operates (Shakeela & Becken 2015:65).

Climatic variation is a significant environmental problem facing the world (Jamaliah & Powell 2017:1). The science of this is that strategies to deal with the causes and outcomes of climate change need a solution across all countries through a joint and cooperative effort of all nations (DEA 2015:9). According to Denton, Wilbanks, Abeysinghe, Burton and Gao (2017:1101), the fifth IPCC assessment report calls for a form of development that combines adaption and mitigation to acquire the goal of sustainable tourism development. The primary purpose of this approach is to recover from climate change impacts and adapt to climate change (New, Liverman, Schroeder & Anderson 2016:1).

The importance of mitigating and adapting to climate change with regards to the law and science is that South Africa is exceptionally susceptible and exposed to climate change in its socio-economic as well as the environmental context (DEA 2015:8). Climate change mitigation and adaptation will enable the country to respond successfully to the impacts posed by climate change and extreme weather events.

Climate change adaptation needs a thorough knowledge regarding the exposure of the environmental systems as well as the strategic growth and management alternatives to enhance the adaptive capacity of the systems to deal with the outcomes of climate change (Joyce *et al*. 2018:516). Consequently, the importance of adaptation measures to climate change indicates the necessity of climate-smart tourism operations to reduce the negative impact posed by climate change on the environment and tourism business operations (Elum *et al.* 2017:248).

Climate change mitigation and adaptation measures are critical when responding to climate change impacts on the tourism industry (Zhao, Yan, Wang, Tang, Wu, Ding & Song 2018:85). Responding to climatic variations can be reached by successfully merging the emissions reductions and facilitating adaptation strategies (Zhao *et al*. 2018:85). Employing mitigation and adaptation strategies results in a win-win scenario that creates a low-carbon pattern and ensures a sustainable growth future for tourism (Zhao *et al*. 2018:85).

According to the national climate change response white paper by the DEA (2015:11), "South Africa's response to climate change has two objectives. The first one is to successfully manage the irreversible impacts of climate change through interventions

that develop and sustain South Africa's social, economic and environmental resilience and emergency adaptive capacity. The second objective is to make a fair contribution to the global effort to minimise the GHG concentration on the atmosphere to avoid the harmful effects that come with global warming as a result of climate change".

The common mitigation and adaptation measures in South Africa include adopting a carbon budget approach that will enable companies (including tourism companies) to reduce their carbon emission and utilising the National GHG Emissions Trajectory Range where the outcomes of mitigation measures can be evaluated (DEA 2015:5). In the biodiversity or natural environment sector, the government's mitigation and adaptation measure to climate change involves expanding protected areas and national parks in their adaptation planning process to respond to climate change (Department of Environmental Affairs and Tourism-DEAT 2018:30).

Despite the above mentioned, most adaptation strategies are still focused on minimising sensitivity to daily climatic display by preventing risk, advance recognition systems as well as the management of water demand (Ziervogel *et al.* 2015:6). Consequently, the country has little experience in implementing the adaptation measures and programmes associated with long-term climate change (Ziervogel & Zermoglio 2015:133). According to Ziervogel *et al.* (2015:6), South Africa has little practical knowledge and expertise regarding climate change adaptation tracking and assessment. However, the government has prioritised this issue at the national level and is participating in research to investigate the design, procedures and implementation systems to observe and monitor adaptation strategies to climate change (Doria, Boyd, Tompkins & Adger 2019:810).

2.7   Tourism climate change mitigation and adaptation strategies
In the history of the earth's climate, studies indicate that the climate of the earth has gone through changes that led to remarkably warmer temperatures across the globe (Smith & Holmes 2019:403). The changes occurring in the climate show that the world is continuously facing severe challenges that are inevitable and are influencing the natural environment in which tourism is heavily reliant (Simpson, Scott & Trotz 2016:80). These challenges require all the tourism industry sectors to adopt measures to respond to climatic variation (Hoogendoorm *et al.* 2016:59).

Mukogo (2015:20) argues that "the tourism sector is the fastest growing industry which plays an essential role in the economic development of a country, especially in developing countries, therefore, the industry can make enormous contributions towards tackling or mitigating and adapting to the challenges posed by climate change". This will enable the tourism industry to guide towards adapting and supporting environment-friendly operations and promoting green practices (Scott, Dawson & Jones 2018:577). The tourism industry has the capabilities to develop into a sustainable industry if it can put forward solid and adequate practices to respond to climate change (Pollock 2018:30). Practices that the industry can adopt include the following:

According to Dube and Mearns (2019:200), some hotels are turning to adopt the green building code in the construction of hotels in a bid to respond to the challenge of climate change. One such example is Hotel Verde Cape Town Airport, a green building hotel designed to be environmentally friendly, with installed energy-saving equipment, water-efficient and run on renewable energy (Dube & Mearns 2019:200). This drastically reduces the carbon footprint of the hotel and renders it a climate-resilient building. According to Booyens and Rogerson (2016:391), Hotel Verde Cape Town Airport has on-site greywater recycling systems, on-site composting systems, utilise solar collector and wind power plant for the production of up to 14% of the hotel's energy. They further add that the hotel offers incentives to guests (tourists) for not utilising the heat or climate control and not washing and replacing linen and towels daily.

Environmentally friendly buildings are used as a way to educate people (including tourists and tourism owners) about the importance of adopting green practices and possible ways of reducing our carbon footprint (Diana & Victor 2015:27). In response to water shortages induced by climate change such as those we have seen in Cape Town in 2018, many hotels around the world include reusing bed linen and towels, placement of cards or signs at key water consumptions points and encouraging tourists to use water responsibly (Page, Essex & Causevic 2018:57). They educate staff about acceptable saving water practices and installing faucet aerators and dual-flush toilet systems (Dinarescos & Sauri 2015:623). This points out that the water-

saving measures are cost-effective and reduce the costs of operating, thus, increasing the profit margins.

A study about promoting responsible water use in the United States conducted by Han and Hyun (2018:87) confirms that reusing towel programmes and measures support saving and sustainable water use. Tourism operations and activities put pressure on the production and demand for energy, which causes more damage and degradation to the ecosystem and the natural environment because of the buildings and infrastructure it needs (Parpairi 2017:170). Energy is an essential aspect of life; it acts as an indispensable element in most emerging countries (Türkoglu & Kardogan 2018:53. Energy resources are the main factors that indicate a country's level of development (Türkoglu & Kardogan 2018:54), therefore, efficient energy consumption has become a severe issue.

Energy efficiency is defined by Ganda and Ngwakwe (2016:86) as the means that the policies, technologies and strategies used to tackle the challenges of residential, commercial and national energy to minimise the financial costs and GHG emissions that cause global warming. Since the 1980s, there has been growing concerns about the fact that using fossil fuels as a way for generating energy causes global warming, therefore, improving energy efficiency has been a better strategy for reducing the GHG emission that causes global warming, which in turn, causes climate change (Ang 2016:574).

As the population continues to grow, the needs of tourists for luxurious holiday experiences continue to grow as well, therefore, the need for responsible energy consumption is a must to achieve the future sustainability of the tourism industry and livelihood (Singh, Syal, Sue & Korkmaz 2015:302). Türkoglu and Kardogan (2018:55) pointed out that with the increased rate of population growth, technological developments and increasing living standards, the energy demand is also increasing. For this reason, a consistent policy is a must for the tourism (hospitality) sector to ensure a sustainable tourism industry and to minimise the problems posed by climatic variation due to global warming (Kocaslan 2017:53).

According to Hotel Energy Solutions-HES (2011:20), various studies indicate that the accommodation sector has the capabilities to save at least 10 to 15% of the energy

they use. Bruns-Smith, Choy, Chong and Verma (2015:35) state that the industry can employ several sustainable and environmental measures to minimise and conserve energy consumption.

In the Southern African region, climate change adaptation is of enormous concern given the vulnerability of its dependence on nature-based tourism in protected areas (Kupika, Gandiwa, Kativu & Nhamo 2016:14). Wildlife resources in protected areas have the tendency to develop mechanisms to cope with the impacts of climate change (Kupika *et al.* 2016:14). In spite of the fact that wildlife has the ability to adapt to the impacts of climate change naturally, some researchers argue that the identified impacts of climate change might deserve mitigation strategies (Sheikh, Corn, Leggett & Folger 2006:637). On the other hand, wildlife managers intervened in adaptation measures by manipulating the wildlife habitats and resources to respond to climate change (Prato 2009:923).

Climate change mitigation is also a major concern in protected areas. Mitigating to climate change in response to climate change in the nature reserves and wildlife sector include adopting effective use of fossil fuels, renewable energy such as solar and wind power, and expanding the forest areas to remove more greenhouse gases (especially carbon dioxide) from the atmosphere (Kupika *at al.* 2016:14)

Given the precise relationship between climate change and tourism, especially to nature reserves, this study seeks to investigate the impact and response of nature reserves on climate change-induced extreme weather events. The study's central question is how climate change has affected nature reserves in South Africa. The second question is about determining how nature reserves respond to the impacts of climate change in both mitigation and adaptation.

2.8   Conclusion
In this chapter, it appears that tourism is a significant economic industry in Southern African countries including South Africa. For many decades, the tourism sector has been the leading profit-making sector and the most significant contributor to the GDP of the country. Consequently, the tourism sector is a contributor to climate change. Tourism contributes to climate change with 5% of GHG emissions. The impacts of extreme weather conditions because of climate change undermine tourism operations.

Given that tourism is a contributor and a victim of climate change, there is a need for the tourism industry to devise measures to mitigate and adapt to climate change to ensure a sustainable tourism industry. Green building, energy efficiency, water-saving, and other strategies to promote nature-based tourism such as wildlife tourism are mitigation and adaptation practices that the hospitality industry can use to mitigate and adapt to climate change.

Chapter 3:   Research Methodology

3.1   Introduction

The selection of a relevant methodology for a research study depends on the dynamics of the research topic as it locates the limitations and academic standards that form the study (Makhaola 2015:34). Methodology "is the philosophical framework with which the research is conducted or the formulation upon which the research is based" (Brown 2006:361). Consequently, the objective of this chapter is to explain the methodologies which were utilised in this research study. This chapter also covers aspects such as the research design, data collection methods, data analysis, data management and ethical considerations.

3.2   Research Design

The study adopted the pragmatism philosophy, which informed the use of the mixed-methods research design. Johnson, Onwuegbuzie and Turner (2007:112) define pragmatism as a modern philosophy that provides the theory of knowledge that informs the research design and argumentation for mixing qualitative and quantitative research methods. Pragmatism originated as a philosophical movement in the late 19th century (Maxcy 2003:51) as a paradigm to close the gap between the structuralist orientation and scientific approaches of aged methods and the sailing orientation of advanced techniques (Creswell 2013:88; Creswell & Clark 2011:88).

The primary assumption of the pragmatism approach is that there is no sole objective reality, however, the subjective inquiry can be conducted (Erlandson, Harris, Skipper & Allen 1993:28). Goles and Hirschheim (2000:249) pointed out that "the process of acquiring knowledge is a continuum rather than two opposing and mutually exclusive poles of either objectivity and subjectivity". By using a pragmatism approach, the researcher employed qualitative and quantitative research design (Creswell 2015b:25) to examine, understand and explain the distinctive aspects of the same phenomenon (Maree 2016:309). According to Pansiri (2006:191), a pragmatism approach emphasises employing an excellent technique to answer the main research question.

This study also followed a case study approach. Yin (2014:16) explains a case study research "as an empirical inquiry that investigates a contemporary phenomenon (case) in-depth and within its real-world context especially when the boundaries

between phenomenon and context may not be evident." Yin (2014:17) argued that a case study research inquiry emphasises that a single result in a research study depends on multiple sources of data and evidence bearing from the same point.

Yin (2014:20) further states that "a case study research approach enabled the researcher to answer the how, what and why research questions in a real-life context", namely Phinda Private Game Reserve. The researcher took a formal standing and employed a broad observation approach based on two principles; a look at the study area as a whole with an open-minded attitude advised by (Verschuren 2003) and adopt various methods of data triangulation focused on dispelling the tunnel vision. The case study research approach was used to answer the following research questions: what are the impacts of climate variability and change on Phinda Private Game Reserve? How is Phinda Private Game Reserve mitigating climate change in its tourism business operations' value chain? How is Phinda Private Game Reserve adapting to climate change impacts? A similar study conducted by Dube (2018) also utilised a case study research approach. Saunders, Lewis and Thornhill (2016:184) further point out that when following a case study research, the researcher is able to understand the dynamics of the topic and acquire broad knowledge gathered about the subject matter.

This study made use of a triangulation mixed-methods research design. A mixed-methods research design allowed the researcher to use both qualitative and quantitative research designs without the limitations of using either qualitative or quantitative research design (Maree 2016:313). According to Maree (2016:313), a mixed-methods research design collects, analyses, and combines qualitative and quantitative research designs to understand a research problem completely. The purpose using triangulation, mixed-method research design aims to acquire different but complementary data on the same topic (Morse 1991:120). The triangulation mixed-method research design allowed the researcher to combine the qualitative and quantitative strengths and weaknesses to directly compare and contrast the qualitative and quantitative results (Patton 2014:232). When using a mixed-methods research design, the researcher can form insight into the natural world matters based on the pragmatism approach (Patton 2014:232).

Exploratory and descriptive research methods were used in this research study. Exploratory research is a research technique that investigates and examines cases that are not analysed and presented better to understand the issues (Marshall & Rossman 2006:262). Descriptive research is a research approach that allows the researcher to acquire a holistic picture of the matter being explored and bring out how issues are related to each other (Bumberg, Cooper & Schindler 2005:21). Descriptive research enabled the researcher to answer questions related to climate variability and change impacts on the selected private game reserve's tourism operations. In contrast, exploratory research allowed the researcher to explain how the selected game reserve is mitigating and adapting its tourism business operations' value chain to respond to climate change.

3.3   Study area

The study area for this study is Phinda Private Game Reserve. This study area was selected because it is a well-known and one of the luxury private game reserves in South Africa (&Beyond 2021:3). Besides, it is economically, ecologically and culturally significant. Lastly, there are limited studies conducted on this private game reserve.

Phinda Private Game Reserve is a privately owned game reserve named after the Zulu name called "Phinda", meaning the return in the sense of conservation (Africa Foundation 2016:8). The reserve was established in 1991 in KwaZulu-Natal province between the Mkuze Game Reserve and iSimangaliso Wetland Park (&Beyond 2015:3) with the vision of creating responsible and sustainable conservation through responsible tourism. Phinda Private Game Reserve covers 23 000ha of conservation land (&Beyond 2014:3).

The reserve was the first Big Five private game reserve established in KZN (&Beyond 2015:3). The reserve has particular plants that are endemic to this area due to its coastal rainfall pattern. The reserve prefers a lush green environment commonly referred to as the Seven Worlds of Wonders (&Beyond 2015:3). According to &Beyond (2015:4) "the seven distinct habitats allow for a much greater variation in species and landscapes". The seven unique habitats include the sand forest, which shelters many animals, including the Big Five and over 415 species of birds (Highbeam 2007:2).

Phinda Private Game Reserve receives an average of about 1 000mm of rainfall annually (&Beyond 2021:6), with rainfall expected any time of the year. Usually, the rainfall is short-lived and comes in the form of short cloud bursts of thunderstorms. The area is generally warm, with the Indian Ocean playing a controlling factor. Summer temperatures can be very high, with a daily range of temperatures between 25°C and 35°C (&Beyond 2021:6).
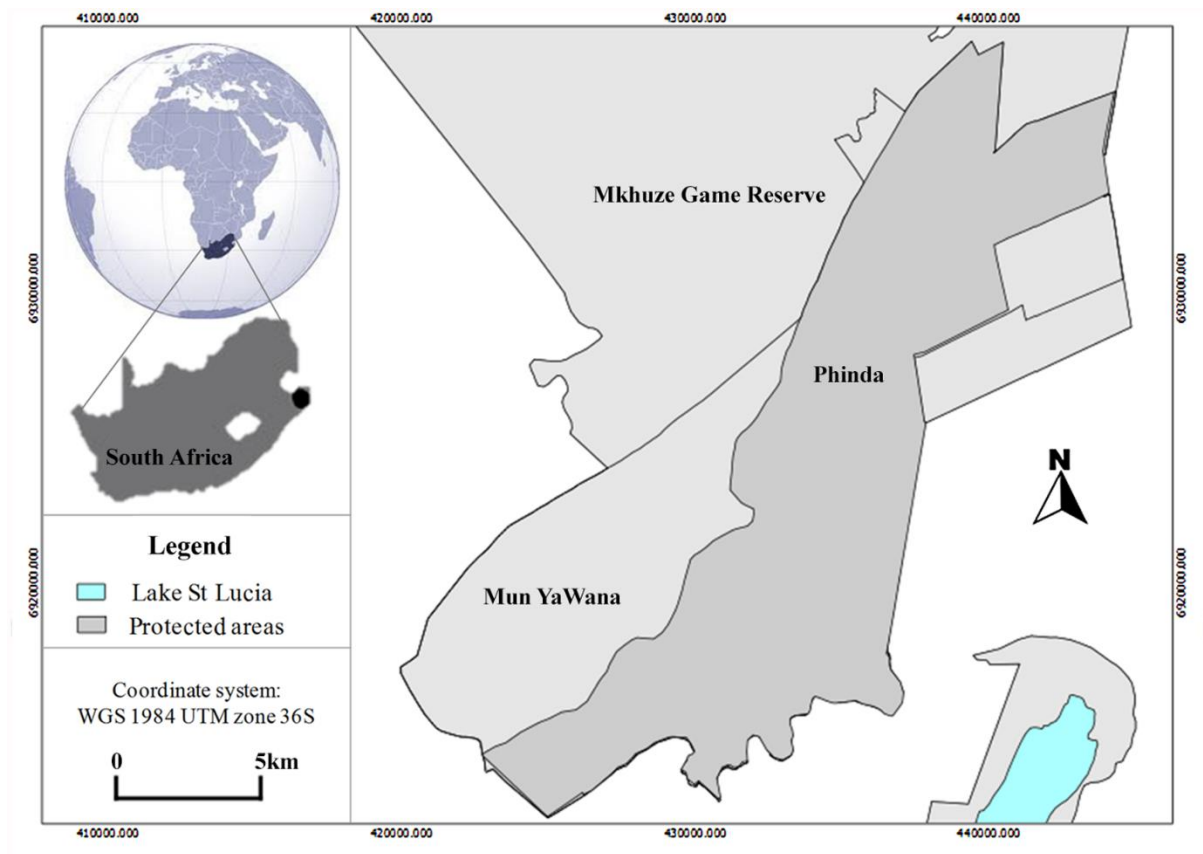
Figure 3.1: Phinda Private Game Reserve, KwaZulu-Natal, Hluhluwe. Source: Rostro-García, Kamler and Hunter (2015:4)

3.4   Study population

According to Hair, Celsi, Money, Samouel and Page (2015:165), a population "is an entire group of individuals, objects or elements to which a research project applies". Identifying the population is a crucial stage of the research (Matjeka 2012:77). The population for this study included the employees at the Phinda Private Game Reserve, managers from the parent company, namely &Beyond, to the selected traditional community leaders. In the process of the study, the researcher interacted with the directors, managing directors, sustainability managers, tour guides, game rangers,

conservationists, facilities managers, community leaders, frontline staff, maintenance staff and general workers. The aim was to acquire a holistic understanding of how this important business is affected by climate change and how it is dealing with the impacts of climate variability and change.

In order to capture the experiences and relevant events at the game reserve, the study considered only employees who had worked for five years or more at the game reserve because of their experience and knowledge about climatic changes in the area. Other criteria for participant selection included participant availability, experience and knowledge of climate change and its impacts. In total, 30 in-depth interviews were conducted with staff members and stakeholders as shown in Table 3.1.

Table 3.1: A brief overview of the selection criteria and knowledge required from participants

Group	Number of interviewees	Information required
Facilities managers	2	Information on green facilities design, cost of mitigation and adaptation technologies, cost of impacts of climate change on tourism infrastructure and facilities, challenges and opportunities.
Directors	2	Knowledge about behavioural changes that are being employed to reduce greenhouse gas emissions of the tourism business
Managing directors	2	Anticipated opportunities of going green.
Sustainability manager/ Conservationists	2	Information on carbon emissions reduction targets, sustainability reports, climate change mitigation and adaptation plans, and sustainability projects to offset carbon emissions.
Tour guides	4	Observed impacts of extreme weather events on tourism infrastructure and feedback from tourists.
Game rangers	5	Observed extreme weather events on the selected private game reserves.
Housekeepers	4	Knowledge about the strategies that have been implemented to respond to climate change.
General workers and frontline staff	4	Technologies to minimise the adverse outcomes of climatic variation and harsh climatic events in tourists at the selected private game reserves.
Community leaders	5	Information about the climatic trends in the area and the impacts of climate change (extreme weather events) affecting the area.

3.5   Sampling and description of the sample

Sampling is an integral part of qualitative and quantitative research methods (Dube 2018:63). Kumar (2014:229) defines sampling "as selecting a few from a more extensive group as the basis for estimating or predicting the prevalence of an unknown piece of information". Sampling makes research to be more accurate and economical

(Showkat & Parveen 2017:1). Probability (such as simple random sampling) and non-probability sampling (convergence sampling, quota sampling, non-random sampling and snowball sampling) are the two methods utilised in numerous studies.

In this study, the researcher used a non-probability sampling method to select the participants who were willing to participate in the research. Non-probability sampling is a sampling method that uses non-random methods to select the sample (Maree 2016:198). In this method, the researcher studied, explored and analysed specific phenomena to collect relevant and accurate information from the participants (Showkat & Parveen 2017:5). The researcher chose this sampling method because, according to Maree (2016:198), it is time, cost-effective and easy to apply (Showkat & Parveen 2017:5).

The study used a purposive sampling method. Purposive sampling is a sampling method that allows the researcher to select participants according to their knowledge and judgment while keeping the main objectives of the research in mind (Showkat & Parveen 2017:7). The purposive sampling method was used to select the relevant participants (sustainability managers, managers, owners, directors, conservationists, tour guides, game ranges, and frontline staff and community members) because it is the appropriate sampling method to select the participants who have the adequate experience and judgement about the climatic changes of Phinda Private Game Reserve.

The purposive sampling approach was also used to select the key informants. To recruit the participants, the researcher looked at their job description and the number of years they have been working for Phinda private game reserve. Data collected included the history and experiences of extreme weather events, the impacts of climate variability and change, climatic trends, mitigation and adaptation measures in response to climate variability and change. The purposive sampling technique was selected on the basis of its effectiveness in selecting respondents with the relevant information to address the objectives of the study. The researcher used a purposive sampling technique to select the relevant participants for the study. It is also cost-effective and more accessible (Showkat & Parveen 2017:7). A referral sampling method was also used when selecting the community leaders that is defined as "word-of-mouth referrals by other informant(s)" (Atkinson & Flint 2001:8).

In selecting the community members, the researcher interacted with the Phinda Private Game Reserve's employees involved in Africa Foundation Project (employees who work with the community leaders in community development projects sponsored by Phinda Private Game Reserve) to request interviews with the community leaders. The language used during the interviews was the community leaders' native language (isiZulu) because most of the community leaders were old people and for their understanding of the questions and in providing relevant answers. The community leaders were involved in the data collection for this study because they possess relevant and reliable knowledge about the history and experiences of the climatic changes of the area where Phinda Private Game Reserve is located.

3.6   Pre-testing

Pre-testing plays an essential role in identifying and eliminating measure errors that could harm the study's outcomes when conducting the research (Caspar, Peytcheva, Yan, Lee, Lui & Hu 2016:392). Caspar *et al.* (2016:392) defined pre-testing "as the collection of qualitative or quantitative techniques and activities that allow researchers to assess the research tools that will be deployed to eliminate errors that may be missed during the development". Pre-testing acts as an effective way of enhancing accuracy in the qualitative data collection process (Bowden, Fox-Rushby, Nyandieka & Wanjau 2002:322). When pre-testing, various activities designed to evaluate the ability of data collection methods are utilised to achieve the adequacy of field processes (Caspar *et al.* 2016:392).

A pilot study was used as a pre-testing technique for this study because it acts as a foundation of good quality research, and it is an essential step in research as it is used in all types of research studies (Hazzi & Maldaon 2015:53). According to Polit, Beck and Hugler (2001:342), "a pilot study is a feasibility study conducted on a small-scale version of a study or a trial run conducted in preparation for broader research," and it is a process conducted as a way of pre-testing the data collection methods (Baker 2014:122). The data collection method that was pre-tested is the interview questions. The pre-testing or pilot study was done in February 2021. Prior to the pilot study, the researcher set up an online meeting to conduct the pilot study with the private game reserve managers (key informants) due to the presence and spread of COVID-19 in the country and the adherence to the nation's lockdown restrictions.

During pre-testing, the researcher focused on evaluating language proficiency and content effectiveness of the data collection method, administering questions to the participants and setting a timer for the estimated completion time to assess the length of full interview delivery and improving methodological skills. The researcher took notes of these observations to improve the questions further. The researcher collected more information about the research area, which helped in identifying potential problems that could arise in the research process during fieldwork and data collection, especially from certain sections of participants.

3.7   Data collection methods

Various data collection methods were used to collect data in this study, which were in line with qualitative (in-depth interviews and field observation) and quantitative (archival data and secondary data) research design. Using various research instruments allowed the triangulation of data from different sources, ensuring its internal and external validity. While some methods address a single research objective or question, other instruments are designed to collect data for multiple research objectives or questions. Lancaster (2015:1) pointed out that collecting data using various methods aims to increase reliability and validity of the results because different methods are used to collect data from multiple sources to answer a single research question.

The research methods used to collect data are field observations and in-depth interviews. The fieldwork was conducted in May 2021 at Phinda Private Game Reserve. The researcher first conducted interviews followed by field observations. The last methods to be undertaken was archival and secondary data analysis. The data collected through interviews was collected until data saturation was reached. The targeted study population was asked about the climate change trends and impacts, adaptation strategies and mitigation measures at the game reserve (See Annexure A).

3.7.1   In-depth interviews

In-depth Interviews are used as a data collection method in social sciences, where the purpose is to reveal other people's views, descriptions, and perspectives on the subject matter that are addressed (Jentoft & Olsen 2019:182). This method enabled the researcher to determine whether the participants understood the question, and the researcher had the flexibility to vary the structure and wording to suit the conditions

(Dube 2018:57). Furthermore, Kumar (2014:5) indicated that in-depth interviews allow the researcher to re-order the questions simultaneously, maintaining a natural flow. The interviews were conducted with the reserve's employees, ranging from senior management such as hospitality and tourism managers, lodge managers, conservations managers, kitchen staff, game rangers, tour guides, operations staff, and community leaders. The interviews with the staff members were used in this research to answer the research questions. They are used as a pragmatic and efficient methodology for cost-effectively collecting data (Gilchrist & Williams 1999:74). It is regarded as the most flexible method of collecting data. It provides participants with more space and freedom to share their perspectives on the research topic and expand on the topic beyond the researcher's intent (Lokot 2021:4).

The researcher chose this method because it allowed the researcher to obtain more knowledge and insight into the research topic and gather more knowledge to answer research questions from experts in the field (McKenna, Iwasaki, Stewart & Main 2011:387). Besides, interviews enabled the researcher to gather expert knowledge on the topic (Taylor & Blake 2015:153). Through the use of the interviews, the researcher was able to collect more knowledge about climatic changes, the impacts of climate variability and change, and extreme weather events that had occurred at Phinda Private Game Reserve and the area and how it is affecting the tourism operations' value chain as well as the knowledge about the adaptation and mitigation strategies in combating climate change.

When selecting the interviewees, the researcher used a referral sampling method. The researcher requested at least five participants from each department (sustainability and conservation department, financial department, maintenance department, operations department and IT department) at the game reserve to acquire as much information as possible. However, in some of the departments, it was challenging to get the requested number of participants because they were unavailable. Semi-structured interviews were conducted using an interview guide. The guide comprised various questions such as those that focused on climatic trends, impacts on flora, fauna, infrastructure, tourists, employees, aesthetics, and the game reserve as these categories are the ones that are mostly affected by climate change and they are vital in their overall tourism operations and services. Other critical questions that were

covered in the research include those regarding mitigation and possible adaptation strategies that are being taken and can be taken to alleviate the impacts of climate variability and change.

Before the fieldwork, the researcher arranged interview appointments in advance through emails and telephone to identify the critical informants before the interviews. The interviews were conducted in May 2021 at Phinda Private Game Reserve (Forest and Mountain lodge) with the staff members and the surrounding communities (Mqobokazi and Makhasa) with the community leaders. However, the Covid-19 communication during the interviews was severely affected as some of the participants, especially the community leaders, were not entirely comfortable during the interviews even when the masks were on. During the interviews, the researcher started each interview process by introducing herself to the participants, explaining the research objectives and interview procedures and explaining confidentiality and anonymity issues to the participants. As part of ethical consideration, the researcher requested permission from the participants to interview them and record their interviews. When they agreed to participate in the interviews, they provided verbal consent. While explaining the critical issues to the participants, the researcher-maintained eye contact with the participants to build and establish rapport.

During the interviews, the researcher took notes and noted questions where further probing was needed. When the participants provided negative or short answers, a follow-up question was asked to refine the answers further. With the express permission of the interviewees, the interviews were recorded using a digital voice recorder for onward transcription. The interviews took on average an hour to complete whereas those with other staff members (IT staff, financial staff, tour guides and game rangers) took between 20 and 30 minutes. Staff interviews were customised to talk to the operational side of the work and its interface with the subject of the research, while the community members' interviews were about the history of climatic changes and extreme weather events of the area.

3.7.2 Field observations

Field observation is a widely used tool that is part of the triangulation process both in qualitative and quantitative research and is commonly used in social and educational research (Punch 2014:112). Considering the research question, the purpose of using

this method in this study was to obtain the context of the reserve and observe some key aspects of the reserve such as water holes and try to see if there are any traces of impacts of climate variability and change. The observer was on the lookout for evidence of bush encroachment, erosion, evidence of climate mitigation and adaptation measures such as water harvesting, green building design initiatives and other adaption measures at the various lodges (Forest and Mountain lodge) located within Phinda Private Game Reserve.

After prior permission from Phinda Private Game Reserve, observations were conducted with the assistance of game reserve staff to help explain some features, particularly on the impacts of climate variability and change, adaptation and mitigation strategies employed at Phinda Private Game Reserve. As Dube (2018:56) describes, notes in a narrative form, pictures and videos of the landscapes were taken and all observations were collected in a detailed manner. Professionalism and objectivity were maintained to guarantee independence and impartiality and guarantee the data's integrity and reliability as described by Kumar (2014:5).

3.7.3 Archival data

According to Jones (2010:1008), archival data analysis is any data that other people previously collected. Archival data analysis captures real-time information over time and maintains previous measurements for retrievals and visualisation (Stehle & Kitchin 2020:354). Stehle and Kitchin (2020:354) argued that although previously observed real-time data becomes out of date, rapidly changing displays quickly and storing longitudinal information is not a trivial task, the added context of previous measurements is useful for analyses of changing cities and from contextually understanding current observations. This method allows researchers to analyse data pulled from existing records such as census data, court records, personal letters and old newspapers (Gonzales & Meyers 2018:1). The study obtained archival data climate data (temperature and rainfall data) from the South African Weather Station at Mbazwana meteorological station. The climate data was analysed to study the aggregated temperature and rainfall over the years and see how the area's climate is changing.

3.7.4 Secondary data

Secondary data analysis is defined as the analysis of data collected by other people from another primary purpose (Johnston 2014:619). The use of secondary data analysis is increasing given its broad access to archived records in today's digital time (Middleton, Beaman, Blyth, Hughes, Neale, Philips & Salter 2014:54). This method was selected because of its ability to provide the researcher with extensive data sets, which will not ordinarily be possible for primary research (Chow & Kennedy 2014:57). Secondary data was conducted to triangulate information on climate change mitigation and adaptation strategies that Phinda Private Game Reserve employed in response to climate change impacts.

In this study, archival data analysis was conducted to obtain data on extreme weather events and climatic trends through climate data in the area where Phinda Private Game reserve is located (Hluhluwe) because the data is always recorded and available. The climate data was obtained from South African Weather Services at Mbazwana meteorological station located 50km from Phinda Private Game Reserve. The collected climate data was analysed using a Mann Kendall trend test analysis to acquire, interpret and present the climate data to observe the increase or decrease in rainfall and temperature in the area.

3.8 Internal and External validity

Validity refers to the degree to which an instrument can measure what it should measure (Blumberg *et al.* 2005:18). Internal and external validity are significant components when conducting a research study (Baldwin 2018:31). Internal validity assesses how the study is designed, conducted and analysed to answer the research questions (Andrade 2018:499). In contrast, external validity examines the manner in which the results of the study are generalisable to other contexts (Juni, Altman & Egger 2001:87).

To ensure the validity of the study and results, a relevant methodology (research design) was chosen and carefully conducted to respond to the research objectives and answer the research questions by initiating a logical link between the research objectives and questions. A thorough methodological study of the methods used by similar studies was done to improve and ensure content validity. The primary data collection method (interviews) was pre-tested to ensure the questions' content

accuracy and language competency. As part of ensuring external validity, triangulation and paralleling of the procedure were conducted (Hanumanthappa 2014:56).

3.9   Data analysis

According to Marshall and Rossman (1999:150), data analysis is described as a "process of bringing order, structure and meaning to the mass of collected data". It makes information meaningful, explaining and theorising, which means searching for general statements between data categories (Schwandt 2007:6). For qualitative data, content and thematic analysis were used (Cohen, Manion & Morrison 2013:561). According to Maree (2016:112), content analysis is an important technique that allows the researcher to reveal and explain behaviours, context, locations, people and events. On the other hand, a thematic analysis is defined as a method that focuses on the theme inspection of aggregate data (Makhaola 2015:40). The data analysis was done using NVivo. The interview transcripts and field observation notes were fully read to understand the problems from a holistic perspective and the files were uploaded on NVivo for coding.

NVivo is described as a software developed by the QSR International for analysing qualitative data (Philips & Lu 2017:1). This software allowed the researcher to store, manage, organise and analyse unstructured data from such as audio recordings (Philips & Lu 2017:1). NVivo was used in this study because it allows the researcher to organise raw data, build relationships among the data, and assign and develop data to create a report and provide results (Philips and Zwicky 2017:3). Also, this technique has been used by many researchers to analyse qualitative data (Insua, Lantz & Armstrong 2018:141).
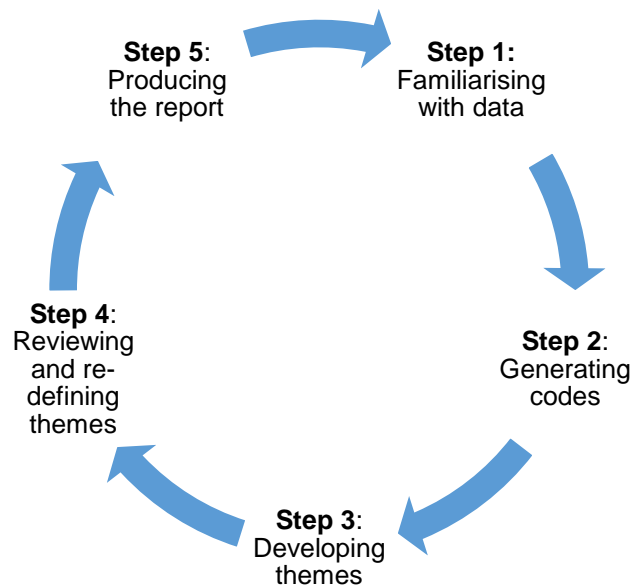
Figure 3.2: Steps to analysing interviews and field observation transcript. Source: Terry, Hayfield, Clarke & Braun (2017:28).

The first step in the analysis of interview and field observation transcripts is familiarisation. This step requires the researcher to actively interact with the data by listening and watching if the dataset is audio or video (Terry *et al.* 2017:28). Generating codes is the second step in the analysis of transcripts. This step requires the researcher to make meaningful codes attached to a specific segment of the dataset (Terry *et al.* 2017:30). This step is followed by theme development, which involves examining the clarifications to determine the relationships between them and the researcher uses prior knowledge (Scott & Usher 2011:98). Scott and Usher (2011:98) pointed out that a series of general developments shows that individual relationships are strong under the examined setting.

Then, the researcher moves to reviewing and redefining the themes. At this stage, the researcher evaluates whether the themes work well with the coded data, the dataset and the research objectives and questions (Terry *et al.* 2017:37). This involves writing the analysis (Terry *et al.* 2017:42), formalising these philosophical structures and drawing inferences from cases at other times and places (Scott & Usher 2011:99).

As part of data analysis, the researcher ran a time series analysis using a Mann-Kendall trend test analysis to analyse the precipitation and climate (temperature.

According to Alhaji, Yusuf, Edet, Celestine and Agbo (2018:3), the Mann-Kendall trend test is a "non-parametric test for identifying trends in time series data. It is a statistical test widely used for the analysis of trends in climatology and in hydrologic time series". Statistical analysis was done to measure the standard error, standard deviation, average and interval reliability (Ayyub & McCuen 2011:105). They further pointed out that a Mann-Kendall trend test is often used to detect monotomic changes or trends in a series of environmental data, climate data and hydrological data (Alhaji *et al.* 2018:3).

The benefit of using this test is that it does not need the data to be distributed appropriately and the values are evaluated as an ordered time-series (Alhaji *et al.* 2018:3). The Mann-Kendall test was conducted using the XLSTAT. Graphs were plotted using the Microsoft Excel sheet and were used to study the trends (variations) of these parameters (temperature increase or decrease and rainfall increase or decrease). The data were analysed to deduce any changes in the climate in trends occurring in the private game reserve and were represented with graphs.

3.10 Data management

Sanjeeva (2018:3) define research data management "as the effective handling of information that is created in the course of research". In addition, she stated that data management is an important part of the study. Research data management includes planning and creating, organising, structuring and preparing data for and storing it, sharing it with others or storing it for a long time (Sanjeeva 2018:3). The researcher managed and stored the research data in cloud storage (Google Drive) so that no one other than the researcher and the supervisor could view or access the data. The data were also stored in an encrypted file and password-protected. The data will be destroyed post-publication once the mandatory five years of research publication elapse.

3.11 Ethical Considerations

Ethical considerations were given serious attention during the planning, fieldwork and reporting of results. The research was conducted in accordance with the Vaal University of Technology's Research Ethics Policy, ethics reference number FREC/HS/02/10/2020/6.1.2. Ethics approval was obtained first before any fieldwork was conducted. To conduct the research, permission was sought from the

management of the private game reserve first. A thorough briefing of the aim and objectives of the study was outlined, together with a sample of questions for a face-to-face interview with the key informants to obtain approval. A written consent letter to conduct the study was sought from the highest decision-makers of the game reserve investigated. The high decision-makers were employees who were in leadership and high management positions. Informed consent, anonymity and aggregate reporting were some of the standards adopted to ensure ethical behaviour during fieldwork. The collected data were only used in this research and only the supervisor and the student can access it.

Chapter 4: Results and discussions

4.1 Introduction

This chapter highlights findings on the evidence of climate variability and change impacts at Phinda private game reserve. The chapter seeks to answer the first research question of this research study. The chapter is divided into two sections. The first section looks at climate variability and change evidence at Phinda Private Game Reserve. The second section looks at the impact of rainfall and other climatic events at Phinda Private Game Reserve.

4.2 Evidence of climate change and variability at Phinda Private Game Reserve

The study found that the average annual maximum temperature in the area had increased over the period of study, 1995 to 2020 (Figure 4.1). On the other hand, the minimum temperature had also decreased over the same period of study, pointing to an increased variance between the maximum and minimum temperatures. The average annual maximum temperature over the period had increased from an average of 26.5°C to about 27.3°C, signifying an annual average temperature increase of about 0.8°C over 26 years. The average maximum temperature for the area was determined to be about 26.9°C with a standard deviation of 0.97.
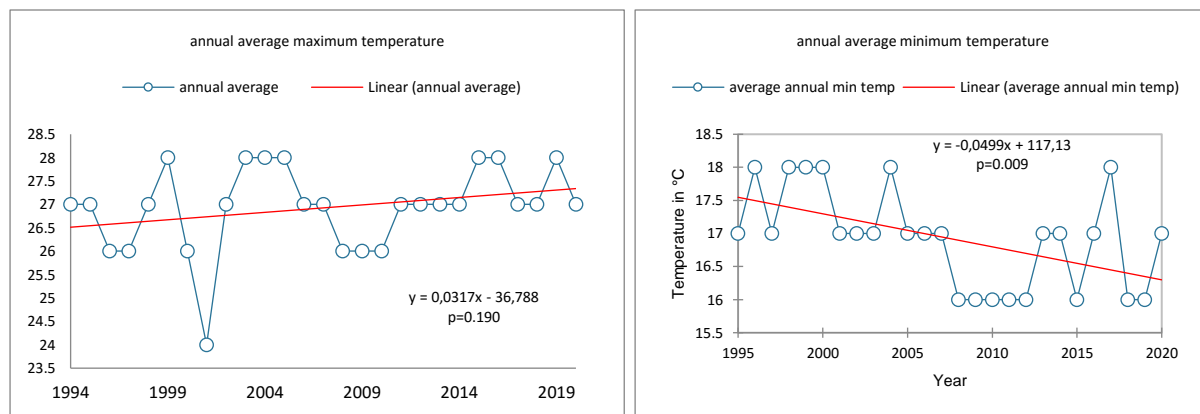
Figure 4.1: Maximum and minimum temperatures for Mbazwana Meteorological Station 1995-2020

Given that the computed p-value was 0.190, which is greater than the significant alpha 0.05, the annual average temperature increase was statistically insignificant. On the contrary, there was a statistically significant decline in annual average temperature decrease as it declined from about 17.5°C to about 16.3°C marking a decline of about 1.2°C. The *p*-value was found to be 0.009, which is lower than the significant alpha of 0.05.

Although there was a statistically insignificant average annual temperature, a look at the monthly and daily maximum temperature revealed that while some months had not witnessed a significant increase in temperature, other months had experienced a significant temperature increase. To be precise, four months had witnessed statistically significant maximum temperature, namely February, May, June and July, as indicated in Table 4.1. Generally, all months showed that maximum temperatures were increasing, although this increase was not statistically significant. Only one month (February) in summer witnessed a statistically significant increase in temperature while the winter months (June and July) showed signs of significant warming. May recorded the highest significant temperature increase where the temperatures pushed into the mid-20s.

Table 4.1: Months with significant temperature increase C, Hluhluwe (significant alpha is 0. 05)

Month	p-value	Opening Temperature	Closing Temperature	Temperature Increase	Monthly Average Temperature	Standard Deviation
February	0.049	29	30.2	1.2	29.8	1.167
May	0.007	25	27	2	25.9	1.074
June	0.038	23.9	25.1	1.2	24.5	0.820
July	0.012	23.8	24.9	1.1	23.7	1.285

On the other hand, monthly temperatures for most months recorded a decline in minimum temperatures, except for March, April and May, where there were insignificant temperature changes. The rest of the months recorded a significant mean monthly temperature decline as indicated in Table 4.2.

Table 4.2: Months with significant temperature decrease in °C, Hluhluwe

Month	p-value	Opening Temperature	Closing Temperature	Temperature Decline	Long term Monthly Average Temperature	Standard Deviation
January	0.002	22	20	-2	21	1.071
February	0.024	21.5	20	-1.5	20.8	1.086
September	0.004	16.2	14	-2	15.5	1.209
October	0.003	17	16	-1	17.1	1.269
November	0.007	20	18	-2	18.8	1.116
December	0.015	22	19	-3	20.2	1.109

The area where Phinda is located (Hluhluwe) was experiencing a statistically significant number of hot days and sultry days, as indicated in Figure 4.2. This is in line with the anticipated increase in the number of hot days globally. The study found

that the number of extremely hot days (above 40°C) is concentrated between October, November, December, January and then, again in April. The highest number of extremely hot days was reported in December.
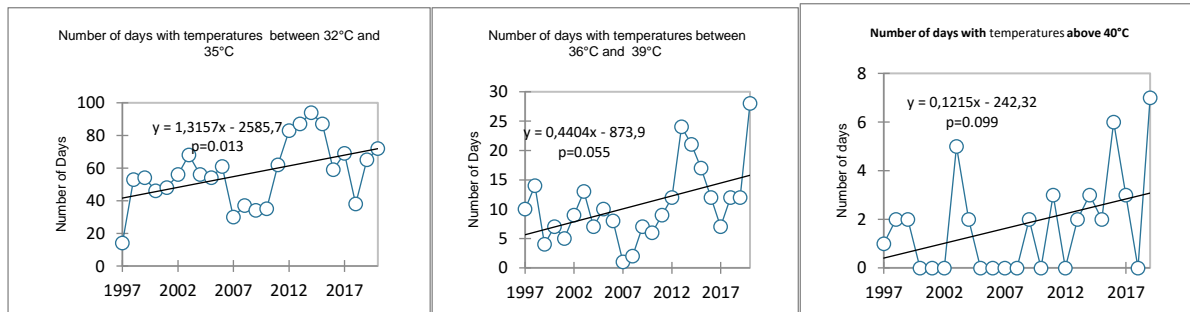
Figure 4.2: Trend in the number of hot and extremely hot days in Hluhluwe 1997 to 2020

While the increase in average maximum temperature was expected, the decline in monthly minimum temperature was an unexpected occurrence, as ordinarily, the observation is that temperature trends are on the increase globally (Intergovernmental Panel on Climate Change-IPCC 2018:5). The increase in monthly and by proxy daily temperature and a decline in minimum temperature means that the daily temperature ranges for the area can be quite high on some days, which could have various impacts on human physiology and temperament.

The same occurrence has implications on energy use at the Phinda Private Game Reserve, especially at the lodges and camps, as it increases energy demand for cooling and heating purposes. Energy demands would increase during the day for cooling purposes and air conditioners would be needed to warm up the places during the night or early hours when the temperature drops drastically. During the day, temperatures are very high, with some days showing temperatures surpassing the 40°C temperature mark (Figure 4.2). The demand for cooling will be high, while extremely low temperatures will escalate the demand for heating through air conditioners and geysers. An increased use of air conditioners inevitably will lead to more energy use and more carbon emissions, which could create a spiral for global warming since the lodge is not carbon neutral.

The observed warming in the winter months resonates well with other findings from elsewhere in the world where the warming of winter months is threatening tourist activities such as the Winter Olympics (Scott, Hall & Gössling 2015:8). In Southern Africa, the warming of winters is expected to affect the sustainability of snow at Afriski

Mountain Resort in Lesotho. Some animal species that thrive in winter can have long-lasting impacts on game reserves, such as Phinda Private Game Reserve. This assertion resonates well with observations by Marshall, Gothard and Williams (2020:54), who noted that an increase in winter temperature has lasting impacts on insects and spring phenology complexly and requested research in determining the net losers and winners for such a development.

4.2.1 Impact of temperature increase on tourism's operations at Phinda Private Game Reserve

The impact of extreme temperatures is particularly concerning for employees at Phinda who were the main focus of this study. There was an acknowledgment that the area is generally warm, the employees complained that the temperature was particularly high in Hluhluwe. The area's high humidity also worsened the temperature given its proximity to the Indian Ocean (a warm ocean) and the St Lucia Wetlands Park and other rivers that act as sources of humidity. The impacts of warming in the area profoundly impacted employees' performance with many complaining of heat fatigue on certain days. Besides, community members from host communities complained of battling to sleep on very warm days because of excessive heat.

Of the employees who participated in the study, 75% indicated that they sometimes experienced difficulty sleeping at night due to the heat. The most affected employees were those with no access to air-conditioned rooms. The employees who used fans on hot days were not entirely happy because they felt fans recycle and blow off hot air. Therefore, it makes little sense to switch them on. Disturbed sleep due to heat was of particular concern to tour guides, given their work schedule. Respondent XV indicated that:

> "on *very hot days, we battle to sleep. Given that we have to work long hours and wake up early in time for the morning drive, it becomes particularly challenging as we are always tired".*

Disturbed sleep is particularly challenging as it threatens employee performance and alertness in a very demanding sector. Studies conducted in other parts of the world indicate that lack of sleep is also increasing in those parts with dire consequences for people. Matsui (2017:1) noted that warmer nights were defined as any night temperatures above 25°C. Given that sleep is a physiological requirement, lack of

sleep is attributed to increased illness, particularly among people who suffer from heart diseases. Obradovich, Migliorini, Mednick and Fowler (2017:205) observed that lack of sleep was prevalent amongst the elderly in particular and was common amongst the marginalised. Women were seen to suffer the worst effects due to lack of sleep. Consequently, lack of sleep also increased people's susceptibility to diseases, chronic sickness and had an adverse impact on human beings' psychological and cognitive functioning. Therefore, there is a need to take steps that ensure the health and protection of tourists and tourism employees in such environments as disturbed sleep tends to be a common feature in the tourism sector within the Southern Africa region (Dube & Nhamo 2021:25).

Regarding the operational side of things, high temperatures were reportedly challenging for staff working in the fields, including operations teams and rangers. The interviewed rangers indicated that their vehicles do not have roof coverings, which presented challenges, particularly on extremely hot days as they battle the direct sunlight heat. The rangers made concerted efforts to protect themselves against the heat by wearing hats and long shirts. Unfortunately, it did not make much of a difference. They also indicated that tourists are not patient on extremely hot days when they go out on game drives and often show signs of irritability when tour guides stop for commonly sighted species. Respondent XS noted that;

> *"It is often challenging as tourists want to quickly go through the game drives and return to their rooms where it is cooler".*

The effect of heat on tourists was also observed by hospitality staff who work at the lodge. These employees advised that on scorching days, tourists tend to want to spend time in their rooms and by the swimming pool to escape the heat. The high temperatures also affect the game viewing experience for the tourists as some of the animals, particularly the big cats, hide under trees and amongst the bushes due to the heat. Given that animals hide in trees during the day to avoid the heat, this inevitably affects game viewing and tourists' satisfaction taken at these times.

The kitchen staff also complained that extremely hot days present challenges for their work as it becomes unbearably hot. On very hot days, the heat extraction fans, which ordinarily function as heat regulators, are incapable of reducing the heat levels in kitchens, making it difficult to work. Kitchen spaces might require an additional cooling

system to ensure that they are conducive for the working staff. In addition, staff working in the massage parlour also indicated that hot days are not conducive for massage treatments. It becomes uncomfortable to work because people tend to be sweaty. In an effort to resolve this challenge, their parlour temperatures are airconditioned at 22°C, a temperature that was determined to be ideal for massage.

The maintenance team that works at the lodges indicated that they have also been faced with an overrunning of air conditioners on hot days, resulting in more equipment malfunctioning. They reported that the demand for air conditioning maintenance and gas refill in such cases increases, a factor that can be attributed to increased usage. There were complaints about fridges and air conditioners not working properly during very hot days. This calls for gadget manufacturers to revise their product manufacturing to cater for the increase in temperatures. In some cases, the staff resorted to pre-cooling rooms before tourists arrive so that when tourists check-in, the rooms are at the right temperature. This pushes up energy costs and the carbon footprint of tourism operations. Encompassing green building design can be an alternative way to deal with these challenges.

The Information and Technology (IT) team complained that infrastructure had to be repaired frequently during extremely hot days. SFPs (small form-factor pluggable), servers and bit switches were reported to be particularly vulnerable to excessive heat. In particular, the SFP at the Mountain Lodge was reportedly getting burnt more often than other areas when temperatures were very high. The increased need for maintenance and IT maintenance escalated operational costs. Communication was also disrupted by such occurrences in and around the lodge, which is a challenge. The SFP temperature sensitivity and their effect on functionality are well documented by Kodet, Panek and Prochazka (2015:18). Given the demand for connectivity (Satake 2019:33), some chances of disrupted communication can affect tourist satisfaction and experience in such instances.

Besides the impact of temperature on human and tourism infrastructure, the rising temperature was observed to hurt bird species in the game reserve. Employees indicated that most birds populate near roofs on very hot days and in some cases, they just fall and die. The vulnerability of birds to excessive temperature is documented, with studies indicating that birds struggle to survive temperatures over

the mid-30s (Moagi, Bourne, Cunningham, Jansen & Ngcamphalala 2021:242). According to Moagi *et al.* (2021:242), when temperatures are between 35° C and 40°C, birds reduce foraging efficiency, body weight and reduce breeding success. The study also revealed that the number of sweltering and extremely hot days has been increasing over the years. This is a disturbing trend as Phinda considers birding as one of its unique tourism offerings. Continued death of birds can negatively affect bird sighting and tourist satisfaction for birders.

4.3   Rainfall pattern and its impacts on tourism operations and other climatic events at Phinda Private Game Reserve

4.3.1   Rainfall pattern and its impacts on tourism operations at Phinda Private Game Reserve

Rainfall in Hluhluwe occurs mainly in summer, with rainfall expected at any time of the year. It emerged from the climate data that the Hluhluwe area is witnessing a decline in the annual average amount of rainfall throughout the study. Nonetheless, this change was found to be statistically insignificant; however, this change is environmentally significant. The data from meteorological station indicate that rainfall has been decreasing on an annual basis (see Figure 4.3). Evidence shows that the area throughout the study, only seven years recorded rainfall amounts that were above the average rainfall for the area. Over the last ten years, only two years recorded rainfall that was above the average rainfall, namely 2011 and 2012. After that, the area has been receiving below average rainfall, which points towards drying episodes.
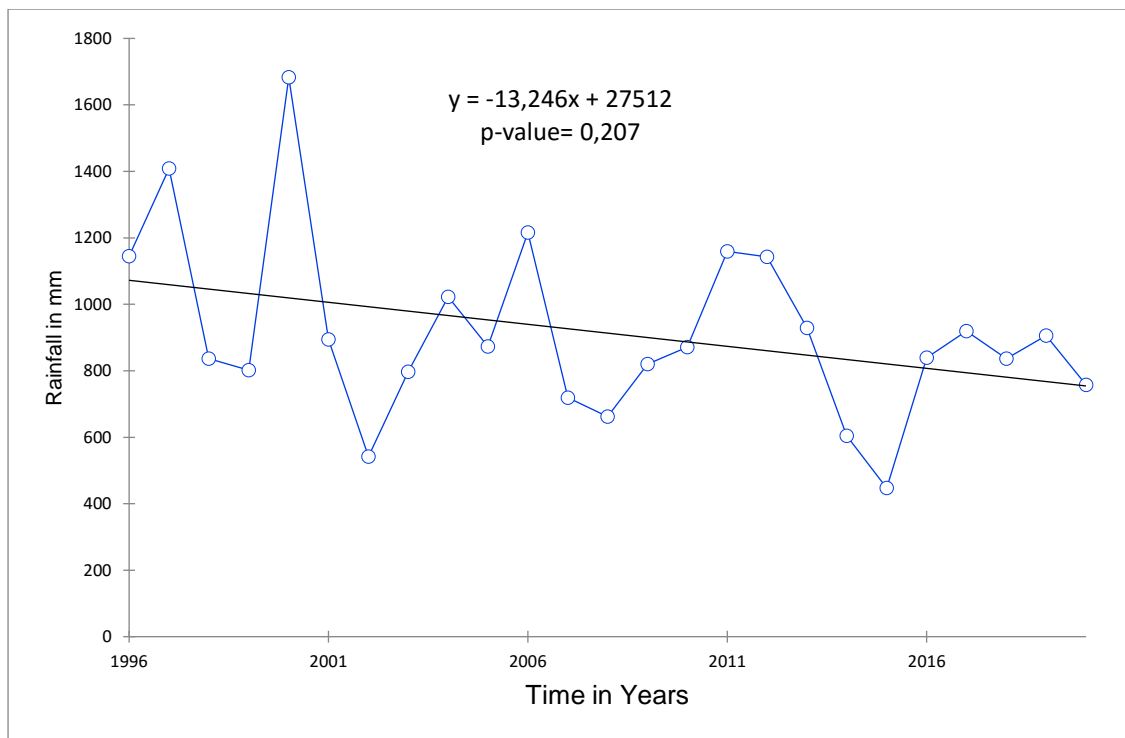
Figure 4.3: Annual rainfall pattern 1996 to 2020

In 1999 and 2008, the area recorded the second driest or minimum amount of rainfall of 1mm, and this was against the average of 80mm and 133mm of rainfall per year. This indicates that there is an increase in the occurrence of drought in the area resulting in negative impacts on the vegetation, animals and water supply.

Figure 4.4: Bush encroachment. Source: Author.

The increased occurrence of droughts in the reserve encourages bush encroachment and dryness in waterholes and wetlands. As a result, many woody plants, bushes and shrubs occupy the natural area, thereby compromising the grass for the grazing animals. Bush encroachment has severe negative threats to biodiversity and groundwater recharge. It emerged from the interviews that the water levels in many waterholes become very low during a period of drought and less rainfall. This negatively affects water-dependent animals like the Hippos and Crocodiles, which spend most of their time in the water.

The year 2000 should have been a flood that would have resulted in the damage of tourism superstructure and infrastructure such as roads and dams could have been swept away. This was confirmed in an interview with the key informants. The game reserve can receive rainfall any time of the year, although this rainfall decreases significantly. Evidence shows that the highest rainfall amount was received in 2000. After that, rainfall has been in decline ever since. Evidence shows that between 1996 and 2020, the area has been receiving below average expected rainfall, with the worst

ever recorded drought over the past two decades having been witnessed in 2015, which was a drought year that was induced and compounded by the El Niño (Funk, Davenport, Harrison, Magadzire, Galu & Galeid 2018: 591).

There is also evidence that rainfall in the area is highly variable annually. This was also confirmed by interviews where interviewee XW stated that:

"*The rainfall pattern for the area used to be predictable, but recently, it has become difficult to predict because of the abnormal changes in the climate.*"

This sentiment was also echoed by several other respondents who pointed out the unpredictability of the rainfall pattern on an annual and seasonal basis in the area. As a result of climate abnormalities, the area receives late rainfall in summer and early rainfall during the winter months. It was reported that the rainfall in the area is normally short-lived and sometimes comes in the form of outbursts. This has consequences for road infrastructure as massive erosion in certain parts of the reserve ensues. This increases operational costs for road maintenance and can disrupt tourists' movement, especially those who might not be using 4X4 vehicles.

The maximum and most wet year over the 25 years was recorded in 2000. In that year, the area recorded a high rainfall amount of 1683mm against the annual rainfall average of 916mm. Monthly, some months have been witnessing record-high rainfall receipts with some months have witnessed as much as close to half or more than a quarter of rainfall expected in one year. November and January seem to be witnessing some of the extremely wet days. Over the past periods, rainfall as high as more than 200mm and above 300mm has been received in the area (See Figure 4.5). Such high volumes of rainfall are worrying, particularly their impacts on the infrastructure such as roads. The wettest month has been November 2000 followed by January 2021. A record amount of 386mm and 309mm was received in those months respectively. The occurrence of tropical cyclones was critical in increasing the average amount of rainfall received in some years.
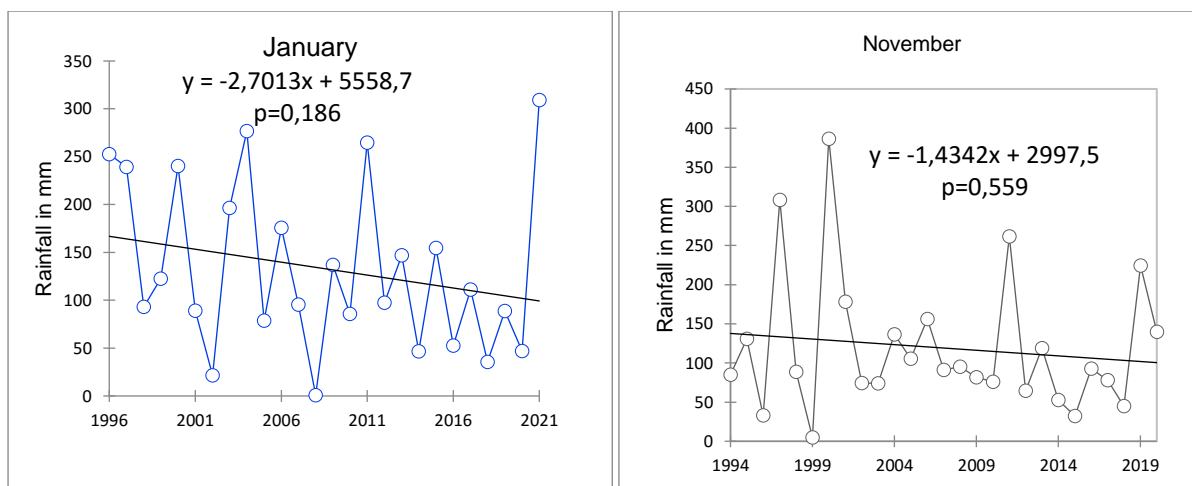
Figure 4.5: Second highest and minimum rainfall received

It was reported from the interviews that during heavy rainfall periods, the reserve becomes inaccessible to both the tourists and the employees due to damaged and muddy roads. Dams were reported to overflow, which caused some parts of the reserve to be blocked by the overflowing water. This compromised the game drive activities for the tourists and employees to go to work. Interviewee XW indicated that tourists' vehicles including the game drive vehicles, get stuck on the muddy roads after heavy rainfall. This has negative impacts as it becomes impossible to conduct game drives and host outside dining and bush dinners and activities. However, there is evidence showing that the rainfall has been decreasing in the area over the past 25-years

On the overall month on monthly rainfall pattern, several months have been witnessing a decline in the amount of rainfall received. Table 4 shows that only two months have witnessed an increase in rainfall, although this was not statistically significant. The other months save, for May and September, have witnessed a decline in rainfall amounts.

Table 4.3: Rainfall patterns in the area

Month	Increase	Decrease	Estimated change in average precipitation amount
January		Yes	From about 160mm to 98mm
February		Yes	From about 90mm to 47mm (Statistically Significant)
March	Yes		Increase from 96 to 105mm
April		Yes	From 99mm to 76mm
May		**Static**	Almost static at46mm

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June		Yes	From 41 to about 38mm
July		Yes	From about 45 to 39mm
August		Yes	From about 40 to 33mm
September		**Static**	Almost static at about 50mm
October		Yes	From about 100mm to 85mm
November		Yes	From about 130mm to 98mm
December	Yes		From about 51mm to 80mm

Source: Author

February is the only month that has witnessed a statistically significant change in rainfall amount received, as shown in Figure 4.6, which saw rainfall on a downward spiral from 1996 to 2021.
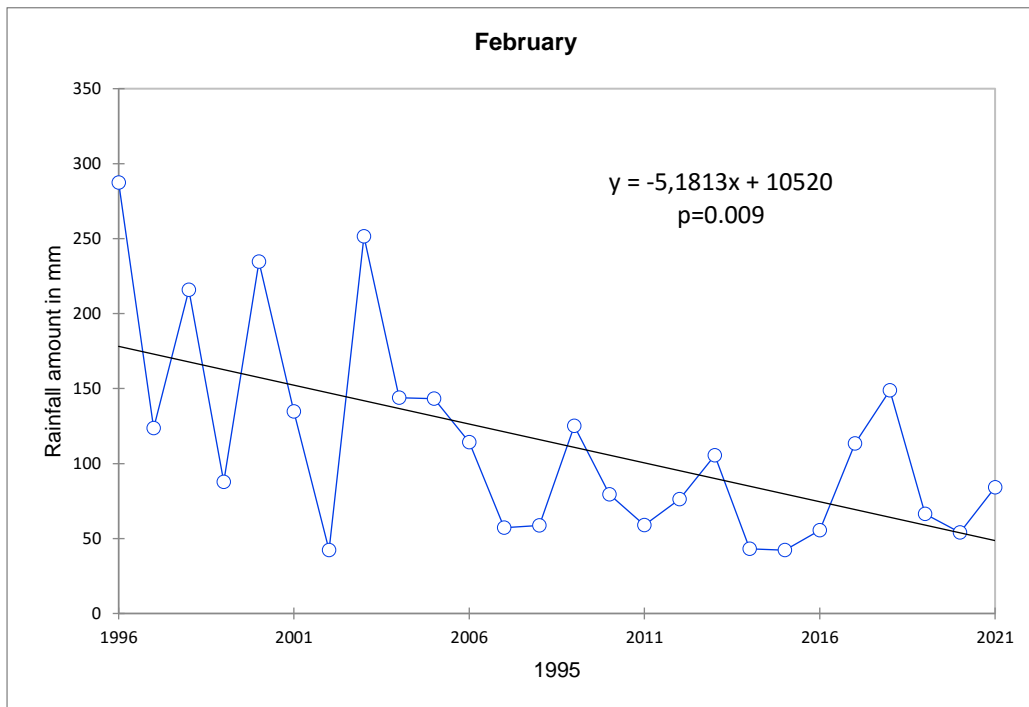
Figure 4.6: The decrease in February rainfall from 1996 to 2021

A decrease in rainfall could indicate increased droughts, which could be problematic for flora and fauna in the game reserve. As a result of less rainfall and frequent drought, the waterholes, particularly the dams and some wetlands, show that they are stressed and taking a strain. Often, drought causes disturbances to the ecosystems because the overall primary productivity is repeatedly compromised. This could also affect the birth cycle of animals in the reserve and the game viewing quality in the reserve.

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Evidence from field observations and interviews with key informants indicated that some sections of the reserve were battling bush encroachment, which can be traced back to the increased episodes of droughts. One interviewee had this to say:

 "Bush encroachment is the biggest threat to the reserve".

It was further pointed out that animals such as lions, cheetah, leopards and hyenas were spread all over the reserve in previous years. Consequently, the animals started sharing the same habitat in recent years because some parts of the reserve are too thick and inhabitable for animals. As a result, the lions killed the cheetahs, and the mortality rate for cheetahs increased.

Bush encroachment also causes a negative impact on the grazing animals because there is inadequate grass for the animals to graze. It was pointed out that bush encroachment disrupts game viewing by that the bush becomes too thick for the tourists to see the animals. This can adversely affect the tourist experience as the bush thickets compromise the game viewing quality. Due to the increased impact of bush encroachment and alien vegetation, operational costs were increased as more money was being invested in bush clearing to ensure the ecological integrity of the veld.

Another interviewee confirmed that a severe drought occurred in previous years, resulting in some animals dying and the elephants drinking swimming pool water. During this period, the dams were dry to the extent that they had to transport water from the nearby communities to the reserve to supply the animals. As a result of this severe drought period, the trees and grass were dried out. In addition, some lodges were closed due to water shortages and employees were seconded to other lodges within the reserve and some employees were sent to Phinda Ngala in Mpumalanga. Fitchett, Grab and Thompson (2015:460) pointed out that a significant increase in drought occurrence will cause harm to the well-being of animals and the plant life-cycle with a side effect on the producers and the whole food.

Apart from unpredictable rainfall patterns, the area was also vulnerable to tropical cyclones and related storms. From archival data, it emerged that several tropical cyclones that have affected parts of KZN have impacted the game reserve. Some of the tropical cyclones that affected Phinda include Eloise in 2020/2021 and tropical

cyclone Domoina in January 1984. Tropical cyclones are often disruptive and destructive to tourism due to high amounts of rainfall, flooding and very high winds that destroy anything within the storm's track. Floods habitually live large chunks of land eroded, and roads destroyed.

Storms and freak storms were also increasing, according to evidence from the interviews. The costly storm occurred in the early months of 2021, resulting in the tent's damage covering the outside dining area for the tourists. This was massive damage for the reserve as this tent was a relaxing dining area for the tourists, especially during extremely hot days. The damage of this infrastructure had a negative impact on the operation costs and the experience for tourists because a large amount of money had to be invested in rebuilding the tent as the reserve management covered the costs.

4.3.2 Lightning events

Many previous studies projected an increase in global lightning events because of climate change over the coming century (Schumann & Huntrieser 2007:3823; Murray 2016:115; Tost 2017:1125). Less rainfall over a long dry season and a delay at the end of the dry season increase the potential for lightning events and wildfires (Fill, Davis & Crandall 2019:5). It emerged from the interviews that the incident of lightning events in the area is increasing. This increase could be associated with less rainfall and extreme temperatures experienced by the area. A study by Romps, Seeley, Vollaro and Molinari (2014:851) found that lightning events increase with warmer temperatures.

Lightning events usually occur during the summer months when the area is experiencing extreme temperatures. Interviewee XW indicated that:

> "*Lightning is severe when it is extremely hot. The lightning event often lasts for an hour and then comes back to strike again; it can strike for about five times a day*".

Several other respondents, including those from host communities, complained about the frequency and intensity of lightning in the area and how destructive it is. It was reported that lightning disrupted the power and communication network. Telephones and power lines get affected, making it difficult to communicate with other employees

and tourists in other lodges within the reserve and outside. Some interviewees mentioned that they are afraid of lightning and it becomes difficult and scary to work when there is a lightning event as some of them had been struck by lightning at their homes in the past.

The lightning events also affect the tourists who come to visit the game reserve. Many of the outdoor activities cannot be undertaken during a lightning event. Activities such as game drives, beach vacation, turtle nesting conservation, outdoor dining and bush dining are compromised because it is unsafe for the employees to take tourists outside during such an event. However, some of the interviewees mentioned that most tourists usually spend time outside even when there is lightning because they find it fascinating to watch the lightning strikes.

4.3.3 Sea level rise

Since the 1980s, the sea level has been rising with increasing sophistication based on the output from climate change models (Stammer, van de Wal, Nicholls, Church, Cozannet, Lowe & Hinkle 2019:9232). The IPCC (2019:1) pointed out that the increase in sea level rise is essentially due to global warming and polar ice melting. This will result in coastal flooding and beach erosion, thereby putting a lot of pressure on coastal tourism activities. Studies indicate that the sea level is rising as the global temperatures continue to rise (Lindsey 2019:5). Sea level rise has devastating impacts on the coastal tourism activities, infrastructure and aquatic life on the sea. Sodwana Bay was used as a case study for this scenario.

During a field observation, there was clear evidence of coastal erosion at some of the beach resorts that are part of the product offering by Phinda. At the Sodwana beach, trees that had previously grown into big trees and formed part of the coastal defence are being eroded from the seaside and dying off with roots exposed. This means future tidal activities can be even more damaging as the coastal defense is taken away. As the sea level rise and beach erosion progresses, many aquatic lives will suffer significantly. It was reported that the sea level rises due to the warming up of the ocean has negative implications on turtle nesting, habitat, behaviour and turtle conservation as the area is a critical breeding site for endangered turtles. Veelenturf, Sinclair, Paladino and Honarvaur (2020:10) pointed out that "as the sea level continues to rise,

many beaches will become steeper and narrower causing invincible berms along the vegetation line and the turtle could be the first to lose their nesting habitats.

It was observed that as the sea level rises with coastal flooding due to global ocean warming up as a result of climate change, coastal erosion will likely increase. The erosion of the coastal areas has devastating impacts on the coastlines. This often results in n steep beaches and the beach becomes unpleasant or attractive for the tourists to enjoy the beach, mainly the sand, because almost all of the sand is washed away to the sea.

The erosion of coastal beaches will affect coastal tourism and increase the vulnerability of beaches to climate change impacts and harsh weather conditions.

Interviewee XW pointed out that the beach is becoming steep due to sea-level rise. This will have catastrophic implications for beach tourism as most tourists, especially international tourists, would no longer be intrigued to visit the beach. Beaches are at risk as a result of the rising sea level. Of significant concern to this study is the fact that Sodwana bay is a rich breeding ground for turtles. Increased coastal erosion is an imminent threat to turtle nesting sites with far-reaching implications on flora and fauna. The turtles are a part of the tourism product offering for tourists that visit Phinda. Given the disturbances caused by climate-related weather extreme events, the private game reserve had several initiatives in place to foster mitigation and adaption in build to ensure resilience and sustainability.

4.4   Chapter Summary

This chapter highlighted the impacts of climate change variability and change affecting the reserve's tourism operations. It emerged from this chapter that climate variables such as temperatures, rainfall, drought, sea-level rise and incidents of lightning and storms events were amongst the impacts of the climate variability and change impacts affecting the game reserve's tourism operations. The meteorological data indicated that the area is experiencing increased extreme temperatures, which had devastating impacts on employees and tourists. The rainfall trends were noted to decrease, thereby encouraging drought and bush encroachment. The sea-level rise, incidents of lightning events and storms were also increasing. As the result of these extreme climatic impacts, the game reserve needs to devise measures to mitigate and adapt to the implications posed by climate variability and change.

Chapter 5: Climate change mitigation and adaptation

5.1 Introduction

The tourism industry is one of the industries that contributes significantly to global warming and, consequently, climate change (Hoogendoorn & Fitchett 2018a:7). Therefore, it is in the interest of the tourism industry to reduce and adapt to climate change to limit the harmful impacts to be reached as the tourism industry is vulnerable to climate change (Csete & Szecsi 2015:477). There is an urgent need for practical solutions in responding to climate change whilst gaining from the tourism industry (Ojha, Ghimire, Pain, Nightingale, Khatri & Dhungana 2016:415). &Beyond is heavily biased in promoting responsible and sustainable tourism in all its tourism and safari operations (Dube, Nhamo & Mearns 2020:89). Responsible tourism practices at the national level in every country and practical actions are necessary for addressing and responding to environmental issues such as climate change, sea-level rise, water shortages, food shortages, energy consumption, new and renewed diseases and environmental refugees (Sifolo & Henama 2017:196).

5.2 The electricity used by Phinda Private Game Reserve

Given that Phinda Private Game Reserve uses electricity generated from Eskom to operate, the reserve also tries to reduce its energy consumption by using less energy to mitigate climate change impacts through efforts to enhance environmental performance and promote energy efficiency in all its lodges and offices. The game reserve closely monitors and reports on energy usage as a critical component of monitoring their carbon footprint and reports its energy usage through its annual impact assessment reports with ambitions of annual improvements. Phinda Private Game Reserve, as part of &Beyond, is one of the few companies that measures carbon emissions per tourist intending to continuously improve. In 2015, the company sought an ambitious target of reducing carbon footprint per tourist from 16kg per head to 14.7kg per head by 2020. However, emissions for properties in South Africa (Figure 5.1) have remained higher than the group average factor attributed to the fact that South Africa's electricity is carbon-intensive given the country's reliance on coal driven electricity from Eskom.
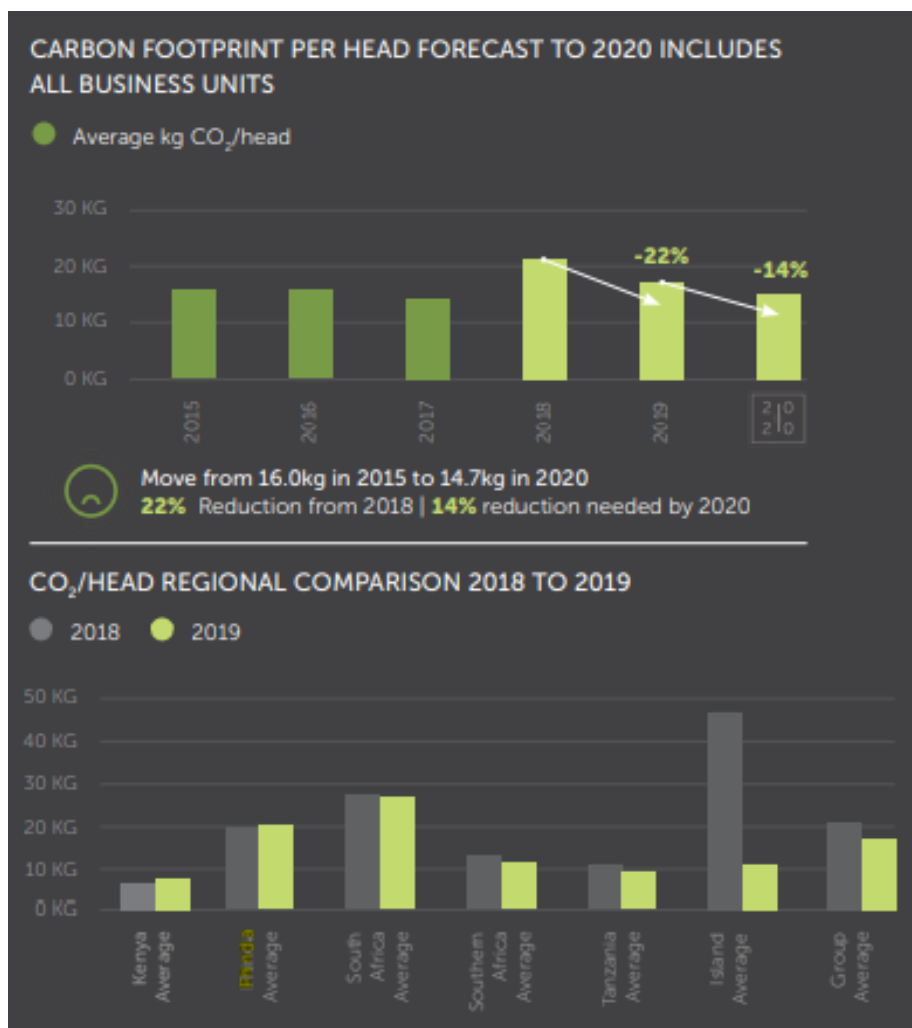
Figure 5.1: Carbon footprint per head forecast to 2020 includes all business units. Source: &Beyond (2019:55)

Phinda Private Game Reserve has not moved to solar like other properties owned by &Beyond, especially those located in Namibia and Botswana (Baker & Mearns 2017:1). They currently rely on improving energy efficiency and using alternative energy sources to deal with their carbon budget. Among other measures, Phinda uses gas energy for a number of its kitchens as an alternative to electricity. Some appliances such as cooking stoves are run wholly on gas in various camps.

As part of promoting energy efficiency, the company installed an energy efficient heat pump at Bayete staff camp. Heat pumps have been touted as one of the key strategies for reducing energy, promoting hotels sustainability and fighting climate change. (Bianco, Righi, Scarpa & Tagliafico 2017:329). Other initiatives include hanging laundry, which is not for emergence use. At Forest Lodge, the company installed

washing machines that have a fast spin-drying facility. The machines use centrifugal force, which assists in reducing tumble drying time and inadvertently saves electricity, which assists in cutting back on carbon emissions.

To ensure that energy efficiency is one of the necessary measures to deal with the impacts of climate change, as a standard of good practice, the staff members are always encouraged to use energy effectively by turning off all the unattended machines and appliances such as switching off the lights at night and turning off the stoves when done cooking. Improving energy efficiency has been a better strategy for reducing the GHG emission that causes global warming, which causes climate change (Ang 2016:574).

The reserve management purchases and uses eco-friendly appliances that use less electricity such as refrigerators, air-conditioners, washing machines and dryers to reduce their energy usage and cut electricity costs. They also encourage laundry staff not to use towel dryers during peak season as a way to reduce energy consumption.

Due to climate change, the shortage of water resources has become a global challenge requiring measures to save water at every level. The use of semi-desert and desert plants as part of the garden landscape is also aimed at reducing water that is used for garden irrigation. The game reserve's management installed low flow showerheads in tourists' rooms to ensure water conservation and reduce the tourists' carbon footprint. Water-saving showerheads (Figure 5.2) are used as measures to adapt and mitigate climate change by using water responsibly. Studies indicate that low-flow showerheads can help save water and reduce energy consumption costs on water (Minami, Minoru & Yoshihiko 2015:4055).

Figure 5.2: Measures put in place to save water at Phinda Private Game Reserve: Author

However, in as much as the reserve is doing what it can to reduce water usage, field observations revealed that some of the taps that were used in bathrooms and washing basins release a lot of water. The use of non-dual systems in toilets was also found to be a concern as it is heavy on water consumption. The continued use of water tubs is also worrying as it is often associated with high water consumption within the hospitality industry (Torres-Bagur, Ribas & Vila-Subirós 2019:3583; Gössling, Araña & Aguiar-Quintana 2019:273). This is something that might require additional attention at some time to ultimately reduce the water footprint of the game reserve.

Figure 5.3: Areas of potential high water consumption areas in Phinda's accommodation. Source: Author

The reserve reduces its carbon footprint of transporting water by making use of a local water bottling plant. Some of the interviewees reported that one of the primary targets the reserve management is aiming at is to reduce plastic water bottles and use glass water bottles (Figure 5.4). By using glass water bottles, the reserve will minimise some of its impacts because glass water bottles are recyclable and have a minimal carbon footprint and lower environmental impact instead of using plastic water bottles and aluminium bottles (&Beyond 2020:69). This assists in addressing the challenge of ocean pollution and response and addresses the climate change issues associated with water transportation.

Figure 5.4: Glass water bottles. Source: Author.

5.3 Climate change adaptation at Phinda

Adapting to the changing climatic conditions by the tourism sector, especially private nature reserves, is of enormous importance in promoting sustainability in the tourism and the conservation industry and dealing with climate variability and change impacts. It emerged from the fieldwork that drought is one of the biggest challenges the reserve is facing due to climate change, which often results in water supply challenges in the reserve and the surrounding areas (Mqobokazi and Makhasa community). To respond to this threat, the reserve uses various water-saving techniques such as water harvesting.

Water harvesting techniques to adapt to climate change by Phinda private game reserve were observed during a field observation in some of the reserve's lodges. The

water tanks are placed near the buildings to collect water from the roof when it is raining through gutters into the storage tanks. The harvested water is generally used for domestic purposes, mainly during a drought and when there is a water shortage in the reserve. Sharma and Smakhtin (2016:3) pointed out that given the severity of drought and population growth, it is crucial to explore systematically the potential for rainwater harvesting, water conservation and water use to respond to climate change. Dinarescos and Sauri (2015:623) point out that water-saving measures are cost-effective and reduce operating costs and increase profit margins.

As the result of the increased episodes of droughts and less rainfall in the reserve, the reserve management has constructed several small earth dams to store water that animals can consume during the dry season and drought episodes (Figure 5.5). These are also significant reservoirs of aquatic life such as fish, crocodiles (Crocodylidae) and hippos (Hippopotamus amphibious). The small earth dams are used as a climate change adaptation strategy to address challenges imposed by droughts in the area. These are also valuable aesthetical properties for tourism and recreation purposes.

Figure 5.5: Small earth dams as a climate adaptation strategy. Source: Author.

To ensure that water usage is kept at a minimum, the landscaping of the gardens is done using local plants that are well adapted to dry conditions, which limit the demands for watering. The surroundings are also lined with indigenous plants and trees, which help regulate the temperature around houses and the demand for air conditioning. Trees are critical for temperature regulation and also assist in climate change mitigation as they act as carbon sinks (see Dube & Nhamo 2021).

One of the challenges faced by the world because of increased temperatures and drying is the increased risk of fire (Kumari & Pandey 2020:87). Fire poses a great risk to tourism infrastructure (Dube & Nhamo 2019c:2025) including lodges. To reduce the risk of fire, the lodge creates a fireguard around the establishment. In addition, fire hydrants are also installed (Figure 5.6) to deal with fire emergencies as most lodges are in proximity as the lodge sought to ensure minimal disturbances to the ecosystem. The lodges are equipped with a fire detection alarm system to reduce the damage caused by the fire in lodges should there be a fire. Interviewee XW mentioned that fire hydrants are installed to put out the flames of the fire to prevent the fire from destroying the property for protecting the nearby animals, vegetation, staff and tourists. Besides, it prevents the fire from spreading across the reserve when there is a fire outbreak caused by either people or had occurred naturally because of the extreme temperatures in the reserve. High-capacity fire hydrants are essential for reducing fire outbreaks (Lee, Kim & Lee 2021:1).

Figure 5.6: Technology put in place to deal with fire risk at Phinda. Source: Author

In line with other conservation establishments, the company has constructed lodges using local materials including thatching, which assist in temperature regulation. Thatching assists in ensuring that buildings are warmer in winter and cooler in summer as grass used for thatching is a thermal insulator (Dube & Nhamo 2021b:177). This also reduces the demand for air-conditioning in establishments. In response to global warming and the need for cooling, the establishments are fitted with air-conditioners and cooling fans (Figure 5.7). This was confirmed during field observation. During the interviews, the interviewees pointed out that all the tourists' rooms have air-conditioners and ceiling fans to control the temperature and ensure comfortable temperatures. Interviewee XS reported that the air-conditioners are usually turned on before the guest can enter the room to allow the temperature to cool down.

Figure 5.7: Technology employed to adapt to increasing temperature

The use of the dual invertors for cooling the rooms does not only address adaptation demands for the lodge but also talks to climate change mitigation. Dual investors are known for being energy efficient, which assists in cutting back on carbon emissions (Dube & Nhamo 2020:55). A study by Almogbel, Alkasmoul, Aldawsari, Alsulami and Alsuwailem (2020:191) revealed that air conditioners with invertors could use as little as 44% more energy than conventional airconditioners. Fans and air-conditioners were the appliances that some employees used to reduce the heat and increasing temperatures, especially when they find it difficult to sleep at night. The reserve management has also installed fans in the kitchens to regulate and cool down the heat for the employees that work in the kitchen.

However, the design of some lodges was found to be faulty and not as promoting energy efficiency. Long walls to the roof and vast rooms, although creating a spacious atmosphere, are also problematic as they create large area space for heating or cooling, raising the demand for energy use. This could account for high energy usage and a bigger carbon footprint.

To deal with the increasing temperatures, the reserve has swimming pools (private swimming pools) next to the tourists' rooms and a community pool (Figure 5.8) for the tourists to use for enjoyment and swimming when experiencing heat stress caused by the high temperatures. The swimming pools allow the tourists to cool down from the high temperatures they experienced in the reserve when they were on game drives and when they were outside their rooms without air-conditioners and fans.

Figure 5.8: Community swimming pool and the private swimming pool for the tourists

Ideal temperatures for the tourists are essential for ensuring that they enjoy holidays at every destination. The game reserve management has built traditional lantern-lit African Boma at the Forest lodge to ensure ambient temperature for the tourists when having outside dinner. The traditional lantern-lit African Boma is built with wood to allow the air to enter the space and allow the tourists to enjoy the area. Inside the Boma, the serve had ensured that the area had matured and tall trees provided a shade for the tourists during hot and extremely hot days. The traditional African Boma has an incredible temperature for relaxing and enjoying the food and the atmosphere around under the canopy of the stars. (Mkono 2011:253)

Figure 5.9: The traditional lantern-lit African Boma. Source: Author

Increased incidents of droughts promote bush encroachment as seen earlier. To deal with bush encroachment caused by climate change, the reserve cut the encroaching bush to minimise the bush and clear the spaces. This method of cutting the bush is also an advantage to game viewing activities as tourists can be able to see the animals. The interviewees also mentioned that they sometimes spray herbicides in some parts of the bush. Burning some part of the bush or habitat to control the bush or grass regime is also implemented to deal with the frequent occurrence of bush caused by climate change and the increasing carbon dioxide in the atmosphere.

Figure 5.10: Cutting the bush as a strategy for dealing with bush encroachment. Source: Author.

The reserve management also provides educational programs to encourage the staff members to conserve and use water responsibly and adapt to the increasing temperatures. It was reported that drinking water is one of the measures the reserve management is promoting and encouraging to adapt to the extreme heat and increasing temperatures. Other interviewees mentioned that they always drink water when working and they carry bottles of water when taking tourists to game drives for themselves and the tourists. They also pointed out that they usually wear long sleeve t-shirts, hats and cover their legs with thin blankets to protect themselves from the sunrays and the extreme heat caused by the extreme temperatures. In most cases, they use sunscreen as a prevention measure against the sun rays and they sometimes park under the tree shades to cool off.

It came out from the interview that the coping strategy during the summer season, when the temperatures are extremely high, the reserve management and the tour guides and field guides sometimes reschedule the game drives, primarily the

afternoon game drives, because of the high temperatures. The afternoon game drives are usually conducted in the early evening when it is cool enough to take the tourists outside for game viewing. In support of this, a study conducted by Dube and Nhamo (2020c:6) pointed out that game drives activities should probably be rescheduled, particularly the afternoon game drives to be conducted in the early evening because of the extreme temperatures during the day.

In attempting to deal with the impacts of soil erosion on the reserve caused by droughts and heavy rainfall as a result of climate change, the maintenance team graded and flattened the soil on the road. Some Interviewees reported that they often avoid off-loading and use the designated trail road and do not step onto the vegetation when showing tourists the animals hiding in the bush or under the tree shades. They also mentioned that when they were fixing and rebuilding the tent destroyed by heavy rainfall and storms, they used strong materials to withstand heavy storms and floods.

5.4 Animal research and conservation as an adaption strategy

Research is necessary to protect and effectively conserve endangered species (&Beyond 2020:49). &Beyond has a formal agreement with the University of South Africa (Unisa) in identifying a sustainable need in their animal conservation and operations. Phinda has also invested enormously in developing its research base, impacting its wildlife management and conservation decisions. To protect animals against harsh climatic conditions, research animal coping mechanisms and conservation is vital. It enables wildlife managers and conservationists to investigate the importance of animals adapting to the extreme climatic conditions of climate change and global warming.

Rhino without borders, an ocean without borders, the lionscape coalition and the African Pangolin working group, are some of the initiatives that &Beyond has in trying to protect and conserve the wildlife for tourism attraction and wildlife preservation. The Rhino without borders initiative was established to ensure rhino survival by creating a viable breeding population through the translocating of 100 rhinos from high-risk poaching areas in South Africa to the safety of wilderness in Botswana. In contrast, the ocean without borders aims to support and establish marine conservation areas to protect aquatic lives by working with the neighbouring communities and partners.

Africa's lion population has decreased with the recent estimates of its population at an alarming 20 000 (&Beyond 2020:42), proving that lions are one of the endangered animals in the African region. The purpose of this initiative is to increase the number of wild lions by doubling it by 2050 and to recover from the last number of in over the past 25 years by strategically addressing the factors of humans in conflict, habitat loss, the legal trading of lions and illegal hunting of the lions. The African Pangolin working group was created to focus on reintroducing the pangolin species into suitable habitats and reverse the local extinction.

5.5   Chapter Summary

The chapter was aimed at discussing the mitigation and adaptation strategies employed by Phinda Private Game Reserve in responding to the impacts of climate variability and change. This chapter highlighted that the game reserve monitors its carbon footprint and energy usage and report on its annual impacts report. The reserve is also one company that measures carbon emissions per tourist. The use of glass water bottles and low-flow showerheads is one of the game reserve's measures to reduce its carbon footprint. It also came out from this chapter that the game reserve had installed fire hydrants, fans, air-conditioners, swimming pools and built traditional lantern African Boma to adapt to the extreme temperatures and extreme climatic conditions. Cutting of the bush is also a measure that the game reserve uses to deal with the frequent occurrence of bush encroachment.

Chapter 6:   Conclusions and Recommendations

6.1   Introduction

This chapter seeks to provide conclusions, recommendations and limitations of this study. The conclusions of the study are drawn based on the study results, and the study's shortcomings are mentioned. Recommendations are made regarding the tourism climate change mitigation and adaptation strategies for private nature reserves. Limitations and the value of the study are highlighted.

6.2   Evidence and impact of climate change

The study was aimed at determining tourism climate change impact, mitigation and adaptation strategies at Phinda Private Game Reserve, KwaZulu-Natal, South Africa. The study sought to answer the following research questions: what are the climatic variables at Phinda Private Game Reserve? What are the impacts of climate change at Phinda Private Game Reserve's tourism operations? What climate change mitigation strategies are adopted by Phinda Private Game Reserve's tourism business operations' value chain? Which adaptation strategies are being adopted by Phinda Private Game Reserve in responding to climate change impacts?

The findings of the study indicate that the impacts of climate variability and change are increasing as evidenced by increasing temperatures in some months, a general decline in rainfall, increased occurrence of drought, increased occurrences of lightning events, sea-level rise and severe storms with adverse impacts on tourism and tourism operations at the game reserve. The increased occurrence of extreme weather events has resulted in several challenges for the game reserves, which calls for action to either mitigate or adapt to various climate change challenges.

The study found that there is an increase in the number of extremely hot days with temperatures above 35 °C and 40 °C. This development has far-reaching implications on flora, fauna, and tourism role players at the game reserve. Birds were reportedly quite vulnerable as some fell off to death on some extremely hot days as the number of heatwaves increased. As part of its tourism operations, Phinda also takes its tourists to the coastal areas where turtles are nestling. An increase in temperature is likely to

upset the reproduction of turtles as soil and sand temperatures rise where turtles breed.

The increase of extremely hot days has adverse impacts on the employees and the tourists. The employees were experiencing difficulties sleeping at night due to heat stress from soaring night temperatures, which tends to affect their workplace performance. On the other hand, tourists showed signs of irritability as a result of extreme temperatures during game drives. An account from field guides revealed that an increase in temperature was also found to have a damaging impact on telecommunication infrastructure, aiming to ensure internet connectivity to guests and employees alike.

On an annual basis, the study found that although the area receives rainfall throughout the year, there has been a decrease in the annual average amount of rainfall between 1996 and 2020. On a month-to-month basis, all months except December witnessed a general decline in rainfall receipts. The worst drought experienced in 2015 was attributed mainly to El Niño and worsened by climate change. Some intense drought episodes have also been observed. Droughts have a devastating impact on the water supply, affecting tourism employees and drinking water for animals. Droughts have led to some staff camps being shut down in the past with employees being deployed elsewhere. In addition, droughts have placed an additional burden on bush encroachment, which is a challenge from a tourism and conservation perspective.

Over the past decade, only two years recorded rainfall above the average rainfall namely 2011 and 2012. The decrease in rainfall had devastating impacts on the vegetation, animals and water supply. Evidence also showed that the area received the highest rainfall amount in 2000. The game reserve was also found to be equally vulnerable to tropical cyclones and has faced the backlash of the increased incidence of tropical cyclones in the area. The participants reported that rainfall in the area is ordinarily short-lived and it often comes in outbursts due to climate abnormalities. Intense rainfall activity has been reported to have a devastating impact on infrastructure such as roads. Due to increased intense rainfall, the reserve has also witnessed increased costs in weather-related damages to infrastructure and property. The destruction of roads is disruptive to tourists' movement, especially those who

might not be using 4X4 vehicles, as some reserve parts become inaccessible due to muddy roads.

The study revealed that lightning incidents usually occur in the summer months when it is extremely hot. Lightning events disrupt communication infrastructure, making it challenging to communicate with other employees and tourists in other lodges and outside the reserve. Some employees mentioned that they find it difficult to work when there are lightning events as some of them had experiences of being struck by lightning at their homes. Lightning events also affect outdoor activities such as game drives, beach vacation, turtle nesting conservation, outdoor dining and bush dining.

6.3   Climate change mitigation and adaption at private game reserves

Given that tourism releases a considerable amount of greenhouse gas emissions, which propel climate change, Phinda private game reserve is in line with the need to practice sustainable and responsible tourism, taking steps to reduce its carbon footprint. To that effect, the game reserve has several initiatives in place to reduce its energy from a tourism perspective. The company attempts to construct energy-efficient buildings by adopting various innovative ways that reduce its lodges' energy intensity.

In addition, it was found that the game reserve is promoting energy efficiency by using appliances that consume less energy, such as the use of energy-efficient lights, using gas stoves and encouraging staff to switch off all the unattended appliances, amongst other such measures. The reserve had also installed low flow showerheads in tourists' rooms to save water and, by proxy, energy consumption, particularly from heating water, which is a key driver of carbon emissions. As a measure for reducing the reserve's carbon footprint, the reserve had installed water bottle plants and used glass water bottles to reduce the carbon footprint associated with the transportation of products such as water. The reserve's efforts resonate very well with general industry practice. Regardless of the efforts made, the lodge has a lot of improvement in terms of renewable energy investment to further cut its carbon footprint. Baseline data shows that Phinda remains one of the carbon-intensive operations within the &Beyond enterprise. The fact that there is already energy benchmarking is a welcome development on its own.

Given the glaring evidence of the impacts of climate variability and change, there is a need to ensure tourism resilience, largely through the adoption of appropriate climate change adaption to reduce the risk and cost of climate change at Phinda private game reserve. Climate change adaptation is a critical part of tourism and any business enterprise in Africa. Phinda Private Game Reserve has put in place certain measures to adapt to climate change and build a resilient tourism industry. Given the multiple threats facing the reserve such as droughts, global warming, and intense rainfall activity and localised flooding amongst others.

To deal with the adverse impacts of drought, which often trigger water shortages, the private game reserve has instituted measures aimed at reducing water usage such as installing low flow shower heads in bathrooms and using flowers that are drought resistant to reduce water usage for flower irrigation. Water harvesting is also done in some units to increase the amount of water. In addition, earth dams have been constructed to increase water security and availability for animals in years of droughts which are on the increase. The company has also intensified animal conservation efforts to monitor how species are responding to climate change to guard against species extinction and biodiversity decline.

To deal with increasing temperatures, the game reserve use grass as part of the roofing material. Thatching acts as a thermal insulator that assists in cooling the units in times of heat to reduce heat stress. The use of invertor air conditioners and cooling fans is aimed at ensuring a conducive temperature for both guests and employees. In addition, the installation of large swimming pools is aimed at providing cooling points for tourists to escape the heat that is normally experienced in the area. The lodge maintains and plants trees near the lodges to assist in the cooling of the air surrounding the lodges.

Given the increased fire risk, the game reserve has also invested in appropriate technology aimed at reducing fire risk around accommodation units including the development of fireguards. Overall, the game reserve also has insurance to cover climate-related risks.

6.4   Recommendations

In light of the study findings, certain areas were identified as areas of improvement to address some of the climatic challenges at the game reserve. It emerged that rising temperatures affected all employees including field staff, kitchen staff and game rangers and current measures do not seem to be addressing these challenges. To that effect, this study recommends an improvement in staff accommodation to guarantee that they are climate-smart and to ensure the comfort and productivity of the employees. Relooking into the design and retrofitting the kitchen to address excessive heat is a matter that warrants attention either through putting in place additional air conditioners or more powerful extraction fans to condition the atmosphere.

Tourists and infrastructure also suffer from increasing temperatures that call for new thinking in tourism operation to ensure adaptation. Therefore, the study recommends that considering rangers and tourists, it might be prudent for companies to ensure vehicles have adequate roofing to warrant their stakeholders' health, safety and comfort. Such covering could be adjustable considering employee challenges. Proper cooling of staff and green building investment for staff accommodation cannot be considered a luxury but an absolute necessity with overall benefits for the company through energy efficiency and well catered for staff. Some activities can be adjusted to also take into consideration the daily high temperatures.

Continued usage of some equipment such as bathtubs is of particular concern, especially amidst increasing water shortages. Phinda might need to rethink some of its bath equipment to address the challenge of high-water usage in line with the demands for sustainable tourism practice.

There is also a need to ensure the resilience of the infrastructure that is at the lodge to reduce the risk of loss in both accommodation and road infrastructure in a manner that addresses climate risks such as extreme wind, tropical cyclones and flush floods. Nature-based solutions can also be investigated and infused into this part of resilience building. This might require retrofitting and redesigning some infrastructure to ensure climate-smart and resilience.

The study further recommends the adoption of additional measures to deal with its carbon footprint. Given that the investment in solar has drastically come down in the past few years, there is a need for the organisation to seriously consider investing in renewable energy to reduce its Scope 1 emissions. The usage of 4X4 vehicles also exerts a considerable carbon footprint. The company must consider ways of investing in electric vehicles when practically possible. As a measure of best practice, the reserve must put in place measures to offset its carbon footprint and that of its tourist going. Lastly, the study recommends for future research to be conducted based on the findings of the study.

References

&BEYOND. 2019. Impact Review. Retrieved 9 19, 2021, from
https://www.andbeyond.com/wp-content/uploads/sites/s/impacts-Review-19.pdf.

&BEYOND. 2014. Phinda private game reserve. Retrieved 04 04, 2021, from
http://www.andbeyond,com/south-africa/palces-to-go/pinda-private-game-
reserve.htm

&BEYOND. 2015. Phinda private game reserve. Retrieved 04 04, 2021, from
http://www.andbeyond.com/conservation-community/care-of-the-wildlife.htm

&BEYOND. 2021. Phinda Private Game Reserve. Retrieved 09 16, 2021, from
https://mk0cs00242yfx7ww7i54.kinstacdn.com/wp-content/uploads/sites/5/Phinda-
Destination_Brochure_April2021.pdf.

AFRICA FOUNDATION. 2016. Africa foundation. Retrieved 04 04, 2021, from
http://www.africafoundation.org.za

ALHAJI, U. U., YUSUF, A. S., EDET, C. O., CELESTINE, O. O. & AGBO, E. P.
2018. Trend analysis of temperature in Gombe state using Mann Kendall trend test.
Journal of Scientific Research and Reports, 20(3):1-9.

ALMOGBEL, A., ALKASMOUL, F., ALDAWSARI, Z., ALSULAMI, J. &
ALSUWAILEM, A. 2020. Comparison of energy consumption between non-inverter
and inverter-type air conditioner in Saudi Arabia. *Energy Transitions,* 4(2):191-197.

ANDRADE, C. 2018. Internal, external and ecological validity in research design,
conduct and evaluation. *Indian Journal of Psychological Medicine,* 40(5):298-499.

ANG, B. W. 2016. Monitoring changes in economy-wide energy efficiency: From
energy-GDP ratio to composite efficiency index. *Energy Policy,* 34(1):574-582.

ATKINSON, R. & FLINT, J. 2001. *Assessing hidden and hard to reach populations:
Snowball research strategies.* England: University of Surrey.

AYYUB, B. M. & MCCUEN, R. H. 2011. *Probability, statistics and reliability for
engineers and scientists.* 3rd Ed. New York: Taylor & Francis Group, IIC.

BAKER, M. & MEARNS, K. F. 2017. *Applying sustainable tourism indicators to measure the sustainability performance of two tourism lodges in the Namib Desert. African Journal of Hospitality and Leisure,* 6(2):1-22.

BAKER, T. 2014. *Doing social research.* 2nd Ed. New York: McGraw-Hill & Inc.

BALDWIN, L. 2018. Internal and external validity and threats to validity. In *Research concepts for the practitioner of educational leadership, Baldwin L*, (pp. 31-36). New York: Brill. doi:10.1163/9789004365155

BECKEN, S. & ZAMMIT, C. & HENDRIKX, J. 2015. Developing climate change maps for tourism: Essential information or awareness raising? *Journal of Travel Research,* 54(4):430-441.

BECKEN, S. 2015. A review of tourism and climate change as an evolving knowledge domain. *Tourism Management Perspectives,* 6(1):53-62.

BERGMÜLLER, R., SCHWARZ, A. & TISCHLER, S. 2018. *Climate change challenges and solutions in infrastructure planning and adaptation.* Paris: Consulting engineers. Retrieved from www.ilf.com

BIANCO, V. R. 2017. Modelling energy consumption and efficiency measures in the Italian hotel sector. *Energy and Buildings,* 149(1):329-338.

BLUMBERG, B., COOPER, D. R. & SCHINDLER, P. S. 2005. *Business research methods.* London: McGracw-Hill.

BOOYENS, I. & ROGERSON, C. M. 2016. Responsible tourism in the Western Cape, South Africa: An innovation perspective. *Tourism: An International Interdisciplinary Journal,* 64(4):385-396.

BOWDEN, A.,FOX-RUSHBY, J. A., NYANDIEKA, L. & WANJAU, J. 2002. Methods for pre-testing and piloting survey questions: Illustrations from the KENAOL survey of health-related quality of life. *Health Policy & Planning,* 17(1):322-330.

BROWN, S. R. 2006. A match made in heaven: A marginalized methodology for studying the marginalized. *Quality and Quantity,* 40(3):361-382.

BRUNS-SMITH, A., CHOY, V., CHONG, H. & VERMA, R. 2017. *Environmental sustainability in the hospitality industry: Best practices, guests participation and customer satisfaction Cornell hospitality report.* California: Cornell University.

BUSINESS MONITOR INTERNATIONAL. 2016. *South African tourism report Q3.* Pretoria: BMI Research.

BUTGEREIT, L. & MARTINUS, L. 2018. On safari with Tensorflow: Assisting tourism in rural Southern Africa using machine learning. *International conference on advances in big data, computing and data communication systems* (pp. 1-5). Canada: Institute of Electrical and Electronics Engineers.

CAMPA, J. L., LOPEZ-LAMBAS, M. E. & GUIRAO, B. 2016. High speed rail effects on tourism: Spanish empirical evidence derived for China's modelling experience. *Journal of Transport Geography,* 57(1):44-54.

CASPAR, R., PEYTCHEVA, E., YAN, T., LEE, S., LUI, M. & HU, M. 2016. Cross-cultural survey guidelines. *Journal of Official Statistics,* 28(4):392-418.

CAVALLARO, F., GALATI, O. I. & NOCERA, S. 2020. Climate change impacts and tourism mobility: A destination based approach for coastal areas. doi: 10.1080/15568318.20201762951

COHEN, R., MANION, L. & MORRISON, K. 2013. *Approaches to qualitative data analysis.* 7th Ed. New York: Taylor & Francis Group.

CHOY, S. M. & KENNEDY, D. G. 2014. A comparison between evaluation of computer based testing and paper based testing for subjects in computer programming. *International Journal of Software Engineering and Application*, 5(1):57072.

CRAIG, C. A. & FENG, S. 2018. A temporal and spatial analysis of climate change, weather events and tourism business. *Tourism Management,* 67(1):351-361.

CRESWELL, J. W. 2015b. *30 Essential skills for the qualitative researcher.* London: Sage.

CRESWELL, J. W. & PABLO-CLARK, V. L. 2011. *Developing and conducting mixed methods research.* Thousand Oaks: Sage.

CRESWELL, J. W. 2013. *Qualitative inquiry and research design: Choosing among five approaches.* 3rd Ed. Thousand Oaks: Sage.

CSETE, M. & SZECSI, N. 2015. The role of tourism management in adaptation to climate change- a study of a European inland area with a diversified tourism supply. *Journal of Sustainable Tourism,* 23(3):477-496.

DAVIS-REDDY, C. & VINCENT, K. 2017. *Climate risk and vulnerability: A handbook for Southern Africa.* 2nd Ed. Pretoria: CSIR.

DENZIN, N. K. & LINCOLN, Y. S. 1998. *Entering the field of qualitative research in Denzin NK, Lincoln YS. The landscape of qualitative research: theories and issues.* Thousand Oaks: Sage.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM-DEAT. 2008. *National protected areas expansion strategy for South Africa.* Pretoria: South African National Biodiversity Institute (SANBI).

DEPARTMENT OF ENVIRONMENTAL AFFAIRS-DEA. 2015. National climate change response: White paper. Pretoria. Retrieved August 20, 2020, from http://www.environment.gov.za

DEPARTMENT OF ENVIRONMENTAL AFFAIRS-DEA. 2018. National climate change response: White paper. Pretoria. Retrieved from http://www.departmentofenviromentalaffairs-dea.org.za

DEPARTMENT OF TOURISM. 2017. Annual report. Pretoria. Retrieved 07 10, 2020, from http://www.tourism.gov.za

DEPARTMENT OF TOURISM. 2018. Annual report. Pretoria. Retrieved 07 11, 2020, from http://www.tourism.gov.za

DIANA, O. & VICTOR, Y. 2015. Green building: Analysis of state of knowledge. *International Journal of Construction, Engineering and Management,* 1(3):27-32.

DIAZ-REVIRIEGO, I., TURNHOUT, E. & BECK, S. 2016. Participation and inclusiveness in the intergovernmental science-policy platform on biodiversity and ecosystem services. *Nature Sustainability,* 2(6):457-464.

DINARES, M. & SAURI, D. 2015. Water consumption patterns of hotels and their response to drought and public concerns regarding water conservation. The case of the Barcelona hotel industry during the 2007-2008 episode. *Documentary D'ana Geography,* 61(1):623-649.

DOBBOIS, G., GERON, I. P., GÖSSLINGS, S. & HALL, C. M. 2016. Weather preferences of French tourists lessons for climate change impacts assessment. *Climatic Change,* 136(2):339-351.

DORIA, M. F., BOYD, E., TOMPKINS, E. L. & ADGER, W. W. 2019. Wing expert elicitation to define successful adaptation to climate change. *Environmental Sciences,* 12(1):810-819.

DUBE, K & NHAMO, G. 2020d. Evidence and impacts of climate change on South African national park. Potential implications for tourism in the Kruger national park. *Environmental Development,* 33(1):1-11.

DUBE, K, & MEARNS, K. 2019. *The green building evolution. Tourism and recreational potential of green building: A case study of hotel Verde Cape Town.* Pretoria: Institute of South Africa.

DUBE, K. & NHAMO, G. 2018. Climate change variability, change and potential impacts on tourism: Evidence from the Zambia side of Victoria Falls. *Environmental Science & Policy,* 84(1):113-123.

DUBE, K. & NHAMO, G. 2020b. Vulnerability of nature-based tourism to climate variability and change: Case of Kariba resort town, Zimbabwe. *Journal of Outdoor Recreation and Tourism.* doi:10.1016/j.jort.2020.100281

DUBE, K. & NHAMO, G. 2020c. Sustainable development goals in the tourism sector: Lessons from Grootbos private nature reserve, South Africa. *GeoJournal,* 12(1):1-18.

DUBE, K. & NHAMO, G. 2020f. Greenhouse gase emission and sustainability in victoria falls: Focus on hotels, tour operators and related attractions. doi: 10.1080/19376812.2020.1777437

DUBE, K. &. NHAMO, G. 2019c. Climate change and potential impacts on tourism: Evidence from the Zimbabwean side of the Victoria Falls. *Environment, Development and Sustainability,* 21(4):2025-2041.

DUBE, K. 2019. *Scaling up SDGs implementation: emerging cases from state, development and private sectors.* Retrieved 06 22, 2020, from http://www.springer.com/series/15486

DUBE, K. & MEARNS, K. 2020. &Beyond's Response to the Twin Challenges of Pollution and Climate Change in the Context of SDGs. In *Scaling up SDGs Implementation. Sustainable Development Goals Series* (pp. 87-98). Springer, Cham. doi:10.1007/978-3-030-33216-7_6

DUBE, K. & NHAMO, G. 2019c. Climate change and potential impacts on tourism: Evidence from the Zimbabwean side of the Victora Falls. *Environment, Development and Sustainability,* 21(4):2025-2041.

DUBE, K. & NHAMO, G. 2019b. Climate change and the aviation sector: A focus on the Victoria Falls tourism route. *Environmental Development,* 29(1):5-15. Retrieved from https://doi.org/10.1016/j.envdev.2018.12.006

DUBE, K. & NHAMO, G. 2020a. Tourism business operators' perceptions, knowledge and attitudes towards climate change at Victoria Falls. *The Journal for Transdisciplinary Research in Southern Africa,* 16(1):1-10.

DUBE, K. & NHAMO, G. 2020b. Tourist perceptions and attitudes regarding the impacts of climate change on Victoria Falls. *Socio-economic Series,* 47(47):27-44.

DUBE, K. & NHAMO, G. 2020e. Greenhouse Gas Emissions and Sustainability in Victoria Falls: Focus on Hotels, Tour Operators and Related Attractions. *African Geographical Review*, 6(1):1-16. doi:10.1080/19376812.2020.1777437

DUBE, K. & NHAMO, G. 2021. Greenhouse gas emissions and sustainability in Victoria Falls: Focus on hotels, tour operators and related attractions. *African Geographical Review,* 40(2):125-140.

DUBE, K. & NHAMO, G. 2021b. Private Sector Sustainable Development Goals' Localisation: Case of Kruger Mpumalanga International Airport, South Africa. In Nhamo, Chikodzi, & Dube, *Sustainable Development Goals for Society Vol. 2* (pp. 177-189). Springer, Cham.

DUBE, K., MEARNS, K., MINI, S, E. & CHAPUNGU, L. 2018. Tourist's knowledge and perception on the impacts of climate change on tourism in Okavango Delta, Botswana. *African Journal of Hospitality, Tourism and Leisure,* 7(4):1-18.

DUBE, K., NHAMO, G. & MEARNS, K. 2020. &Beyond Response to the twin challenges of pollution and climate change in the context of SDGs. In *Scailing up SDGs implementation* (pp. 87-987). Pretoria: Springer.

DUBE, K., NHAMO, G. & CHIKODZI, D. 2020a. Climate change-induced droughts and tourism: Impacts and responses of Western Cape province, South Africa. *Journal of Outdoor Recreation and Tourism*, 100319. doi:10.1016/j.jort.2020.100319

DUBOIS, B. & KRASNY, M. E. 2016. Educating with resilience in mind: Addressing climate change in post Sandy New York City. *The Journal of Environmental Education,* 47(4):255-270.

EDWARDS, T. L., NOWICKI, S., MARZEION, B., HOCK, R., GOELZER, H., SERUSSI, H. & ZWINGE, T. 2021. Projected land ice contributions to twenty-first-century sea-level rise. *Nature,* 593(7857):74-82.

ELUM, Z. A., MODISE, D. M. & MARR, A. 2017. Farmer's perception of climate change and responsive strategies in three selected provinces in South Africa. *Climate Risk Management,* 16(1):246-257.

ERIKSEN, S. H., NIGHINGALE, A. J. & EAKIN, H. 2015. Reframing adaptation: The political nature of climate change adaptation. *Global Environmental Change, 35*(1):523-533.

ERLANDSON, D. A., HARRIS, E. I., SKIPPER, B. I. & ALLEN, S. D. 1993. *Doing a naturalistic inquiry: A guide to methods.* Newbury Park: Sage.

ETIKAN, I. 2016. Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics,* 5(1):1-4.

FILL, J. M., DAVIS, C. N. & CRANDALL, R. M. 2019. *Climate change lengthens Southeastern USA lightning-ignited fire seasons.* doi:10.1111/gcb.1472

FINE, M. 2013. Enchoes of Bedford: A 20-year social philosophy memorior on participatory action research hatched behind bars. *American Psychologists,* 63(1):687-698.

FITCHETT, J. M. 2016a. Climate change threats to two low-lying South African coastal towns: Risk vs perception. *South African Journal of Science,* 112(5-6):1-9.

FITCHETT, J. M. 2016b. Economic costs of the 2012 floods on tourism in the Mopani District Municipality, South Africa. *Transactions of the Royal Society of South Africa,* 71(2):187-194.

FITCHETT, J. M. 2016c. Data challenges in the calculation of tourism climate index scores in South Africa. *Tourism an International Interdisciplinary Journal,* 64(4):359-370.

FITCHETT, J. M. 2018. Recent emergence of CAT5 tropical cyclones in the South Indian ocean. *South African Journal of Science,* 5(2):20-42.

FITCHETT, J., GRAB, S. & THOMPSON, D. I. 2015. Plant phenology and climate change progress in methodological approaches and applications. *Progress in Physical Geography,* 39(4):460-482.

FORDRED, C. & MEARNS, K. 2020. The influence of donor funded community development on population growth in selected communities bordering the Phinda private game reserve, South Africa. *Second annual conference of the international geographical union communication on African studies* (pp. 154-166). Durban: University of Zululand.

FUNK, C., DAVENPORT, F., HARRISON, L., MAGADZIRE, T., GALU, G., ARTAN, G. A. & NSADISA, F. D. 2018. Anthropogenic enhancement of moderate-to-strong El Niño events likely contributed to drought and poor harvests in southern Africa during 2016. *Bulletin of the American Meteorology Society,* 99(1):591-596.

GANDA, F. & NGWAKWE, C. C. 2016. Role of energy efficiency on sustainable development. *Environmental Economy,* 5(1): 86-99.

GETZ, D. & PAGE, S. J. 2016. Progress and prospects for event tourism research. *Tourism Management,* 52(1):593-631.

GILCHRIST, V. J. & WILLIAMS, R. L. 1999. Key informant interviews. In 2nd Ed. *Doing qualitative research.* Thousand Oaks: Sage.

GOLES, T. & HIRSCHHEIM, R. 2000. The paradigm is dead, the paradigm is dead long live the paradigm: The legacy of Burell and Morgan Omega. *The International Journal of Management Science,* 28(1):249-268.

GÖSLINGS, S., HALL, C. M. & SCOTT, D. 2018. *Coastal and ocean tourism handbook.* Pretoria: Cambridge, Springer.

GÖSSLING, S., ABEGG, B. & STEIGER, R. 2016. "It was raining all the time": Ex post tourist weather perceptions. *Atmosphere.* doi:10.3390/atmos7010010

GÖSSLING, S., ARAÑA, J. E., & AGUIAR-QUINTANA, J. T. 2019. Towel reuse in hotels: Importance of normative appeal designs. *Tourism Management,* 70(1):273-283.

GÖSSLING, S., SCHRODER, M., SPATH, P. & FREYTAG, T. 2015. Inter-market variability in CO2 emission intensities in tourism: Implications for destination marketing and carbon management. *Tourism Management.* doi:10.1016/j.tourman.2016.06.021

GÖSSLING, S., SCOTT, D. & HALL, C. 2013. Challenges of tourism in a low-carbon economy. *Wiley Interdisciplinary Reviews,* 4(6):525-538.

GÖSSLINGS, S., HALL, C. M. & SCOTT, D. 2018. *Coastal and ocean tourism handbook. Marine environmental protection.* Pretoria: Springer.

GRAY, D. E. 2014. *Doing research in the real world.* 3rd Ed. London: Sage.

HAIR, J. F., CELSI, M. W., MONEY, A. H., SAMOUEL, C. M. & PAGE, M. J. 2015. *Essentials of business research methods.* 2nd Ed. New York: ME Sharpe.

HAMMARBERG, K., KIRKMAN, M. & DE LACEY, S. 2016. Qualitative research methods: When to use them and how to judge them. *Humanam Reproduction,* 3(3):498-501.

HAN, H. & HYUN, S. S. 2018. What influences water conservation and towel reuse practices of hotel guests? *Tourism Management,* 64(1):87-97.

HANUMANTHAPPA, M. 2014. *Threats to validity and mitigation strategies in empirical software engineering.* Munich: Technische Universitat Munchen.

HAZZI, O. & MALDAON, I. 2015. A pilot study: Vital methodological issues. *Business,* 16(1):53-62.

HIGHBEAM, G. 2007. *Game in the bush. The saturday star (South Africa).* Retrieved 04 04, 2021, from http://www.highbeam.com

HOOGENDOORN, G. & FITCHETT, J. M. 2016. Tourism and climate change: A review of threats and adaptation strategies for Africa. Current issues in tourism management. *Current Issues in Tourism.* doi:10.1018/13683500.2016.1188893.

HOOGENDOORN, G. & FITCHETT, J. M. 2018b. Tourism and climate change: A review of threats and adaptation strategies for Africa. *Current Issues in Tourism,* 21(7):742-759.

HOOGENDOORN, G., GRANT, D. & FITCHETT, J. M. 2016. Disjunct perceptions? Climate change threatens in two-low lying South African coastal towns. Bulletin of geography. *Socio-Economic Series,* 31(31):59-71.

HOOGENDOORN, G., MENTJIES, D., KELSO, C. & FITVHETT, J. M. 2019. Tourism as an incentive for rewilding: The conversation from cattle to game farms in Limpopo province. *Journal of Ecotourism,* 18(4):309-315.

HOOGERNDOON, G. & FITCHETT, J. M. 2018b. Tourism and climate change: A review of threats and adaptation strategies for Africa. *Current Issues in Tourism,* 21(14):742-79.

HOTEL ENERGY SOLUTIONS-HES. 2011. *Analysis of energy use by European hotels: Online survey and risk research.* Europe: HES Publications.

INSUA, G. M., LANTZ, C. & ARMSTRONG, A. 2018. In their own words: Using first-year student research journals to guide information literacy instruction. *Libraries and the Academy,* 18(1):141-161.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE-IPCC. 2017. *Climate change 2017: Mitigation of climate change. Contribution of working III to the fourth assessment report of the intergovernmental panel on climate change.* Cambridge: Cambridge University Press.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE-IPCC. 2016. An IPCC special report on the impacts of global warming: Summary for policy makers. Retrieved 06 12, 2020, from http://www.ipcc.ch

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE-IPCC. 2019. *Special report in the ocean and cryosphere in a changing climate-SROCC.* Retrieved 09 20, 2021, from Intergovernmental panel on climate change: https://www. ipcc.ch/srocc.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE-IPCC. 2018.. *Special Report: Global Warming of 1.5°C.* Retrieved July 12, 2020, from IPCC: https://www.ipcc.ch/sr15/download/

JAMMALIAH, M. M. & POWELL, R. B. 2017. *Integrated vulnerability assessment of ecotourism to climate change in Dana biosphere reserve Jordan.* Retrieved August 20, 2020, from https://doi.org/10.100/1368300.2017.1401982

JEFFREY, H. & BLEASADALE, S. 2017. *Tunisia: Mass tourism in crisis? Mass tourism in small world.* Wallingford: CABI International.

JENTOFT, N. & OLSEN, T. 2019. Against the flow in data collection: How data triangulation combined with a slow interview technique enriches data. *Qualitative Social Work,* 18(2):179-193.

JOHNSON, R. B., ONWUEGBUZIE, A. J. & TURNER, L. A. 2007. Toward a definition of mixed methods research. *Journal of Mixed Methods Research,* 1(1):112-133. doi:10.1177/1558689806298224

JOYCE, I. A., BRISKE, D. D., BROWN, J. R., POLLEY, H. H. & MACCARLR, B. A. 2013. *Climate change and North America rangelands: Assessment of mitigation and adaptation strategies.* Nebraska: University of Nebraska Faculty Publications.

JUNI, P., ALTMAN, D. G. & EGGER, M. 2001. Assessing the quality of randomized controlled trials. In *Systematic reviews in health care: Meta-analysis in context* (pp. 87-108). London: BMJ Publishing Group.

JONES, C. 2010. Archival data: advantages and disadvantages for research in psychology. *Social and Personality Psychology Compass,* 4(11):1008-1017.

KAJAN, E., TERVO-KANKARE, K. & SAARINEN, J. 2015. Cost of adaptation to climate change in tourism: Methodological challenges and trends for future studies in adaptation. *Scand Journal of Hospitality Tours,* 15(1):311-317.

KILUNGU, H., LEEMANS, R., MUNISH, P. K. & AMELUNG, B. 2017. *Climate change threatens major tourists attractions and tourism in Serengeti national park, Tanzania. Climate change in Africa.* Dodoma: Springer, Cambridge.

KILUNGU, H., LEEMANS, R., MUNISHI, P. K. T., NICHOLLS, S. & AMULENG, B. 2019. Forty years of climate and land-cover change and its effects on tourism resources in Kilimanjaro National Park. *Tourism Planning and Development,* 6(2):235-253.

KOCASLAN, G. 2017. The place and importance of wind power potential of Turkey in the framework of the target of sustainable development. *Journal of Social Sciences,* 4(1):53-61.

KUMAR, R. 2014. *Research methodology: A step by step guide for beginners.* California: Sage.

KUMAR, B. & PANDEY, A. C. 2020. MODIS based forest fire hotspot analysis and its relationship with climatic variables. *Spatial Information Research,* 28(1):87-99.

KUPIKA, O. L., GANDIWA, E., KATIVU, S. & NHAMO, G. 2017. Impacts of climate change and climate variability on wildlife resources in Southern Africa: Experience from a selected protected area in Zimbabwe. DOI: 10.5772/intechopen.70470.

LA JEUNESSE, I., CIRELLI, C., AUBIN, D. & LARRUE C. 2016. Is climate change a threat for water uses in the Mediterranean region? Results from a survey at local scale. *The Science of the Total Environment,* 543(1):981-996.

LANCASTER, G. A. 2015. Pilot & feasibility studies come of age! *Pilot and Feasibility Studies,* 1(1):1-4.

LEE, Y. H., KIM, M. S. & LEE, J. S. 2021. Firefighting in vulnerable areas based on the connection between fire hydrants and fire brigade. *Sustainability,* 13(98):1-12.

LENZEN, M., SUN, Y., FATURAY, F., TING, Y., GESKE, A. & MALIK, A. 2018. The carbon footprint of global tourism. *Nature Climate Change,* 8(6):522-528.

LINDSEY, R. 2019. Understanding climate change global sea level. Retrieved 09 19, 2021, from https://www.climate.gov.news-features/understanding-climate/clmatechange-global-sea-level

LOKOT, M. 2021. Whose voice? Whose knowledge? A feminist analysis of the value of key informant interview. *International Journal of Qualitative Methods,* 20(1):1-8.

MA, L. & LEW, A. 2012. Historical and geographical context in festival tourism development. *Journal of Heritage Tourism,* 7(1):13-31.

MACKAY, E. A. & SPENCER, A. 2017. The future of Caribbean tourism: Competition and climate change implications. *Worldwide Hospitality and Tourism Themes,* 9(1):44-59.

MAKHAOLA, C. J. 2016. *The challenges of promoting domestic tourism in Durban. Master's thesis.* Durban: University of KwaZulu-Natal.

MAKHAOLA, L. J.-P. 2017. The significance of domestic tourism in Durban, South Africa. *African Journal of Hospitality. Tourism and Leisure,* 6(4):1-15.

MAREE, K. 2016. *First steps in research.* 2nd Ed. Pretoria: Van Schaik.

MARROE, S. I. 2015. Quality and trustworthiness in qualitative research in counselling psychology. *Journal of Counselling Psychology,* 52(1):250-860.

MARSHALL, C. & ROSSMAN, G. B. 1999. *Designing qualitative research.* London: Sage.

MARSHALL, C. & ROSSMAN, G. B. 2006. *Designing qualitative research.* London: Sage.

MARSHALL, M. N. 1996. The key informant techniques. *Family Practice,* 13(1):92-97.

MARTIN, M. B. G. 2005. Weather, climate and tourism a geographical perspective. *Annals of Tourism Research,* 32(3):571-591.

MATJEKA, M. S. 2012. *Analysing the resident's perceived image of the Vaal region as a tourism destination. Master's dissertation.* Vanderbijlpark: Vaal university of technology.

MAXCY, S. J. 2003. Pragmatic threads in mixed methods research in the social sciences: The search for multiple modes of inquiry and the end of the philosophy of formalism. In A. T. Teddlie (Ed.), *Handbook of mixed methods in social and behavioural research.* (pp. 51-89). Thousand Oaks: Sage.

MCKENNA, S., ISAWAKI, P. G., STEWART, T. & MAIN, D. S. 2011. Key informants and community members in the community-based participatory research: One is not like the other. *Progress in the Community Health Partnerships: Research, Education and Action,* 5(4):387-397.

MEYER D. F. & MEYER, N. 2015. The role and impact of tourism on local economic development: A comparative study. *African Journal of Physical, Health Education, Recreation and Dance,* 21(1):197-214.

MICHAILIDOU, A. V. 2016. Interactions between climate change and the tourism sector: Multiple criteria decision analysis to assess mitigation and adaptation. *Tourism Management,* 55(1):1-12.

MIDDLETON, M. M., BEAMAN, J., BLYTH, G. J., HUGHES, K., NEALE, B., PHILIPS, B. & SALTER, J. L. R. 2014. Enhancing knowledge and informing practice. Report on the timescapes archive. Retrieved from http://eprints.whiterose.ac.uk/81104/1/CL_Technical_Report_Final.pdf

MIDGELY G. F. & BOND W. J. 2015. Future of African terrestrial biodiversity and ecosystems under anthropogenic climate change. *National Climate Change,* 5(9):823-952.

MINAMI, O., MINORU, S. YOSHIHIKO, S. & MASAYOSHI, K. 2015. Identifying the physical properties of showers that influence user satisfaction to aid in developing water-saving showers. *Water,* 7(1):4054-4062.

MJIMBA, V. & NHAMO, G. 2019. *The green building evolution.* Pretoria: African Institute of South Africa.

MKONO, M. 2011. The othering of food on touristic eatertainment: A netnography. *Tourists Studies,* 11(3):253-270.

MOHAJAN, H. K. 2017. Two criteria for good measurements in research: Validity and reliability. *Annals of Spiru Haret University,* 17(3):58-82.

MORSE, J. M. 1991. Approaches to qualitative-quantitative methodological triangulation. *Nursing Research,* 40(1):120-123.

MOWFORTH, M. & MUNT, I. 2016. *Sustainable tourism in developing countries: Poverty elevation, participatory planning and ethical issues.* London: Routledge.

MUKOGO, R. 2015. *Greening of the tourism sector is an effective mitigation measure against climate change.* Vermont: International Institute for Research through Tourism.

MURRAY, L. T. 2016. Lightning NOx and impacts on air quality. *Current Pollution Representation,* 2(1):115-133.

MUSHAWEMHUKA, W. R. 2018. Nature-based tourism operators' perceptions and adaptation to climate change in Hwange National Park, Zimbabwe. *Bulletin of Geography. Socio-economic Series,* 42(42):115-127.

MXUNYELWA, S. & TSHETU, L. 2018. Festivals as a niche for local economic development (LED): A case study of the East London port festival (ELDF), Eastern Cape, South Africa. *African Journal of Hospitality, Tourism and Leisure,* 7(3):1-14.

NEW, M., LIVERMAN, D., SCHROEDER, H. & ANDERSON, K. 2016. Four degrees and beyond: The potential for the global temperature increase of four degrees and its implications. Philosophical transformations of the royal society of London. *A Mathematical, Physical, English and Science,* 369(1):6-19.

NHAMO, G., DUBE, K. & CHIKODZI, D. 2020a. Tourism economic stimulus packages as a response to Covid-19. *Counting the Cost of COVID-19 on the Global Tourism Industry.* 353-374. Retrieved from https://doi.org/10.1007/978-3-030-56231-1_15

NHAMO, G., DUBE, K. & CHIKODZI, D. 2020. *Counting the Cost of COVID-19 on the Global Tourism Industry*. Nature Switzerland: Springer International Publishing. doi:10.1007/978-3-030-56231-1

NOVELLA, M. F., GHIOTTI, A., BRUSCHI, S. & BARIANI, P. F. 2015. Ductile damage modelling at elevated temperature applied to the cross wedge rolling of AA6082-T6 bars. *Journal of Materials Processing Technology,* 222(1):259-267.

NYAUPANE, G. P. & CHHETRI, N. 2015. Vulnerability to climate change of nature-based tourism in the Nepalese Himalaya. *Tourism Geographies,* 11(1):95-119.

OJHA, H. R., GHIMIRE, S., PAIN, A., NIGHTINGALE, A., KHATRI D. B. & DHUNGANA, H. 2016. Policy without politics: Technocratic control of climate change adaptation policy making in Nepal. *Climate Policy,* 16(4):415-433.

OSBECK, I. 2014. Scientific reasoning as sense making: Implications for qualitative inquiry. *Qualitative Psychology,* 1(1):34-46.

OTTO, F. E., WOLSKI, P., LEHNER, F., TEBALDI, C., VAN ODENBORCH, G. J., HAGESTEEGER, S., SINGH, R., HOLDEN, P., FUCKAR, N. S. & OLDOULAMI, R. C. 2018. Anthropogenic influences on the drivers of Western Cape drought 2015-2016. *Environmental Research Letters,* 13(12):1-10.

OZYAVUZ, M. 2016. Protected areas and landscape planning. Retrieved from http://www.intechopen.com/books/landscape-planning/protected areas.

PAGE, S. J. & ESSEX, S. & CAUSEVIC, S. 2018. Tourist attitudes towards water use in the developing world: A comparative analysis. *Tourism Management,* 10(1):57-67.

PANDY, W. R. 2017. Tourism enterprises and climate change: some research imperatives. *African Journal of Hospitality, Tourism and Leisure,* 6(4):1-18.

PANDY, W. R. 2018b. Tourism and climate change: Stakeholder perceptions of at risk tourism segments in South Africa. *Euro Economica Editura Universitară Danubius,* 37(2):104-118.

PANG, S. F. 2013. Climate and tourism an overview. *Asia Pacific Journal of Tourism Research*, 3(1):1-20.

PANG, S. F., MCKERCHER, B. & PRIDEAUX, B. 2013. Climate change and tourism: An overview. *Asia Pacific Journal of Tourism Research,* 18(2):4-20.

PANSIRI, J. 2006. Pragmatism: A methodological approach to researching strategic alliances in tourism. *Tourism and Hospitality Planning and Development,* 2(3):191-206.

PARKER, I. 2004. Criteria for qualitative research in psychology. *Qualitative Research in Psychology, 1*(1):95-106.

PARPAIRI, K. 2017. Sustainability and energy use in small scale Greek hotels: Energy saving strategies and environmental policies. *Procedia Environmental Sciences,* 38(1):169-177.

PATTERSON, T., BASTIANONI, S. & SIMPSON, M. 2006. Tourism and climate change: Two-way-street or vicious/ virtuous circle? *Journal of Sustainable Tourism,* 14(4):339-348.

PATTON, Q. M. 2014. *Qualitative research & evaluation methods: integrating theory and practice.* 4th Ed. Thousand Oaks: Sage.

PEETERS, P., HIGHAM, J., KUTZNER, D., COHEN, S. & GÖSSLINGS, S. 2016. Are technology myths stalling aviation climate policy? Transport research part. *Transport and Environment,* 44(1):30-42.

PHILIPS, M. & ZWICKY, D. 2017. Patent information use in engineering technology design: An analysis of student work. *Issues in Science and Technology Librarianship*, 18(1):52-69.

POLIT, D., BECK, C. & HUGLER, B. 2001. *Essentials of nursing research methods.* 5th Ed. Philadephia: Lippincott Williams & Wilkins.

POLLOCK, K. 2018. *The climate change challenge: Implications for the tourism industry.* Toronto: The Icarus Foundation.

PRATO, T. 2009. Evaluating and managing wildlife impacts of climate change under uncertainty. *Ecological Modelling*, 220(1):923-930.

PRESTON-WHYTE, R. A. & WATSON, H. K. 2005. *Nature tourism and climatic change in Southern Africa.* Bristol: Channelview Publications.

PULIDO-FERNANDEZ, J. I. & LOPEZ-SANCHEZ, Y. 2018. *Tourism: Analysis of a global phenomenon from a perspective of sustainability.* Pachura: University of Jaen.

PUNCH, K. F. 2014. *Social research: Qualitative and quantitative approaches.* Thousand Oaks: Sage.

RAUKEN, T., MYDSKE, P. K. & WINSVOLD, D. 2015. Mainstreaming climate change adaptation at the local level. *Local Environment,* 20(4):408-425.

RENNIE, D. l. 2012. Qualitative research as a methodological hermeneutics. *Psychological Methods,* 17(1):385-398.

ROGERSON, C. M. 2016. Climate change, tourism and local economic development in South Africa. *Local Economy,* 31(2):322-331.

ROGERSON, C. M. 2016. Driving developmental tourism in South Africa. *Africa Insight,* 32(3):33-42.

ROMPS, D. M., SEELEY, J.J., VOLLARO, D. & MOLINARI, J. 2014. Projected increase in lightning strikes in the United States due to global warming. *Science,* 346(1):851-854.

ROSSELLO, J. & WAQAS, A. 2015. The use of tourism demand models in the estimation of the impacts of climate change on tourism. *Reviato Turismo Em Analise,* 26(1):4-20.

ROSTRO-GARCÍA, S., KAMLER, J. F. & HUNTER, L. T. 2015. To kill, stay or flee: the effects of Lions and landscape factors on habitat and kill site selection of Cheetahs in South Africa. *PloS one,* 10(2):1-10, e0117743.

ROXAS, B. & CHADEE, D. 2013. Effects of formal institutions on the performance of the tourism sector in the Philippines: The mediating role of entrepreneurial orientation. *Tourism Management,* 37(1):1-12.

SANCHEZ-MARTIN, J. M., SANCHEZ-RIVERO, M. & RENGIFO-GALLEGO, J. I. 2020. Water source as a tourist resource in Extremadura: Assessment of its attraction capacity and approximation to the tourists profile. *Sustainability,* 12(1):1-26.

SAUNDERS, M., LEWIS, P. & THORNHILL, A. 2016. *Research methods for business students.* 7th Ed. New York: Pearson Education.

SHARMA, B. R. & SMAKHTIN, V. 2016. *The Ganges river basin: Status and challenges in water, environment and livelihoods.* Middlesex Polytechnic: Routledge.

SCHÄFER, A. W. & WAITZ, B. H. 2014. Air transportation and the environment. *Transport Policy,* 34(1):1-4.

SCHULZE, R. E. 2007. *South Africa Atlas of climatology and anthropology.* Pretoria: Water Research Commission.

SCHUMANN, U. & HUNTRRIESER, H. 2007. The global lightning-induced nitrogen oxide source. *Atmosphere, Chemistry and Physics,* 7(1):3823-3907.

SCHWANDT, T. A. 2007. *The sage dictionaries of qualitative inquiry.* Thousand Oaks: Sage.

SCHWIRPLIES, C. & ZIERGLER, A. 2017. Adaption of future travel habits to climate change: A microeconomic analysis of tourists from Germany. *Tourism Economics,* 23(6):1275-1295.

SCOTT, D. & USHER, R. 2011. *Research in education: Data, methods and theory in educational inquiry.* New York: Continuum International Pub.

SCOTT, D., DAWSON, J. & JONES, B. 2018. Climate change vulnerability of the US northeast winter recreation-tourism sector. *Mitigation and Adaptation Strategies for Global Change,* 13(6):577-596.

SCOTT, D., HALL. C. M. GOSSLING, S. 2016. A report on the paris climate change agreement and its implications for tourism: Why we will always have Paris. *Journal of Sustainable Tourism,* 24(7):933-948.

SCOTT, D., RUTTY, M., AMELUNG, B. & TANG, M. 2016b. An inter-comparison of the holiday climate index and the tourism climate index in Europe. *Atmosphere,* 7(6):1-17.

SCOTT, D., STEIGNER, R., RUTTY, M. & JOHNSON, P. 2015. The future of the Olympic winter games in an era of climate change. *Current Issues in Tourism,* 18(10):913-930.

SERDECZNY, D., ADAMS, S. & BAARSCH, F. 2016. Climate change impacts in sub-Saharan Africa: From physical change to their social repercussions. *Regional Environmental Change,* 17(6):1585-1600.

SHAKEELA, A. & BECKEN, S. 2015. Understanding tourism leader's perceptions of risks from climate change: An assessment of policy-making processes in the Maldives using the social amplification of risk framework. *Journal of Sustainable Tourism,* 23(1):65-84.

SHEIKH, P. A., CORN, M. L., LEGGETT, J. A. & FOLGER, P. Global climate change and wildlife. *Annual Review of Ecology, Evolution and Systematics*, 37(1):637-669.

SHOWKAT, N. & PARVEEN, H. 2017. Non-probability and probability sampling. Retrieved 06 01, 2020, from http://www.researchgate.net/publication/319066480

SIBISI, M. & ABRAHAMS, D. 2018. The role of ethnic marketing in the promotion of domestic leisure tourism in Johannesburg. *EuroEconomics,* 37(2):190-201.

SIFOLO, P. P. S. & HENAMA, U. S. 2017. Implications of climate change for tourism in Africa. *GeoJournal of Tourism and Geosites,* 20(2):191-198.

SIMPSON, M., SCOTT, D. & TROTZ, U. 2016. *Climate change's impact on the Caribbean's ability to sustain tourism, natural assets and livelihoods.* Washington: Inter-American Development Bank.

SINGH, A., SYAL, M., SUE, C. & KORKMAZ, S. 2015. *Effects of green buildings on employee health and productivity.* New York: American Public Health Association.

SMITH, K. & HOLMES, K. 2019. Researching volunteers in tourism: Going beyond. *Annals of Leisure Research,* 12(4):403-420.

SMITH, T. & FITCHETT, J. M. 2020. Drought challenges for nature tourism in the Sabi Sabi game reserve in the eastern region of South Africa. *African Journal of Range & Forage Science,* 37(1):107-117.

SOUSA, P. M., BLAMEY, R. C., REASON, C. J., RAMOS, A. M. & TRIGO, R. M. 2018. The day zero Cape Town drought and the poleward migration of moisture corridors. *Environmental Research Letters,* 13(12):1-11.

SOUTH AFRICAN LOCAL GOVERNMENT LOCAL ECONOMY. 2016. *Informal economy.* Retrieved from http://led.co.za/topic/informal/economy

STATISTICS SOUTH AFRICA. 2018. Unpacking South Africa's tourism workforce. Retrieved August 13, 2020, from http://www.stassa.gov.za/?p=11862

STATISTICS SOUTH AFRICA. 2019. How do tourists spend their money? Statistics South Africa. Retrieved 08 13, 2020, from http://www/statssa.gov.za/?p=11976

STEYN, J. N & SPENCER, J. P. 2015. Climate change and tourism: Implications for South Africa. *African Journal of Physical, Health Education, Recreation and Dance,* 18(1):1-9.

SU, Y. P., HALL, C. M. & OZANNE, L. 2018. Hospitality industry responses to climate change: A benchmark study of Taiwanese tourist hotels. *Asia Pacific Journal of Tourism Research,* 18(2):92-107.

SWEMMER, A. M., BOND, W. J., HEMPSON G. P., MALHERBE, J., & SMIT, I. P. J. 2018. The ecology of drought- a workshop report. *South African Journal of Science,* 114(10):1-3.

TAYLOR, G. A. & BLAKE, B. J. 2015. *Key informant interviews and focus groups. Nursing research using data analysis.* Chesnay: Springer.

TERRY, G., HAYFIELD, N., CLARKE, V. & BRAUN, V. 2017. *The sage handbook of qualitative research in psychology.* 2nd Ed. Canada: Sage.

TORRES-BAGUR, M., RIBAS, A. & VILA-SUBIRÓS, J. 2019. Incentives and barriers to water-saving measures in hotels in the Mediterranean: A case study of the Muga river basin (Girona, Spain). *Sustainability,* 11(3):3583-3599.

TOST, H. 2017. Chemistry climate change interactions of aerosol nitrate from lightning. *Atmosphere Chemistry and Physics,* 17(1):1127-1142.

TURKOGLU, S. P. & KORDOGAN, P. S. O. 2018. The role and importance of energy efficiency for sustainable development of the countries. DOI: 10.1007/978-3-319-64349-6-5

UNITED NATIONS WORLD TOURISM ORGANISATION-UNWTO. 2018. Climate change and tourism. Retrieved from http://www.unwto.org

UNITED NATIONS WORLD TOURISM ORGANISATION-UNWTO. 2019. Climate change and tourism. Responding to global challenges. Retrieved 08 20, 2020, from http://www.unwto.org

VAN DER SCHYF, M., MEYER, D. & FERREIRA, R. 2019. Analysis of the impact of the tourism sector as a viable response to South Africa's growth and developmental challenges. *Journal of International Studies,* 12(1):168-183.

VAN WILGEN, N., GOODALL, V., HOLNES, S., CHOWN, D. L. & MCGEOCH, M. A. 2016. Rising temperatures and changing rainfall patterns in South Africa's national parks. *International Journal of Climatology,* 36(1):707-720.

VEELENTURF, C. A., SINCLAIR, E. M., PALADINO, F. V. & HONARVAUR, S. 2020. Predicting the impacts of sea-level rise in sea turtle nesting habitat in Bioko Island, Equatorial Guinea. DOI:https://doi.org/10.137/journal.pone. 0222251

VERSCHUREN, P. 2003. Case study as a research strategy: Some ambiguities and opportunities. *International Journal of Social Research Methodology,* 4(1):121-139.

VOWLES, K. F. 2018. Faunal occurrence at naturally-forming waterholes in Shamwari private game reserve, Eastern Cape, South Africa. *Masters thesis.* Johannesburg: University of the Witwatersrand.

WERTZ, F. J. 1999. Multiple methods in psychology: Epistemological grounding and the possibility of unity. *Journal of Theoretical & Philosophical Psychology, 19*(1), 131-166.

WORLD TRAVEL AND TOURISM COUNCIL. 2019. Global economic impact and trends. Retrieved 06 20, 2020, from https://www.wttc.org/economic-impact/country-analysis

WORLD TRAVEL AND TOURISM COUNCIL-WTTC. 2019. Global economic impact and trends. Retrieved 06 13, 2020, from https://www.wttc.org/economic-impact/country-analysis/

YIN, R. 2014. *Case study research design and methods.* 5th Ed. California: Sage.

ZHAO, C., YAN, Y., WAMG, C., TANG, M., WU. G., DING. D. & SONG, Y. 2018. Adaptation and mitigation for combating climate change-from single to joint. *Ecosystems, Health and Sustainability,* 4(4):86-94.

ZIERVOGEL, C., NEW, M. & ARCHER VAN GADEREN, E. 2014. Climate change impacts and adaptation in South Africa. *WIREs Climate Change,* 5(1):605-620.

ZIERVOGEL, G. & ZERMOGLIO, F. 2015. Climate change scenario and the development of adaptation strategies in Africa: Challenges and opportunities. *Climate Research,* 40(1):133-149.

Appendices

Annexure A: Interview guide

Interview guide

Vaal University of Technology

Determining tourism climate change mitigation and adaptation strategies at selected private game reserve in South Africa

Interview Questions

- What has been the climate trends in this area over the last couple of years?
- There is a general talk of climate change and extreme weather events. Would you say these are a challenge to your private game reserve?
- How have extreme weather events affected your private nature reserve?
- How have extreme weather events affected flora and fauna in your private game reserve?
- How is climate change or extreme weather affecting the tourism operations in the private game reserve?
- In recent memory which extreme weather events were most impactful on your operations? Please provide a detailed account.
- What were the financial costs of such an event on the business?
- Did the extreme weather event affect tourism flow to and from the lodge (private game reserve)? Explain.
- Who paid for the cost of the extreme weather event above?
- What remedies did you take to deal with the extreme weather events?
- Would you say you have built enough resilience to deal with the above event if it were to occur again?
- What strategies have been put in place to respond to climate change?
- What measures or technologies being adopted to reduce the carbon footprint produced by the tourism operations?

- What behavioural changes have been introduced to reduce the greenhouse gas emissions of tourism operations?
- What technologies used to reduce the impacts of climate change events on tourists and employees on the private game reserve?
- What measures have been successful in responding to climate change?
- What are the challenges faced by the reserve in responding to climate change?
- What are the potential failures in adopting green technology to respond to climate change?

Is there anything you would like to add?

Thank you for your time.

Annexure B: Language editing certificate

LANGUAGE EDITING CERTIFICATE

Registered with the South African Translators' Institutes (SATI)
Reference number 1000363

SACE REGISTERED

04 November 2021

TITLE: **Determining tourism climate change mitigation and adaptation strategies at a selected private game reserve in South Africa**

This serves to confirm that I edited substantively the above document. The document was returned to the author with various tracked changes intended to correct errors and to clarify meaning. It was the author's responsibility to attend to these changes.

Yours faithfully

Dr. K. Zano

Ph.D. in English
kufazano@gmail.com/kufazano@yahoo.com
0631434276

Annexure C: Ethics clearance approval letter

Vaal University of Technology
Your world to a better future

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The Acting Chair
Faculty Research Ethics Committee
Faculty of Human Sciences
Vaal University of Technology
02 October 2020

RESEARCHER/S: Ms Zinzi E Sibitane

PROJECT TITLE: Determining tourism climate change mitigation and adaptation strategies at selected private game reserves in South Africa

Department: Hospitality Tourism & Public Relations Department

Decision: Approval	**Ethics Reference Number:** **FREC/HS/02/10/2020/6.1.2** **Staff number: (216030374)**

Dear Ms Sibitane

Thank you for submitting the research ethics clearance application for the project *Determining tourism climate change mitigation and adaptation strategies at selected private game reserves in South Africa*. After due consideration the application was approved based on the declaration by the researcher that the issues mentioned in the previous response letter have been addressed as per the table below:

Comments	Response	FREC response
In the information leaflet to the managers, managers need to be informed that their employees will be protected and that they will therefore have no access to data that emanates from this research.	Information added. It is indicated that the reports will be made in aggregate which offers protection to all participants and also no names will be collected on the tool itself which makes it difficult to know who said what. Besides this research is general in nature with no sensitive question or information collected.	Accepted
There is no clear indication of beneficiation for the workers or the game reserve managers, this can be stated in the revised application as well as clarified in the ILs	Benefit statement added as suggested.	Accepted
Staff need to be assured that management have given permission for them to participate and that they agreed that staff will be protected.	Information added as requested.	Accepted
The IL to the gatekeepers needs to include: a). what exactly will be done, with whom, how and what might be disrupted? b). what are the benefits to the reserve? c). how the reputation of the reserve be protected? d). what are the potential risks?	The information is added to the permission letter from the game reserves as stated. • No foreseeable disruptions or damages are anticipated from this research. • There are no potential foreseeable risk of this study. Nothing in the tools can be potentially construed as damaging from the tools provided unless the committee wants to point to specific issue in the tools. • The sustainability managers will be given a	Accepted

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e). permission needs to be given to talk to the staff and accepting their anonymity	chance to look at the final report to check if there is potential damaging information as per standard practice to screen out potentially damaging information if any. • The permission is sought in the request letter and it is pointed out that participation will be anonymous	
The FREC raised concerns that targeting only two reserves might not make anonymity of the game reserves possible in the reporting.	Game reserves can opt to have their names published or not in the consent letter. There is no evidence that the study will prejudice the establishments in any way. Similar studies have published names of companies that participated with permission of the management check Dube and Nhamo (2020) on Grootbos Private Nature Reserve and also another one from similar authors on &Beyond same year.	Accepted

> *In all correspondence concerning this research project please use the Ethics Reference Number provided above.*
>
> *As the primary researcher you undertake:*
> - *To follow only those procedures for which the approval has been given;*
> - *To inform the committee should there be significant deviations from that which has been approved;*
> - *To report any Adverse Events that might occur, within 14 days of the event (following the Guidelines procedure);*
> - *To submit to the committee annual progress reports, where your reporting date is 1 December 2020; and*
> - *To inform the committee on the completion of the project, when the findings have entered the public domain.*

Lastly, we would like to take this opportunity to wish you well with your research endeavours.

Sincerely,

Dr A de Klerk
annekel@vut.ac.za
CHAIR: Faculty Research Ethics Committee
Faculty of Human Sciences
Vaal University of Technology

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Annexure D: Plagiarism report

Determining tourism climate change mitigation and adaptation
strategies at a selected private game reserve in South Africa

ORIGINALITY REPORT

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SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

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3	"Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation in New York State : Final Report", Annals of the New York Academy of Sciences, 12/2011 Publication	1%
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Annexure E: Conference attendance certificate

The 5th International Conference on Events

**Making New Waves in Africa:
Exploring New Frontiers in Festivals and Events**

Cape Town, South Africa
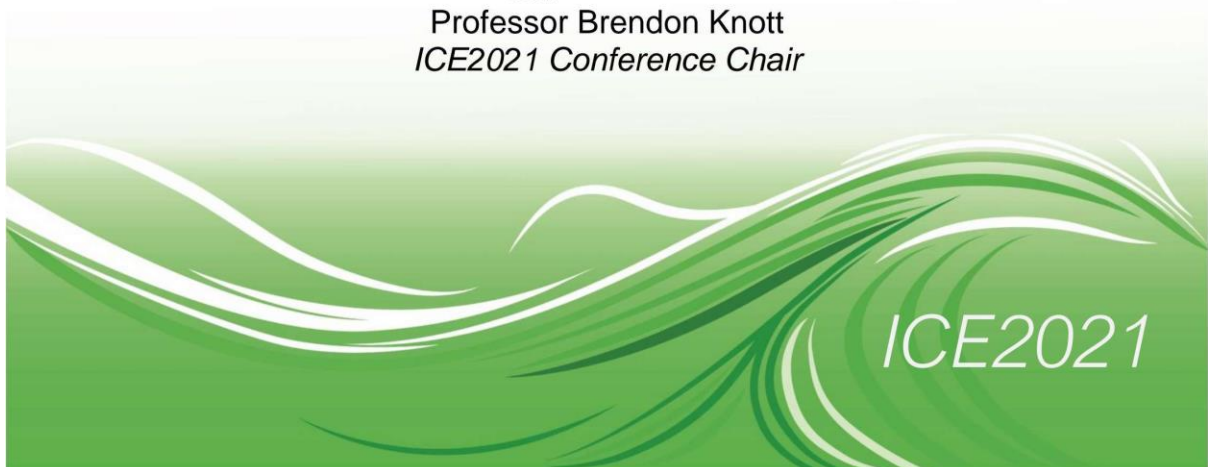16-18 November 2021

CERTIFICATE OF PARTICIPATION

Conservation challenges presented by climate change
to nature tourism in private game reserves

Zinzi Sibitane, Kaitano Dube and Limpo Lekaota

On behalf of the organising committee,

Professor Brendon Knott
ICE2021 Conference Chair

Appendices F: Article publication

Article

Global Warming and Its Implications on Nature Tourism at Phinda Private Game Reserve, South Africa

Zinzi Sibitane, Kaitano Dube * and Limpho Lekaota

Department of Tourism and Integrated Communication, Vaal University of Technology 1, Vanderbijlpark 1900, South Africa; zinzisibitane@yahoo.com (Z.S.); limphol@vut.ac.za (L.L.)
* Correspondence: kaitanod@vut.ac.za; Tel.: +27-710096290

Abstract: The past decade recorded the highest number of high impact extreme weather events such as flooding, rainfall events, fires, droughts, and heatwaves amongst others. One of the key features and drivers of extreme weather events has been global warming, with record temperatures recorded globally. The World Meteorological Organization indicated that the 2010–2020 decade was one of the warmest on record. Continued global warming triggers a chain of positive feedback with far-reaching adverse implications on the environment and socio-economic activities. The tourism industry fears that increased global warming would result in severe challenges for the sector. The challenges include species extinction, disruption of tourism aviation, and several tourism activities. Given the extent of climate variability and change, this study examines the impacts of rising temperatures on tourism operations at Phinda Private Game Reserve in South Africa. The study adopts a mixed-method approach that uses secondary, archival, and primary data collected through interviews and field observations to investigate the impacts. Data analysis was done using XLSTAT and Mann–Kendall Trend Analysis to analyse climate trends, while content and thematic analyses were used to analyse primary data findings. The study found that increasing temperature is challenging for tourists and tourism employees as it affects productivity, sleeping patterns, tourism operations, and infrastructure. High temperatures are a considerable threat to water availability and animal sightings, adversely affecting the game drive experience. Increased heatwaves resulted in bird mortality and hatching mortality for turtles; this is a significant conservation challenge. The study recommends that heat stress be treated as a health and safety issue to protect tourists and employees.

Keywords: extreme temperatures; staff health; heatstroke; sleep disturbance; climate change

1. Background and Introduction

One of the critical aspects raised prominently in the Paris Agreement is the need to curb the temperature between 1.5 °C and 2 °C to preindustrial levels to avoid disruptive climate events buoyed by global warming. Tipping beyond the 2 °C threshold is widely believed to have catastrophic implications for human civilisation as we know it [1,2]. The Special Report on Global Warming of 1.5 °C (SR15), which was published in 2018 by the Intergovernmental Panel on Climate Change (IPCC), paints a gloomy picture of the future if the world fails to drastically reduce its carbon emissions responsible for global warming [3]. There are fears that a continued increase in global warming would adversely affect the achievement of the Sustainable Development Goals. Regardless of the devastating implications of continued anthropogenic warming, evidence suggests that some parts of the world are already experiencing temperatures above the 1.5 °C and 2 °C temperature threshold, with some scientists noting that the world has already entered a climate emergency [4,5].

According to the World Meteorological Organization, 2016 and 2020 emerged as two of the hottest years on record since the documentation of climate data [6]. A global average increase in temperature is a huge concern given that it has adverse impacts on international