

Article

Climate, Tourism and Economic Resilience in the Afromontane Region of Hogsback, South Africa

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Abstract

The village of Hogsback is in an Afromontane region in the Eastern Cape province and caters to nature-based, winter, and cultural tourism markets. This research used mixed methods to explore the trends and variability of the microclimate of Hogsback and linked them to an investigation of the resilience of the local economy. Local temperature, rainfall, and snowfall data were utilized for the climatic analysis. Climatic data revealed an increase in total annual hot days, total annual rainfall, and rainfall days. Interannual variability in total annual rainfall was shown to be increasing. Total annual snow days declined but displayed high levels of interannual variability. Semi-structured interviews with local tourism businesses found that this climate variation could pose a threat to many local tourism activities and events. Although some resilience was already fostered, greater collaboration, cooperation, and partnerships were identified as areas for building future resilience.

Keywords: Afromontane; climate change; resilience; snow; South Africa; tourism

1. Introduction

Climate change is a growing challenge [1]. The Paris Agreement, an international and legally binding treaty on climate change, recognizes the need to build resilience and adaptation to climate change [2,3]. Potential challenges to the global tourism industry include shifts in precipitation and temperature, sea-level rise, carbon pressures, and the increased frequency of extreme weather events [4]. Direct effects on tourism could include threats to biodiversity and cultural heritage, shifts in the seasonality of tourism, changes in activities and attractions, tourist satisfaction, and choice of destination [4,5]. In addition, there will be a potential impact on infrastructure, access routes, business risk, and insurance costs and access [6]. Overall, these factors have the potential to decrease the number of tourists and the economic sustainability of the destination and its individual businesses. Small-scale tourism businesses with limited access to capital are highlighted as particularly vulnerable to climate change as their adaptive capacity is lower [7]. As a result, climate change is already shaping the tourism landscape in terms of investment, planning, demand, and business operations. Incredibly, climate change is not yet a significant feature of tourism policies and planning across the globe [5,8].

Africa experiences a varied and varying climate [9,10]. The continent has significant climatic gradients and disparate climate zones. The African climate also displays significant levels of interannual variability, particularly in terms of rainfall [9]. In addition to the inherently variable nature of the African climate, climate change is likely to increase



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variability in the future. Annual average air temperature increased by between ~1 and 1.5 °C between 1961 and 2015 [1]. Continued increases in annual average air temperature are likely to increase the occurrence of heatwaves over the region [11,12]. In addition to increased average air temperature, and the projected increased occurrence of heatwaves, higher levels of rainfall variability are of concern. Increased levels of aridity have been observed in Africa since the 1980s [13]. Most modern climate change scenarios project prolonged and intense droughts to occur in southern Africa. Shorter-term rainfall variability associated with the El Niño Southern Oscillation (ENSO) also significantly adds to the uncertainty of future water resources in the region [14]. Areas such as the Eastern Cape province of South Africa are already vulnerable to atmospheric variability over different timescales. In late 2019 the province was officially declared a disaster region following a drought that resulted in significant water shortages across the province [15].

Prior to 2000, the literature investigating the relationship between climate change and tourism was very limited but began to increase from the mid-2000s [5]. In fact, three-quarters of the literature they reviewed on the topic was published after 2012 [5]. Despite the risks posed by climate change in the Global South, there is a disproportionate focus on the Global North in scholarship about climate–tourism nexus [5,16]. Scholarship on tourism and climate change in South Africa is growing, however [4,6,17]. Recent case studies looking at the climate–tourism nexus include: St Francis Bay and Cape St Francis [7], Cape Town and the Western Cape [18], Sabi Sands [19], several destinations along the South African coastline [20], and the Mopani District Municipality [16]. South Africa has been identified as one of the top contributing countries to publications on this theme (65 publications), but it is the only African country on the list [5]. Moreover, there is a particular need to develop context-specific and in-depth research on this theme in the Global South [4]. This should allow for greater understanding of the complexity within the climate–tourism nexus and its permutations. It is often argued that climate change impacts are studied in isolation, and their interactions are not explored [5,8]. Particularly within vulnerability and resilience modelling, non-climatic variables like longer-term trends in economic, social, and political systems are often ignored [21]. What is needed within research are multi-disciplinary studies that can acknowledge the complex systems at play [21]. It is within this particular research context that the present study situates itself and attempts to contribute to the conversation.

Narrowing the focus of the present study further, it needs to be contextualized in terms of its geographic characteristics. Hogsback is a village located in an Afromontane region of South Africa, and the local economy is dominated by tourism to the area. Hogsback's tourism product is typical of mountain regions [22]—nature-based in character and including hiking, bird-watching, cycling, and winter tourism. This means that the study falls within climate change and mountain tourism research. Despite the fact that 20% of the land surface of the African continent is mountainous and the geographic contexts are highly diverse [23], only three studies of the 276 conducted within this field before November 2021 emanated from the African continent [22]. African studies directly investigating the relationship between climate change and mountain tourism include Mount Kenya [24], the Kilimanjaro National Park in Tanzania [25], and the Afriski Resort in Lesotho [26,27]. The relative lack of research concerning this relationship in the South African mountain regions is, therefore, stark. Nevertheless, previous studies have produced results that can contribute to the understanding of the climate–tourism nexus in mountainous regions in the Hogsback region. The impacts on mountain tourism can be split seasonally [22]. In summer, impacts include changing seasonality and the appeal of the climate that have an impact on tourist visits, access to amenities and activity and risk caused by natural hazards, and landscape attractiveness and biodiversity [22]. These are all potential risks

to tourism in Hogsback. On the other hand, existing studies of winter tourism have given focus to snow-based activities, predominantly skiing, which require good snow coverage [22]. Adaptations to reduced snowfall and cover include artificial snow production and higher-altitude skiing [27]. These impacts are not relevant to Hogsback, where snowfall does not support skiing and snow acts as an attraction in terms of experiencing snowfall and playing in snow. Nonetheless, less frequent and lighter snowfall may still have an impact on appeal for tourists.

It is within this context that the development of resilience and adaptive capacity within the tourism industry is necessary. Resilience has its roots in psychology and ecology but has been linked to sustainable development since the 1990s [28]. As a result, resilience is a major component of Sustainable Development Goal (SDG) 11, Make Cities and Human Settlements Inclusive, Safe, Resilient, and Sustainable [29]. The precise meaning and characteristics of the concept are open to debate within the literature [30–33]. Nevertheless, the concept relates to ideas of flexibility, recovery, and the ability to bounce back when cities and communities face both acute shocks and long-term, chronic stresses [31]. Climate resilience acknowledges that climate change involves an increased risk of acute shocks like natural disasters and exposure to long-term and slow-onset stresses like temperature increases and sea-level rise [28]. The focus on resilience is a focus on adaptation, capacity-building, and planning for the future, mindful of risks and challenges that may arise [31]. This makes knowledge and understanding of risks and vulnerabilities key to building resilience, and communities must have access to information about climate change available to them [22].

Thinking about resilience is systems thinking [32]. There are five key dimensions of this system: physical, natural, economic, social, and institutional [33]. Some of the main characteristics of resilience include robustness, diversity, integration, inclusion, redundancy, efficiency, connectivity, adaptation, resources, independence, and innovation [33]. The concept can be applied at various scales including the resilience of an individual, a household, a community, and a country [28]. Mountain tourism research has commonly found it important to diversify tourism attractions as an adaptation strategy [22,27]. It is, additionally, important for the social and institutional systems to be strengthened through building business and institutional relationships, connections, cooperation, and community cohesion [34–36]. This could play out through cooperation amongst businesses with potential synergies [34], building community organizations [36] and the encouragement of even power distribution [35], for example.

The present study seeks to extend understanding of the climate variation and trends in Hogsback, the potential threats that changes to climate and weather patterns will have on the local tourism industry, and understand these in terms of the local capacity to build resilience. As such, the study is based on three primary research questions:

1. What long-term trends and patterns are evident in the air temperature, rainfall, and snowfall characteristics of Hogsback?
2. How do observed trends and variability create vulnerabilities for Hogsback's tourism economy?
3. What factors strengthen or constrain the capacity of Hogsback's tourism economy to build resilience to climatic variability and change?

In investigating these relationships, the study also broadens the temporal and geographical scope of existing research and adopts a relatively uncommon, mixed-methods approach. In terms of temporal scope and in contrast to the dominant focus on winter tourism, its breadth is all-season research, which makes up only 16% of the existing literature [22]. It contributes to an extended geographical scope through producing an understanding of African and, specifically, South African manifestations of the climate–

tourism nexus in mountain environments [4,5,22]. Furthermore, a mixed-methods approach to research in this field comprises only 10% of the literature [22]. The present research involved the collaboration between climatology and tourism geography and, therefore, adopted a mixed-methods approach. This approach involved the quantification of the trends and variability of the Hogsback microclimate by applying timeseries statistics to historical, ground-based meteorological data. Interviews with local stakeholders provided qualitative data with which to understand the local tourism industry, the climate–tourism nexus, and resilience-building.

Hogsback: Environmental and Tourism Context

This section situates Hogsback within its environmental and tourism context. The section first outlines the physical and climatic characteristics that distinguish the village from the surrounding Eastern Cape region before outlining the historical development and contemporary structure of its tourism economy. Attention is given to the dependence of local tourism on the natural environment, establishing the characteristics that make Hogsback an appropriate case for examining the climate–tourism nexus and potentially vulnerable to climatic variability and change.

Hogsback (32°35′ S, 26°56′ E) is a village located in the Raymond Mhlaba Local Municipality within the Eastern Cape province of South Africa (Figure 1a,b). It is situated in the Amathole Mountains at about 1270 masl [37]. It is an Afromontane region with indigenous southern mist-belt forests, thicket and grassland, and diverse fauna [38]. Streams, wetlands, and waterfalls form hydrological features within the Tyume, Kat and Klipparts River catchments. The geology is dominated by the Balfour Formation of the Beaufort Group of sedimentary rocks with dolerite intrusions [37]. This lends itself to the formation of the three Hogsback Peaks (1900 masl) and their characteristic inclined dolerite caps, which are thought to be the source of the village’s name.

The Eastern Cape province experiences a variable and heterogeneous climate. The province is situated in the transition zone between the winter rainfall zone (western South Africa) and the summer rainfall zone (eastern South Africa) [39]. It experiences both tropical and midlatitude synoptic weather systems. As a result, it displays strong climate gradients, evident in soil moisture and vegetation profiles, enhanced by strong topographic variation [39]. The climate of the Hogsback area is influenced by its height above sea level, topography, and its location on the south-eastern escarpment of the Amathole Mountains. The climate is characterized as a cool, summer rainfall area with an average annual rainfall of 1200 mm and snow and frost during winter [37]. The region, as with the whole of the Eastern Cape, is prone to experiencing prolonged and severe droughts. Most recently, a severe El Niño-induced drought resulted in water shortages within the province [15], including Hogsback.

Hogsback developed gradually after the arrival of the British settlers in the region in 1820 and had the geographic advantages of being along transport routes, having favourable conditions for primary farming and forestry activities, and capturing the climate of ‘home’ [40]. The first hotel, the Hogsback Hotel (now Hogsback Inn), welcomed travellers from the 1850s, and camping, hiking, picnicking, and foraging parties arriving by ox-wagon were a common feature [40]. Holiday or second homes appeared from 1910 [40]. The settlement grew very gradually at first, and it was only after the construction of a new pass in 1932 that the village became more accessible and grew at a faster pace [40]. Many infrastructural developments have allowed for an increase in permanent residents and tourists [40]. These include the introduction of electricity in 1982, tarring the access road in 1987, and the construction of the municipal reservoir at Plaatjies Kraal in 2000 [40].

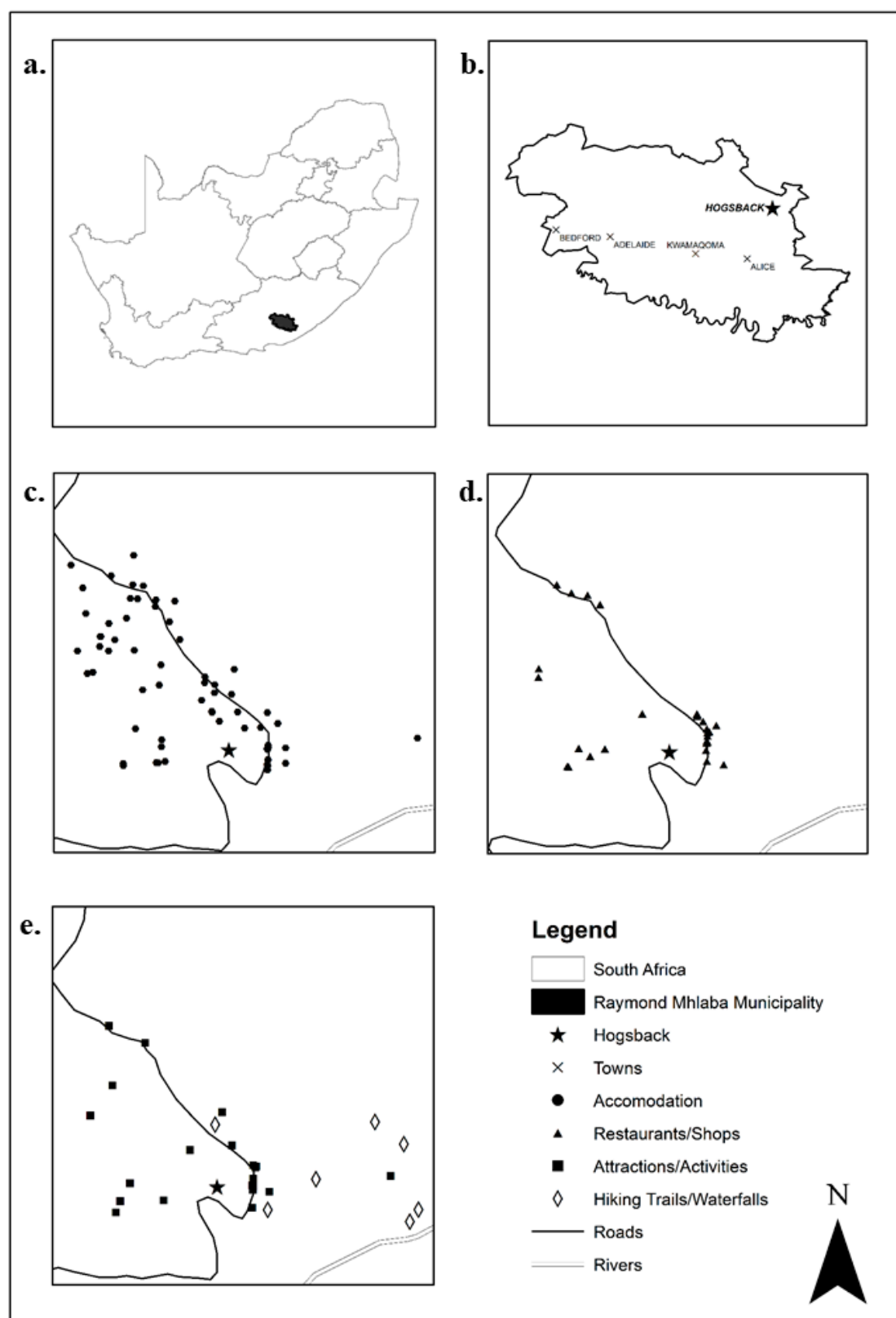


Figure 1. Study site map of the Hogsback area with (a) the location of the Raymond Mhlaba municipality in South Africa, (b) the location of Hogsback within the municipality and surrounding towns, (c) the location of accommodation establishments in the town, (d) restaurants and shops in the town, and (e) hiking trails and waterfalls in the local vicinity of the town.

The contemporary economy of the village is dominated by the tourism industry. Figure 1c–e illustrates the range of tourism-related activities and businesses in the village,

including those directed solely at tourists, like accommodation establishments, and those that serve both tourists and local permanent residents, like shops, restaurants, and activities. Accommodation includes larger establishments and smaller-scale self-catering units and guest lodges. A Visitors Centre was established and built in 1996 in a partnership between the municipality and the residents.

The natural environment of Hogsback is undoubtedly its main tourism product. The area's biodiversity, waterfalls, and mountains lend themselves to various outdoor activities that include hiking, abseiling, mountain biking, fishing, horse riding, and bird-watching [41]. The local climate and weather patterns are integral to the broader environmental system, but they also form an attraction. This is related to the fact that the local climate is an outlier in the broader region. Relatively temperate summers are appealing for outdoor activities, and very cold winters with the prospect of snowfall are a major attraction. Snow-based tourism in the area is based on the experience of snow, and not particular activities, in an otherwise coastal climate-dominated region.

While nature-based and weather-driven tourism is the main function of the Hogsback tourism sector, atmospheric variability over a shorter timeframe can negatively impact tourism in the village. Disruptive snowfall is not uncommon in the area, which can hinder tourism activities and can result in road closures [42]. Heavy rainfall events can result in impassable dirt (mud) roads to the village [43], with severe thunderstorms bringing the potential of localized flooding. Hot and dry conditions associated with prefrontal 'Berg' winds can result in high fire risk, and extensive forestry increases wildfire vulnerability [44]. It is because of this link between weather, climate, and tourism that the present research is highly pertinent.

2. Methods

Long-term meteorological data were obtained from the Agricultural Research Council of South Africa. Historical Automatic Weather Station (AWS) records of daily maximum and minimum air temperatures ($^{\circ}\text{C}$), and daily total rainfall (mm) observed in Hogsback were utilized in this study. The dataset spans a total of 40 years between 1983 and 2022. Quality control of the climatic data included an analysis of missing data per variable per year. Years in which more than 20% of a variable was not recorded were excluded from the subsequent timeseries. As a result, the timeseries does not include any data for the years 1999, 2016, and 2019.

Daily records were processed into annual average maximum and minimum air temperatures, annual average air temperature, and total annual rainfall. In addition to the base variables, an analysis of total annual "hot" days was conducted by quantifying the frequency of days per annum in which Hogsback experienced a maximum temperature greater than 25°C . A threshold of 25°C was selected for the analysis of hot days, as the daily average maximum air temperature over the time period was calculated to be roughly 20°C . A similar process was used to investigate the frequency of "heavy rainfall" days (daily rainfall > 25 mm). A record of snowfall days, starting in 1993, was obtained from a local Hogsback resident and was used to analyze the trend and variability of snowfall in the area.

All datasets (except for the snowfall dataset) were split into two separate periods (1983–2001, and 2002–2022). Timeseries statistics were applied to all variables across the two time periods, yielding two rate-of-change values per variable. Additionally, an overall trend covering the entire record (1983–2022 for the ARC data, and 1993–2022 for the snowfall data) was also calculated. Least-squares regression analyses were performed on the datasets to yield rates of change (slopes). The significance of the calculated rates of change was

tested using Student's *t*-test at a 95% confidence level. Coefficients of variation were used to assess levels of inter-annual variability.

Interviews conducted with a range of stakeholders within local tourism sectors are a highly valuable means by which to explore the climate–tourism nexus [4]. The local tourism industry and economic resilience in Hogsback were explored in semi-structured, in-person interviews with the owners of local tourism-related businesses in early 2023. The sample of 11 businesses included small- and large-scale accommodation establishments, as well as shops, restaurants, and activity-related services. These businesses represent a range of tourism types. Research participants were selected using snowball and purposive sampling. The study received ethical approval from the Rhodes University Ethics Committee (Project number: 2023-7245-7632), and informed consent was obtained from each participant. The researchers were happy that saturation had been reached in the qualitative data collection when no additional data had been found and themes were exhausted [45]. This is in line with the results of a review [46] that found 9–17 interviews typically met data saturation.

Interviews explored the nature of the tourism economy and its link with the local climate, and the capacity for building resilience within the local economy in the face of climate variation. The interviews were recorded, and the resultant data were analyzed thematically.

3. Climatic Analysis and Trends

3.1. Annual Climate Variability and Trends

Trends in the annual average air temperature, annual average maximum air temperature, annual average minimum air temperature, and total annual rainfall were calculated over three time periods of the dataset series (Figure 2). The first timeseries covers the entire period (1983–2022), the second covers the earlier period within the dataset (1983–2001) and the third covers the most recent period (2002–2022).

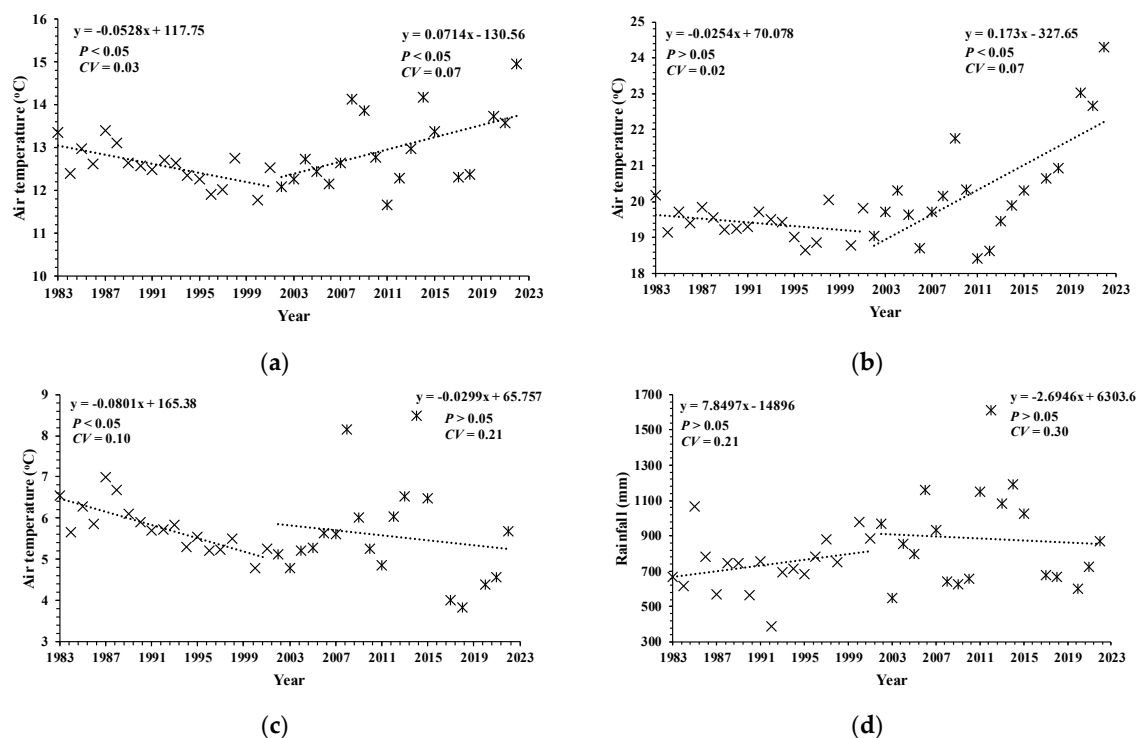


Figure 2. Annual trends and variability observed at Hogsback for (a) average air temperature, (b) average maximum air temperature, (c) average minimum air temperature, (d) total rainfall.

Hogsback experienced an overall increase in annual average air temperature over the period (Figure 2a). Between 1983 and 2022, annual average air temperature increased at a

rate of $0.19\text{ }^{\circ}\text{C decade}^{-1}$ with little interannual variability ($\text{CV} = 0.06$). The overall trend approached significance with a borderline p -value of 0.06. Splitting the entire dataset into two distinct periods displays an interesting result—Hogsback experienced a significant ($p < 0.05$) decreasing trend of $0.53\text{ }^{\circ}\text{C decade}^{-1}$ in annual average air temperature between 1983 and 2001. The trend reversed between 2002 and 2022 when the site was characterized by a significant increasing trend of $0.71\text{ }^{\circ}\text{C decade}^{-1}$ but with higher levels of interannual variability ($\text{CV} = 0.07$, compared to 0.03 between 1983 and 2001).

The observed significant increase in annual average air temperature is likely due to the observed increase in annual average maximum air temperature (Figure 2b). Between 1983 and 2022, Hogsback experienced a significant ($p < 0.05$) increase of $0.60\text{ }^{\circ}\text{C decade}^{-1}$ in annual average maximum air temperature. Annual average maximum air temperature did not experience any significant change between 1983 and 2001 but did display a significant increasing trend of $1.73\text{ }^{\circ}\text{C decade}^{-1}$ between 2002 and 2022. The overall timeseries (1983–2022) was characterized by moderate levels of interannual variability ($\text{CV} = 0.06$) with the later part of the timeseries experiencing a CV of 0.07.

Annual average minimum air temperature decreased in Hogsback between 1983 and 2022 (Figure 2c). The site was characterized by an insignificant decreasing trend of $0.21\text{ }^{\circ}\text{C decade}^{-1}$. Deconstructing the timeseries into smaller periods yields two periods characterized by decreasing trends. Between 1983 and 2001 Hogsback experienced a significant decreasing trend of $0.80\text{ }^{\circ}\text{C decade}^{-1}$ ($p < 0.05$) while the latter time period (2002–2022) was characterized by an insignificant decreasing trend of $0.30\text{ }^{\circ}\text{C decade}^{-1}$. Both the overall timeseries, and the latter period experienced relatively high levels of interannual variability ($\text{CV} = 0.16$ and 0.21 respectively).

Total annual rainfall, being the sum of rainfall recorded between January and December, in Hogsback increased between 1983 and 2022 (Figure 2d). Overall, the site experienced a borderline significant ($p = 0.07$) increasing trend of $59.66\text{ mm decade}^{-1}$. Neither of the shorter time periods displayed a significant rate of change, though the latter time period (2002–2022) was characterized by an overall decreasing trend of $26.95\text{ mm decade}^{-1}$. Rainfall, at all timescales considered, displayed the highest levels of interannual variability, with CV values greater than 0.20. Of special note is the dramatic decrease in total annual rainfall between 2014 and 2020 associated with the most recent El Niño event (2014–2019) and prolonged drought conditions, and the subsequent increase in rainfall associated with La Niña conditions (2020–2022).

3.2. Total Hot Days

Total annual hot days, defined as a day in which the average air temperature exceeded $25\text{ }^{\circ}\text{C}$, were also analyzed (Figure 3). Timeseries statistics for the period between 1983 and 2022 indicate that Hogsback experienced a significant increase in total annual hot days, with a rate of change of $10.68\text{ days decade}^{-1}$. The overall timeseries was also characterized by high levels of interannual variability, with a CV of 0.32. While the overall timeseries is characterized by a significant increase in hot days, the earlier time period (1983–2001) did not display a significant trend, although a lower level of interannual variability was noted. The latter time period (2002–2022) did display a significant increasing trend of $30.78\text{ days decade}^{-1}$ ($p < 0.05$) as well as higher interannual variability ($\text{CV} = 0.36$).

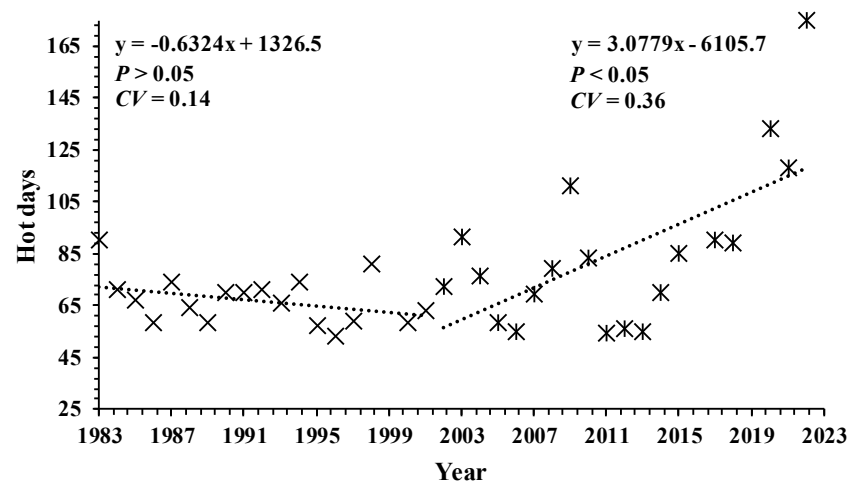


Figure 3. Trends and variability in the annual total of hot days observed in Hogsback.

3.3. Heavy Rainfall Days

Changes in heavy rainfall days were investigated in addition to the traditional analysis of total annual rainfall (Figure 4). For the analysis, a heavy rainfall day was considered to be a day on which more than 25 mm of rainfall was recorded. Heavy rainfall days increased significantly in Hogsback over the entire timeseries (1983–2022) with a rate of change of 1.16 days decade^{−1} ($p < 0.05$). Hogsback experienced high levels of interannual variability in heavy rainfall days alongside the significant increasing trend ($CV = 0.55$).

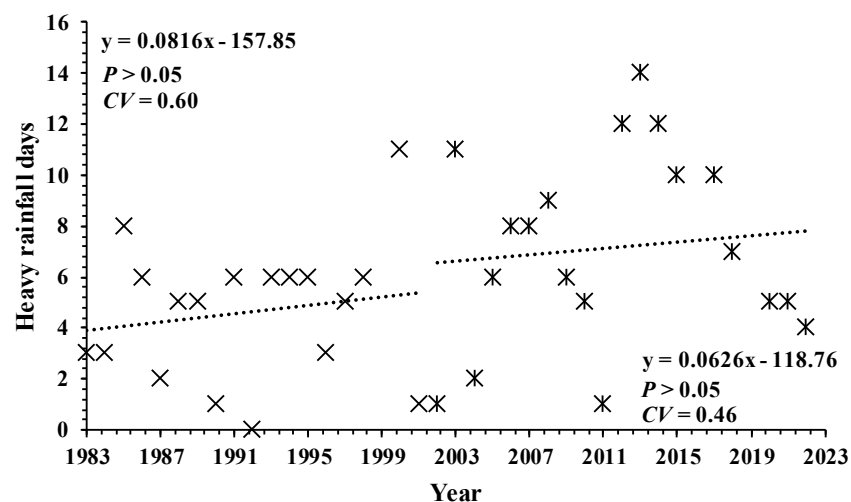


Figure 4. Trends and variability in the annual total number of heavy rainfall days observed in Hogsback.

3.4. Snow Days

The frequency of days on which Hogsback experienced snow events was analyzed using self-reported snowfall occurrence data from a local, longstanding property owner. The collection of snowfall events by the property owner began in 1993. For this analysis, any instance of “snow”, “sleet”, “freezing rain” was considered a snow event. Hogsback, based on the data, experienced an overall decrease in total annual snow days between 1993 and 2022 (Figure 5). An insignificant ($p > 0.05$) rate of change of 0.62 days decade^{−1} was observed. Snow days displayed the greatest level of interannual variability across the studied climatic variables with a CV of 0.88.

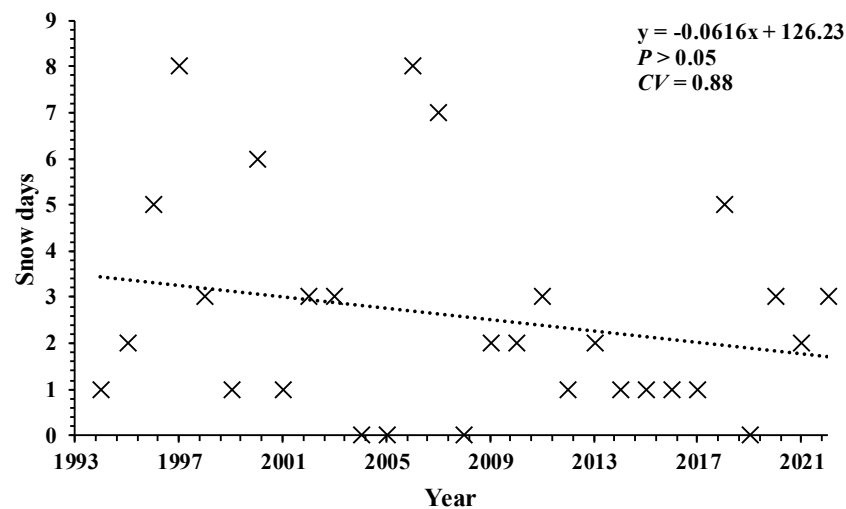


Figure 5. Trends and variability in the annual total number of snowfall days observed in Hogsback.

4. Economic Resilience

Interviews revealed three themes that are relevant to the opportunities and threats to local resilience capacity, both in general and with regard to climate issues.

4.1. Community Cooperation, Collaboration and Coordination

Interviews revealed that cooperation, collaboration and coordination exist within the local community and enable many joint projects, but the level to which this occurs has its limits. There are different interest groups within the community and interviews reveal that some quite fundamental disagreements exist. This comes down to differences in lifestyle, local investment, and visions for the future of the village and tourism. For instance, there seems to be a lack of consensus about the desirable level of growth within the tourism industry. Interviews revealed that some residents and homeowners are annoyed by the impact that tourists have locally. Others are happy with the size of the tourism industry and fear that growth will pose a threat to the atmosphere and character of the village. In addition, there is a push from some quarters to grow the tourism industry and to promote the village for mass tourism, encouraging tour packages and higher occupancy rates. Two features of the tourism industry illustrate these local tensions. First, the local Visitors' Centre closed for many years because of a lack of continued financial support from the government. Some residents saw it as a resource that required revival as it served a necessary purpose in disseminating information to tourists. Others, however, believed that online platforms and the availability of information through this means have rendered this kind of facility unnecessary. Second, the limited nature of local cooperation, collaboration and coordination is illustrated in the existence of two Hogsback websites—Hogsback.info (<https://visithogsback.co.za/site/> (accessed on 19 August 2026)) and its associated social media pages and Hogsback Tourist Information (<https://hogsback.com/> (accessed on 19 August 2026)). Interviews revealed that the existence of the two different websites was representative of a lack of agreement and thus, coordination, within the local tourism industry. After this research was conducted in early 2023, an announcement was made on the Hogsback Facebook page in June 2024 to herald the newly created Hogsback Tourism Organization (HTO). Whether this organization will have efficacy in creating coordination and collaboration in the community is yet to be seen.

In addition to these issues, interviews revealed that the activities of the local forestry company were often at odds with the tourism industry and the rest of the local economy. Concern was expressed about the closure of access points and routes to hikes and waterfalls that cross land owned by the forestry company [47]. In addition, concerns were raised

about the effect that the forestry company had on the local built and natural environment. These concerns related to the activity of heavy vehicles on local roads and the damage these trucks caused, and the effects that plantations had on the water supply to streams and local biodiversity. This tension has, however, shown that cohesion within the community around major issues is possible. The Hogsback Unity Group (HUG) was formed in response to these issues and has lobbied the Department of Forestry, Fisheries and the Environment to intervene as the forestry company operates on state land [47]. An ‘invitation for submissions’ was opened in 2024 for the public to engage with issues of access with the forestry company [48].

4.2. Community-Government Partnerships

The inconsistency of local government support for the Visitors’ Centre is an illustration of the limited role that local government plays in the local tourism industry. Despite reopening in 2024, the local government only staffs the Centre during weekdays and requires locals to run it over the weekends when tourists are more likely to visit. In addition, interviews revealed that local government support for the village is limited in nature, and the maintenance of infrastructure is not regularly conducted. The pass to the village and the dirt roads within it are often in desperate need of repair, and the maintenance of electrical infrastructure is lacking. This means that any large storms or snowfall render roads dangerous or impassible, and strong winds can cause prolonged electrical outages. In addition, during the most recent drought event, the municipal reservoir dried up quickly. The capacity of the reservoir is reportedly only enough to sustain the village for one month without any rain events to replenish water levels. High average annual rainfall means that this is not a problem during most years, but in the event of the recent drought, it became a serious issue. The municipality provided no solutions to the lack of supply, and the local community was forced to develop their own adaptations to ensure a supply of water. In essence, many residents and business owners have had to develop self-reliance, and many have sought to go off-the-grid both in terms of water and electricity supply.

4.3. Resilience Through Route Tourism and Events

Strong elements of resilience have been built in acknowledgement of the seasonal nature of the tourism industry and a bid to ensure the flow of tourists in the village throughout the year. These include a diversification of the tourism industry through events and festivals, route tourism, and MICE (Meetings, Incentives, Conferences and Exhibitions) tourism. Peak tourism season occurs during the June–July (winter) and December–January (summer) periods when schools are closed nationally, and the weather is appealing. First, interviews revealed that there has been a concerted effort to add events and festivals to the calendar and to ensure that these occur during off-peak times. Festivals and events include the Hobbit Trail Runs (April), Hogsback Mushroom Festival (March), the Winter Woollies Weekend (late July), the Hogsback Yoga Festival (July–August), the Hogsback Mountain Blues Festival (September), Hogsback Open Gardens (October–November), the Hogsback Enduro (cycling) Race (November), the Hogsback Arminel Trail Run (December) and other smaller events [41].

Second, in collaboration with broader tourism networks in the Eastern Cape, Hogsback is a member of the Explorer’s Way. This is an example of route tourism that packages cities and towns along a route that includes nature, art, adventure, cultural and historical tourism. It has the potential to link Hogsback with tourists who are in the region for other purposes.

Third, the MICE market is being explored by some of the larger accommodation establishments which have added conferencing and meeting facilities to their properties.

This allows individual businesses to benefit with higher occupancy rates and has a knock-on effect on other businesses within the village.

5. Discussion and Conclusions

The findings of this research have highlighted a close connection between climate and tourism in the village of Hogsback. This discussion aims to bring together the findings of the quantitative analysis of climate data and the qualitative investigation into local levels of resilience and the capacity for developing these further.

Annual average air temperature, as well as annual average maximum air temperature, increased significantly in the village of Hogsback over the study period. The observed rate of change in annual average air temperature ($\sim 2\text{ }^{\circ}\text{C century}^{-1}$) is within the range of values observed elsewhere in South Africa and in line with climate change projections for the region [49]. Hogsback remains an area with a moderate climate, despite the observed increases in average and maximum air temperature, which may delay any adverse impacts of future warming. The observed increase in the annual number of hot days is of concern, though. Days exceeding $25\text{ }^{\circ}\text{C}$ have increased significantly in the area, and while the current average temperatures are still moderate, further increases may result in an increase in localized heatwave events [11]. This could be a concern for outdoor-based physical activities, as it may lead to a rise in undesirable conditions for such attractions.

Rainfall in southern Africa also experiences significant variability at different spatial and temporal scales. Shorter-term variability, because of ENSO, has a marked effect on the Eastern Cape province [50]. Rainfall in the Hogsback area is also marked by significant interannual variability. The rainfall trend observed at Hogsback is a good example of the role of mountain environments in adapting to potential impacts of climate change. Overall, the Eastern Cape province (and other areas of the summertime rainfall season) are expected to experience some level of drying [39]. Hogsback, however, is an example of mountain environments being exceptions to those projections. Total annual rainfall observed in Hogsback between 1983 and 2022 increased (approaching significant), while the later time period (2002–2022) displayed an insignificant decreasing trend. This means that Hogsback needs to prepare for rainfall variability, anticipating periods of drought interspersed with periods of high rainfall. Periods of drought pose an issue in terms of the availability of potable water in the village, and periods of higher rainfall render many outdoor activities unpleasant or risky.

Understanding the impact of climate change on rainfall patterns and severe weather events is a challenging exercise. Increased frequencies of extreme rainfall events are projected for the Eastern Cape [49]. A significant increase in the total number of heavy rainfall days was observed at Hogsback between 1983 and 2022. However, the later period was characterized by an insignificant increase. Heavy rainfall days at all time periods displayed extreme levels of interannual variability. Despite the observed increase and high levels of interannual variability, extreme rainfall events may worsen in the Hogsback area over time. This is of concern for local residents, business owners, and tourists as these events have the potential to disrupt telecommunications and electricity connectivity and render roads in the area impassable.

Winter and snow tourism is a major attraction to the village of Hogsback. It is not linked to specific outdoor activities like skiing, and thus to the need for a specific quality and quantity of snow like at Afriski in Lesotho [27], however. Nevertheless, a timeseries analysis revealed that the total number of snow days is highly variable and decreasing (although at an insignificant rate). A marked reduction in snowfall events may result in fewer winter tourists being attracted to the town, but the unpredictability and variability of snowfall is already seen as a challenge for local tourism.

In addition to these particular challenges, the overall shift in weather patterns and climate poses a risk to nature-based tourism as a whole in the longer term. Moreover, the biodiversity of the area is a major attraction, and any shift in the natural system could have knock-on effects for endemic species and ecosystems.

The five key dimensions of a resilient system [33] form a useful way to understand the findings of this research. The natural and economic dimensions of this system and the relationship between them are at the core of this case study. While these are the focus of the system, the other components and the connections amongst them are equally important. At the core of the research findings, therefore, is the acknowledgement that shifts in the natural environment will have an impact on the local economy because local tourism is nature-based in character. Shifts in weather patterns will likewise have a direct impact on the physical dimension in the form of local water storage capacity, the maintenance of roads, and electricity, and telecommunications infrastructure. In order to build resilience in the face of these challenges, it is the realm of the social and institutional dimensions that needs focus.

Local stakeholders are resilience-minded. There is an acknowledgement of the need to diversify the tourism industry and build robustness both in terms of products and offerings, and building sustainable flows of tourists. As discussed in the findings, this has been done through festivals and events, route tourism, and expansion into the MICE tourism market. However, resilience needs to be built further. There are evident rifts within the community concerning the vision for tourism and some power dynamics are at play amongst tourism businesses and the forestry industry. Greater collaboration, cooperation and coordination need to be built within the local community to present a united front on local challenges. For instance, a shared vision for the village and the tourism industry would create further resilience and opportunities. In addition, holding the local municipality to account and ensuring that their mandated responsibilities are adhered to will require the local community to come together and represent their shared interests, as happened with the closure of the trails and the formation of HUG. There is evidence that tourism efforts are being coordinated [36] and cooperation and synergy between businesses [34] are being built through the newly formed Hogsback Tourism Organization but its efficacy is yet to be seen.

The trend of self-reliance and going-off-grid in order to mitigate against unreliable government support and services is not going to build resilience for all businesses and residents in the long term. For one, affordability is a major barrier to the implementation of these strategies, and small-scale businesses can ill afford them [7].

Recommendations within this research, therefore, include building greater collaboration within the local community and between the community and local government. This could be achieved through a strategic planning workshop with all stakeholders focused on building consensus on local visions and values, extending existing networks, and finding ways to build greater local resilience. Action research specifically focused on facilitating cooperation and building resilience in the village would be an ideal platform on which to do this.

The present study examines the climate-tourism nexus primarily from the supply-side perspective of tourism businesses. Future research could build on this approach by investigating visitors' perceptions on the extent to which heat, rainfall, snowfall and extreme weather influence Hogsback as a destination choice, and the timing of their visits. Contrasting business and visitor perspectives would provide a more complete understanding of how climatic variability translates into tourism demand and destination vulnerability.

This research has contributed to the existing literature concerning the climate-tourism nexus through a context-specific and in-depth case study, as suggested by the literature [4]. The case study helps to build on literature from the Global South, but also demonstrates

how important the local context is within this type of research. The weather and climate of southern Africa is noted for its variability over different scales, and the microclimatic scale of this case study reveals the importance of understanding this. Quantifying the trends and variability of the Hogsback microclimate has illustrated the variable nature of the hyperlocal mountain environment and how it can differ to larger-scale climate projections. This can better inform decision-making and allow for a nuanced approach in building adaptive capacity and resilience. Likewise, understanding the manifestation of the local climate–tourism nexus and local challenges and capacity for resilience can contribute valuable insights for planning.

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