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Implication of Changing Climate on Tourism Development in Southern Tanzania: The Case of Ruaha-Rungwa Landscape

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

East Africa tourism is one of the most successful sectors in the Sub-Saharan Africa (SSA), mainly attributed to the diverse natural landscapes and biological resources, creating special tourism assets. However, despite its importance, the tourism industry, particularly in the southern circuit of Tanzania, has been significantly affected by climate change impacts. The effects of climate change have been detrimental to both the environment and socio-economic activities such as loss of species, disturbances to the timing and patterns of tourism seasons, and disruptions to various tourism facilities and activities. This study examines the impacts of climate and non-climatic factors on tourism development in southern circuit of Tanzania focusing on Ruaha-Rungwa Landscape (RRL). The study adopted a mixed-method approach that uses both secondary and primary data collected through household surveys, interviews Focus Group Discussion (FGD) and field observations. The sample size included 234 household, 110 key informants and 44 FGD

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participants. Data analysis was done using EXLSTAT and Mann–Kendall Trend Analysis to analyse climate trends. SPSS was used to analyse quantitative primary data, while content and thematic analyses were used to analyse qualitative primary data. This study observed nortable changes in climatic conditions over the past 30 years within the study area. These changes includes unreliable rainfall patterns, reduced rainfall, occurrence of rainfall extremes events and increased temperature especially in the last decade in Ruaha National Park. Further, climate change impacts have negatively affected tourism development in the study area, largely related to eruption of wildlife diseases and decline of wildlife population, loss of revenue attributed to early closing of tourism seasonality and destruction of infrastructures such as the tourist amenities. Furthermore, non-climatic factors, such as budget constraints, inadequate investments, poor infrastructure, and uncompetitive position, has observed to hinder the development of tourism activities. The low development of the tourism activities in the area can be attributed to low adaptive capacity of the stressed ecological processes to support provision of ecosystems goods and services. The study recommends that in averting the impact of climate change on tourism development, both climatic and non-climatic stressors must be effectively considered during the planning processes.

Keywords: Climate change impacts on tourism; tourism development; tourism resilient and adaptive measures; Ruaha-Rungwa Landscape.

1. INTRODUCTION

Tourism serves as a powerful driver for both direct and indirect economic expansion, particularly in developing nations, generating over 8% of global employment [1,2] and contributing to more than 10% of the world's Gross Domestic Product (GDP) [2]. In 2011 tourism generated about 2.6% of the GDP of countries in SSA and directly and indirectly accounted for more than 12.8 million jobs of the region [2]. In East African countries, tourism sector has shown to have a substantial and growing impact as a critical economic driver in East African countries [3]. Tanzania is one of the countries that are endowed with abundant natural resources and the most diverse natural landscapes and biological resources [4,5,6]. It has the highest percentage of Protected areas (PAs) coverage worldwide, with more than 600 PAs, a coverage equivalent to about 38% of country's total land area [6]. This accounts for potential tourism asset as well as important areas for wildlife conservation. The nation has been ranked as 4th among 140 countries in terms of its abundance of natural resources relevant for tourism [1].

Being a nature-based tourism country [5,4] it attracts a significant number of tourists from different parts of the world, which increases its shares to the National GDP as well as supporting over 11% of the total employment within the country [7]. Despite this potential of the tourism growth in the Tanzania, the sector growth is heavily concentrated in the parts of Tanzania whereby majority of tourists visit the destination for wildlife safari packages [7,8]. According to [8], the northern national parks of Serengeti, Tarangire, Kilimanjaro Mountains and Arusha National Parks receive large numbers of tourists as compared to southern circuit. National Parks in southern Tanzania are reported to attract only 10% of Tanzania total park visitors, hence the area is mentioned to be underutilised when thinking of tourism growth and contribution to the GDP [7].

Although Tanzania as a country has been increasingly benefiting from the ongoing tourism growth [9], the benefits have not been equally realised by all tourist circuits such as the southern circuit of Tanzania [8,7]. Despite its vast endowment of tourism assets, which includes opportunities for wildlife safaris, hiking, cultural tourism, hunting and other tourism activities in the region, Southern circuit of tourism Tanzania lagged behind with respect to tourism growth which is partly contributed by climatic challenges [10,9,11] as well as non-climatic stressors [7]. Changes in the climatic condition are emerging as one of the key challenges threatening the sustainability of tourism development [12,13]. Although knowledge on the nexus between climate change and tourism is emerging [10], many researchers have been facing challenges in quantifying the effects of climate change on the tourism sector [10,11] as well as quantifying the massive climate change mitigation and adaptation gaps [14,15,16]. In this regard, most of the past studies [10,11] indicate that direct effects of climate change and variability on tourism will be driven by major climate variables, such as temperature, precipitation, humidity and

storm frequency on cultural facilities and natural resources that bear tourism value. For example, it has been indicated that climate, tourist visits, and wildebeest migration are closely related [11]. Generally, climate change has direct and indirect effects on tourism resources in the destinations, policy framework, tourism development and sustainability [17].

Other challenges are linked to the interconnectedness of the direct and indirect effect of climate change [18], relative to other non-climate factors that affect tourism, such as policy development [17]. A wide range of climate-induced environmental changes will have profound effects on tourism across scales [19-22]. Changes in water availability, biodiversity loss [23], reduced landscape aesthetic values, increased natural hazards, coastal erosion and inundation, damage to infrastructure and the increasing incidence of vector-borne diseases will all impact tourism to varying degrees [24].

While there is some progress regarding ecotourism and climate change knowledge, there are still many uncertainties about how various climate parameters and non-climatic factors will affect the tourism sector and its activities [24]. Tanzania in particular tourism and climate studies have increased in the last decade yet there are still considerable sectoral knowledge gaps on tourism development in the context of climate change impacts and non-climatic factors, making it challenging to adopt concrete resilient measures for the sector [10,26,27]. Therefore, this study aims to reduce this scientific gap. The study examines tourism development in the context of climate change impacts in the Southern circuit of Tanzania, using RRL as a study case.

2. MATERIALS AND METHODS

The study conducted in two protected areas of Tanzania namely Ruaha National Park (RUNAPA) and Rungwa Game Reserves (RGRs), known as RRL, which offers diverse tourism activities such as photographic safaris, bird-watching, fly-camping safaris, night drives, and hunting, despite its lesser-known nature-based tourism attractions [7].

This study employed a cross-sectional research design with a combination of both quantitative and qualitative methods [28,29]. Quantitative research methods involved spatial analysis techniques and surveys to assess the impacts of changing climate on tourism development in RRL. A total of 234 households were surveyed to assess the climate change impacts and a review trends and linkages to tourism development in the study area.

Qualitative research methods (interviews, focus group discussions, and observation) were adopted to assess the beliefs, opinions, and attitudes regarding the implications of climate change on livelihood. Purposive sampling method was employed to select a total of 110 key informants for in-depth interviews to examine actors' awareness and perception [29] regarding tourism development in the context of climate change and variability. Further, purposive sampling method was employed to select 44 participants for FGD in the study villages. Selection of the participants considered age, sex, marital status, occupation in key livelihoods sectors (agriculture and livestock keeping) and other socio-demographic variables of the respondents. The focus groups consisted of influential people, elders, pastoralists, farmers, traditional leaders, women, village game scouts, and natural resource committee representatives.

The Tanzania Meteorological Agency (TMA) collected rainfall and temperature data from two stations, Msembe and Rungwa, from 1987-2018 to establish trends and variations, based on the availability of long-term data.

The study utilized IBM SPSS Statistics version 20 to process quantitative data from questionnaires, conduct univariate and bivariate data analysis, and compute cross-tabulation and chi-square to test relationships between variables.

The relationships between variables were tested using cross-tabulation and chi-square (χ^2) using SPSS (equation 1).

$$\chi^2 = \Sigma [(O - E)^2 / E] \quad (1)$$

Where:

Σ denotes the sum across all cells of the contingency table.
O represents the observed frequency in each cell.
E represents the expected frequency in each cell, assuming the variables are independent

Qualitative data from focus group discussions and in-depth interviews were analyzed using

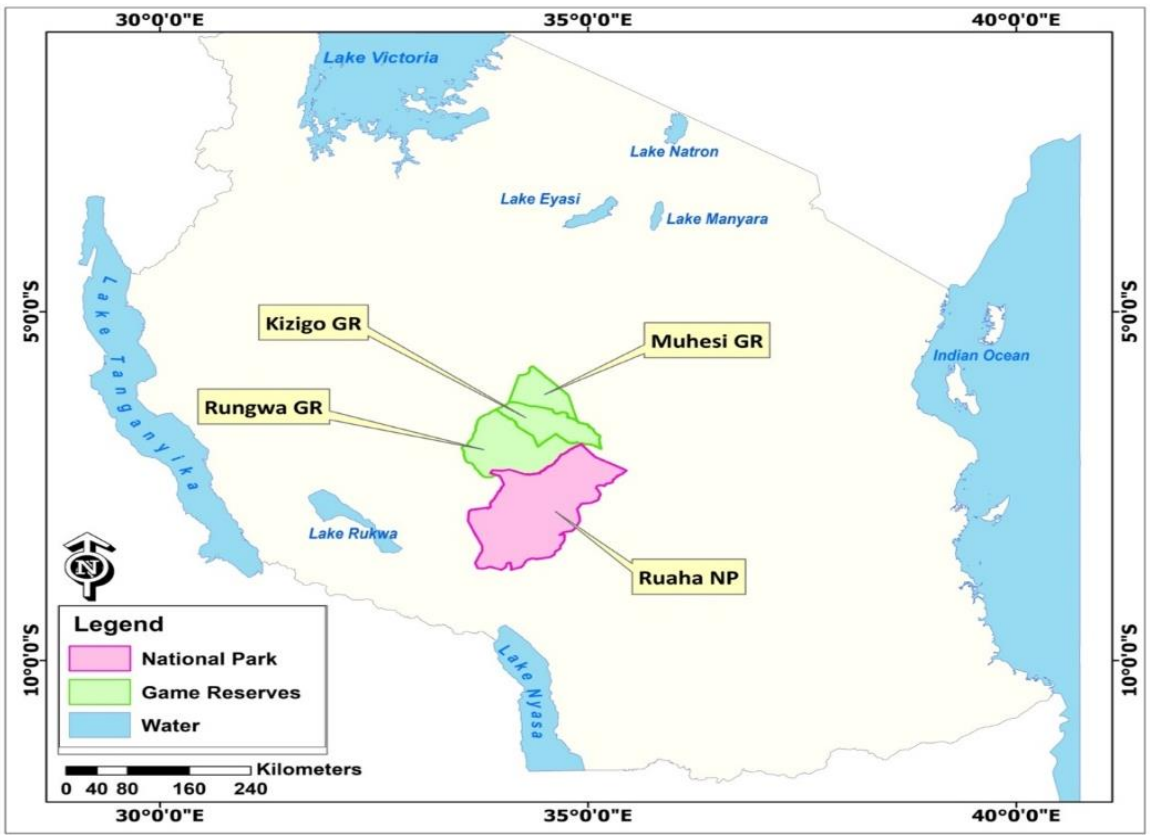

Fig. 1. Map of Tanzania showing the study area (Ruaha-Rungwa Landscape)
Source: IRA GIS Lab, (2021)

content and thematic analysis methods. The analysis was divided into three levels: description, classification, and connection [30,31]. Transcription and annotation were crucial for the classification stage of the data.

The study categorized data into themes like tourism development's impact on climate change, analyzed it into related categories, established connections between themes, and used corroborative evidence to substantiate interpretations and increase the validity of arguments. The study utilized ArcGIS, EXLSTAT, and Microsoft Excel to analyze data on rainfall and temperature variations. Non-parametric statistical procedures, such as Thiel Sen's slope estimator and MK trend test, were used to identify trends [32]. A linear model was used to assess community perceptions of climatic variables, categorized as "yes" or "no" over 30 years. The variables included stable seasonal rainfall, adequate rainfall amounts, reliable or unreliable onset of rainfall, reliable or unreliable cessation of rainfall, increasing temperature, and decreasing temperature.

3. RESULTS AND DISCUSSION

3.1 Climate Change and Variability Patterns, Awareness and Perceptions

3.1.1 Respondents' general awareness to climate change and variability

The study analyzed the awareness of changing climate in local communities using a Generalized Linear Model (GLM) (Figure 2a and 2b) and binomial logistic regression. The results showed that the best explanation for awareness was the combination of occupation and age. Agro-pastoralists, businesspeople, and crop farmers were found to be more aware than employed people and pastoralists (Estimate = -1.599 ± 0.752 SE, Z = -2.126, P = 0.034) (Fig. 2a). Age also increased awareness, but not significantly (Estimate = 0.051 ± 0.035, Z = 1.430, P = 0.153) (Fig. 2b). The study highlights the importance of understanding and addressing climate change awareness.

The study reveals that climate change awareness varies by occupation, with vulnerable

groups, such as crop farmers and agro-pastoralists, being more aware of the impacts of climate change. Vulnerable communities to impacts of climate change are more aware of it than those whose are less vulnerable [33].

Similar study found that pastoralists in Northern Tanzania have low awareness of climate change trends, possibly due to their migration and reliance on crop farming [34]. Other study findings indicate that while elders have a higher awareness of climate change, age is not a significant factor [35], suggesting under-representation of pastoralists' perspectives in their area.

3.1.2 Respondents' perceptions of climate change and variability

Findings from the household interviews and focus group discussions correlated with the results from the key informants' interviews. Results from a GLM with binomial error distribution indicated a significant decrease of trend of stable rainfall seasons (estimate = -0.046 ± 0.007 SE, Z = -6.706, P < 0.01), adequate rainfall (estimate = -0.096 ± 0.087, Z = -10.90, P < 0.01), reliable cessation of rainfall (estimate = -0.011 ± 0.009, Z = -1.212, P = 0.226), and decreasing temperature (estimate = -0.061 ± 0.008, Z = -8.160, P <0.01) over the past 30 years. Reliable onset of rainfall decreased insignificantly (estimate = -0.004 ± 0.007, Z = -0.620, P = 0.535). Similarly, there was significant increase of trend of unreliable onset rainfall (estimate = 0.139 ± 0.014, Z = 10.07, P < 0.01), unreliable cessation of rainfalls (estimate = 0.124 ± 0.012, Z = 10.41, P < 0.01), and increasing temperature (estimate = 0.061 ± 0.007, Z = 8.544, P < 0.01).

Based on the above findings, the study reveal that reduced rainfall and/or unreliability of rainfall patterns can alter vegetation, water availability and wildlife distribution, impacting tourist attractions. Unpredictable rainfall can cause flooding, erosion, and road damage, hindering tourism development and limiting visitor accessibility within the destination. Unstable rainfall patterns can have profound implications for tourism development, affecting various aspects of the industry from accessibility to the overall visitor experience such as natural attractions and tourists' satisfaction. To maintain attractiveness and adapt promotional strategies, destinations should diversify activities and offer indoor and cultural experiences, ensuring steady visitor flow and enhancing tourism industry resilience.

Sustainable tourism practices are crucial for mitigating environmental challenges like water scarcity, habitat changes and ecosystem disruptions. Prioritizing sustainability involves raising awareness, implementing responsible practices, and engaging local communities, thereby enhancing resilience to climate variability and preserving ecosystems.

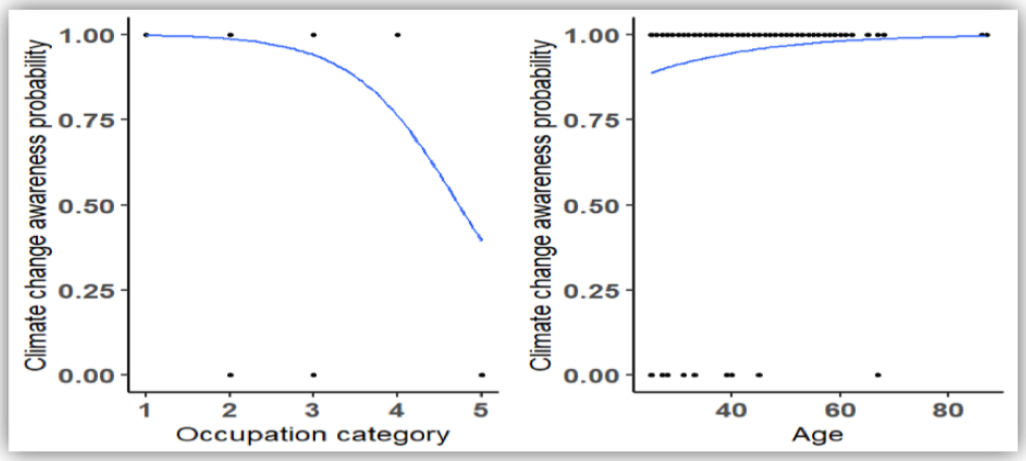

Fig. 2. Local communities' awareness level over the changing climate for the past 30 years as explained by respondent occupation (a) and age (b). (Occupation categories; "1" indicates agro-pastoralists, "2" indicates businessmen, "3" indicates crop farmers, "4" indicates employed people, and "5" indicates pastoralists)

Source: Field survey data, (2021)

3.1.3 Annual rainfall trends for the period 1980s-2018

The study found no significant difference in annual rainfall between 1989 and 2018, but extreme rainfall occurred in 2009 and 2015-2018 in RGRs (LM, $F_{(1, 28)} = 3.516$, $P = 0.06$) (Fig. 3a) and RUNAPA (LM, $F_{(1, 28)} = 1.148$, $P = 0.293$) (Fig. 3b), indicating similar patterns of extreme rainfall, has an implication on the large-scale effects on landscapes.

Similar study found a significant decreasing trend in rainfall from 1975-2017 in the Usangu plains [36], while RUNAPA experienced extreme rainfall during 2009-2018 similar to RGRs as confirmed through analysis of rainfall percentage difference (Fig. 4). The difference can be attributed to the Ruaha ecosystem experiencing low rainfall and increased extreme events, which are generally considered increased rainfall.

The rainfall percentage differences between two parks, RGRs and RUNAPA, over the past 30 years. Results showed a significant increase in rainfall from 2009 to 2009, with RGRs receiving 148.8% more rainfall than 1986, and RUNAPA experiencing a 116.6% increase (Fig. 4).

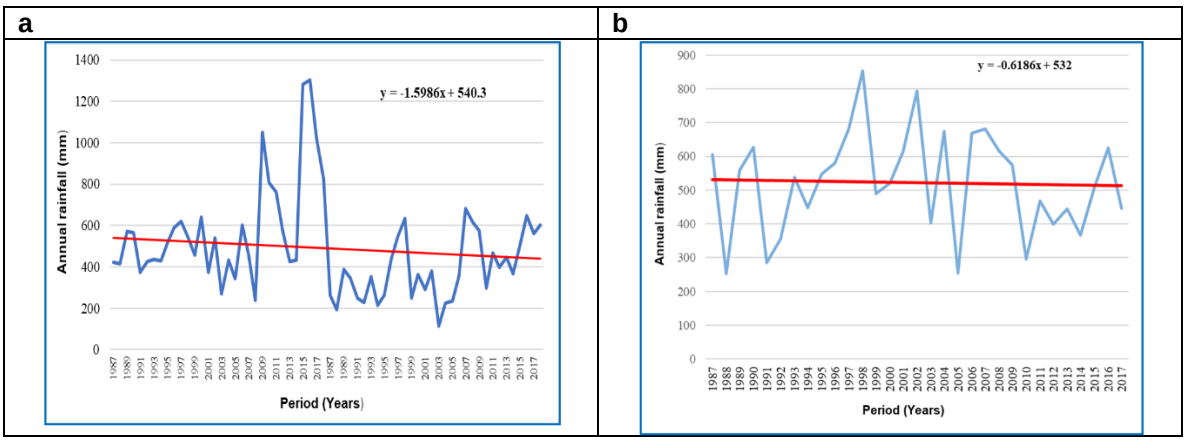

Fig. 3. Annual rainfall trends in RRL; a) RGRs from the 1980s-2018 and b) RUNAPA from the 1980s-2018

Source: Field survey data, (2021)

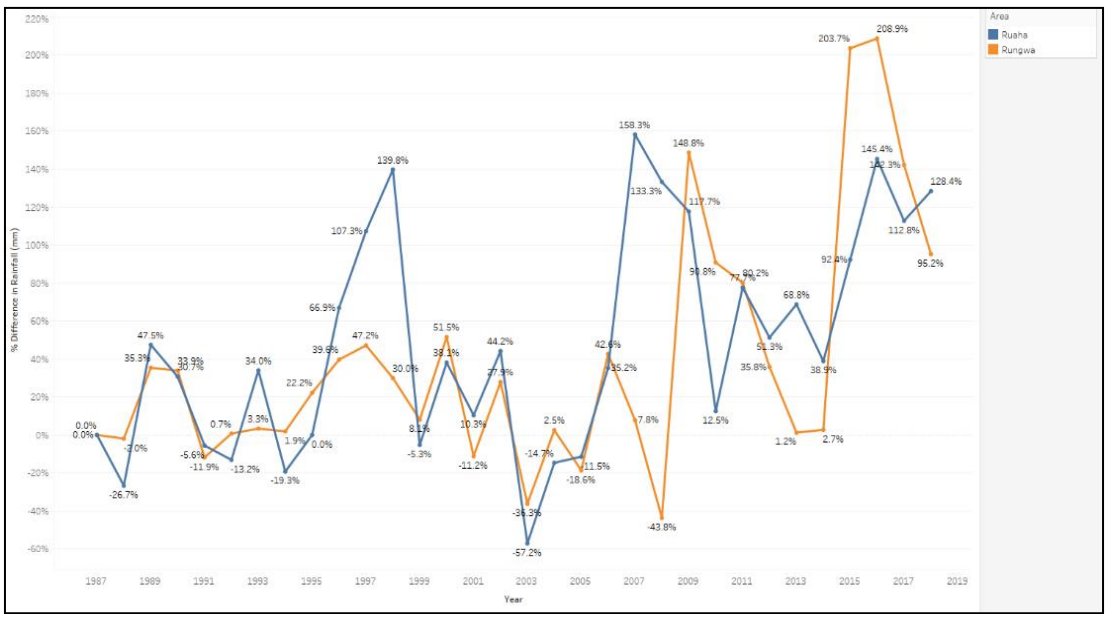

Fig. 4 Percentage difference of rainfall received in RUNAPA and RGRs, 1980s-2018

Source: *Field Data Collection, (2021)*

3.1.4 Annual temperature trends from the 1980s-2018

The study findings Fig. 5 (a and b) shows a statistically insignificant increase in annual temperature trends in RGRs from 1989 to 2018 (LM, F (1, 28) = 1.881, P = 0.181), with a significant decrease from 1999 to 2008 (LM, F (1, 8) = 6.792, P = 0.031) and insignificant increase from 2009 to 2018 (LM, F (1, 8) = 2.287, P = 0.169) (Fig. 5a).

These findings indicate that temperature trends in Southern Circuit of Tanzania do not show a significant increase, highlighting the need for ongoing monitoring and conservation efforts. The stability suggests resilience in ecosystems, possibly due to vegetation cover and land use practices. Authorities may need to adjust management strategies by assessing other environmental stressors or anthropogenic factors that may still pose significant challenges that might require attention.

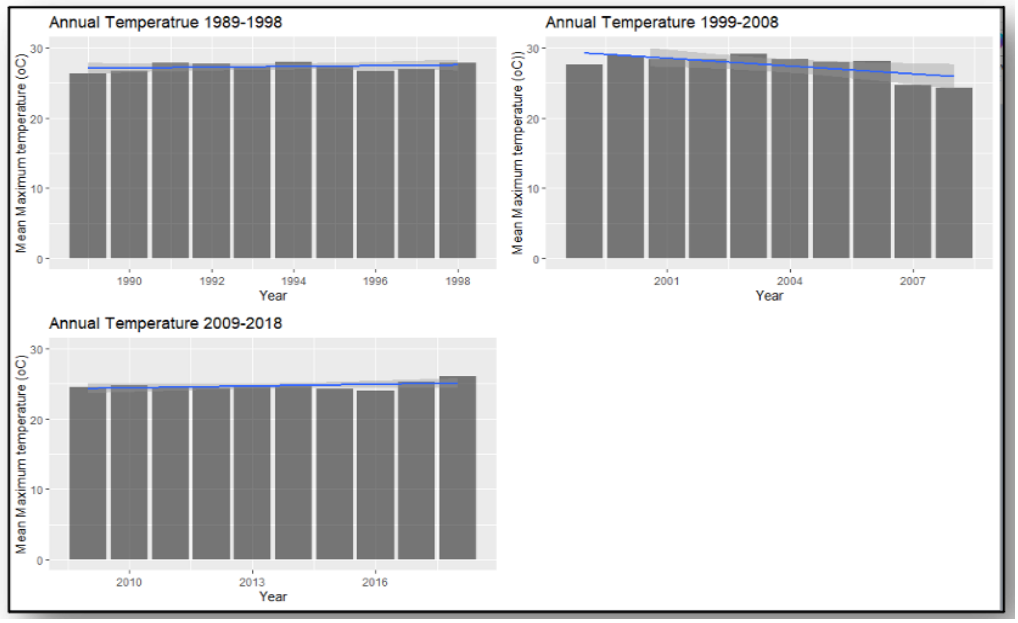

Fig. 5a. Annual temperature trends in RGRs from the 1980s-2018
Source: Field survey data, (2021)

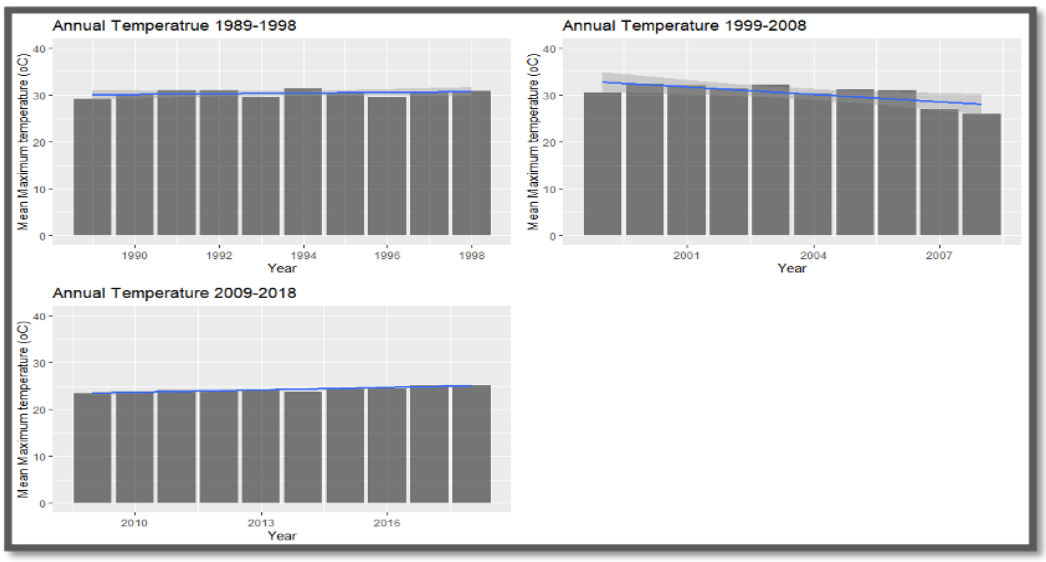

Fig. 5b. Annual temperature trends in RUNAPA from the 1980s-2018
Source: Field survey data, (2021)

RUNAPA experienced a substantial reduction in annual temperature from 1989 to 2018 (LM, F (1, 28) = 2.734, P = 0.109), followed by an insignificant increase from 1989 to 1998 and a significant decrease (LM, F (1, 8) = 0.764, P = 0.408) from 1999 to 2008. In contrast, there was a notable rise in temperature over the previous 20 years from 2009 to 2018 (LM, F (1, 8) = 34.74, P = 0.0004) (Fig. 5b).

Temperature increase in Tanzania's Southern Circuit, particularly in RUNAPA, has disrupted wildlife species' habitats and ecosystems, potentially causing biodiversity decline. This necessitates reassessing conservation strategies and prioritizing habitat restoration and connectivity initiatives. The escalating temperatures also exacerbate human-wildlife conflicts, driven by illegal activities like poaching, fishing, and livestock keeping during climatic extremes.

Reports of comparable findings in Iringa saw temperature rises between 1980 and 2009 [37], The IPCC predicts a 2-4°C increase by the end of the century, however other study findings indicated that forecast 1.4°C by 2030, 1.7°C by 2050, and 1.6°C by 2080 under the low emissions scenario RCP2.6 [38].

Findings from key informant interview revealed that extreme hot days, especially between August and December, are causing tourists to change game viewing schedules and break during the day, impacting wildlife sightings. RUNAPA and RGRs have experienced significant temperature rises over the past 30 years, with the largest increase in 2016 and the lowest in 2000 (Fig. 6).

3.2 Implication of Climate Change on Tourism Development in Southern Circuit of Tanzania

3.2.1 Decreased revenue collection

The study found that Tanzania's Southern Circuit has a decline in tourism revenue due to climate change. Wetter months bring in low revenues than dry ones for RUNAPA and RGRs (Fig. 7A, B & C). RGRs unpredictability in rainfall results in increased revenue during the dry months. Increased precipitation trends and extreme events in RUNAPA results in obstacles to accessibility, challenges in wildlife sighting, and early closing of accommodation facilities subsequently impeding tourism activities as well as revenue accrued.

Despite periods of drought and unreliable rainfall, the study indicated that RUNAPA's revenue increased (Fig. 7D, 7E & 7F). This growth was ascribed to Park Management's efforts in building infrastructure, marketing, and revenue control measures. But climate change and rising rainfall have an adverse effect on tourism attractions, resulting in fewer visitors and revenue collected [11,13].

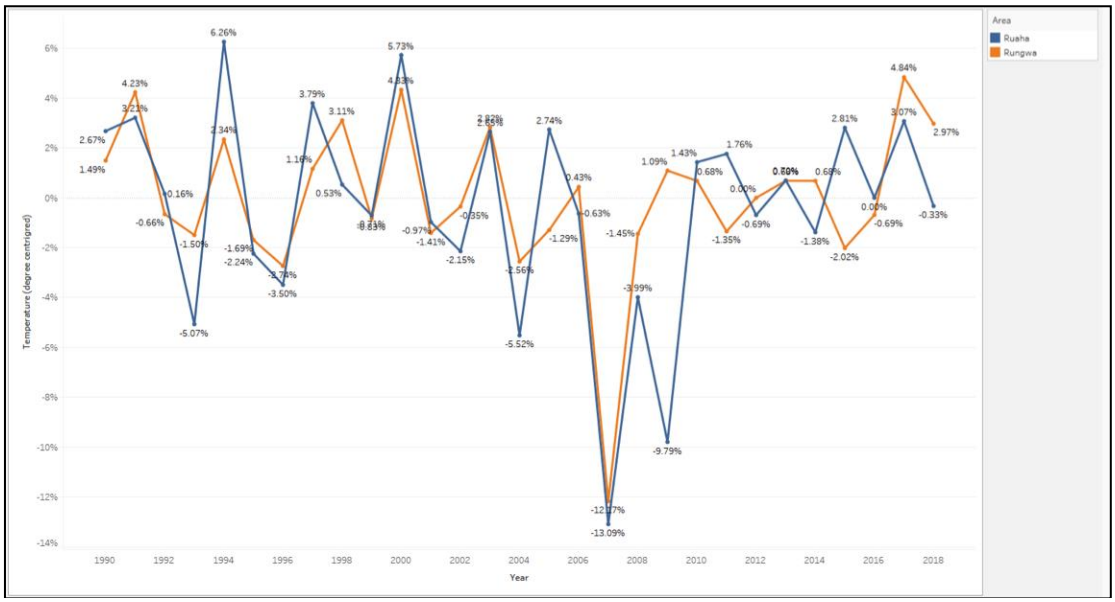

Fig. 6. Percentage difference of temperature in RUNAPA and RGRs, 1980s-2018
Source: *Field Data Collection, (2021)*

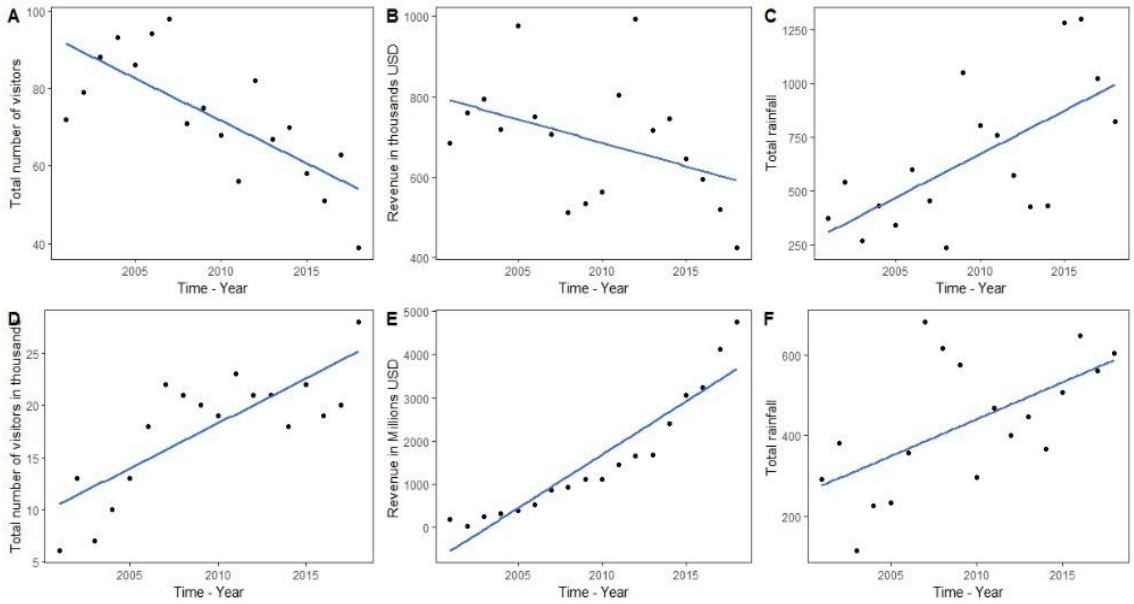

Fig. 7. Trend of total number of visitors, revenues collected in relation to total rainfall received in Ruaha-Rungwa landscape for the period 2000-2018 (Fig. 7A, 7B and 7C in RKM). "A" indicates total number of visitors; "B" revenue collected; "C" total rainfall (Fig. 7D, 7E and 7F in RUNAPA) "D" indicates total number of visitors; "E" revenue collected; "F" indicates total rainfalls

Source: RGRs & RUNAPA, (2020) [48 & 49]

3.2.2 Disruption of tourism seasonality

The study examined the correlation between rainfall seasonal variations and tourism seasonality in Ruaha National Park from 2001 to 2018. Results showed a significant negative but weak relationship between rainfall and tourist numbers (r=-0.342, p=0.165) while a similar correlation was found between rainfall and tourism revenue (r=0.231, p=0.356) (Fig. 9D, 9E & 9F). Ruaha National Park's longer dry seasons (spanning to 8 months) offer potential for tourism development and revenue generation, benefiting both the park and local businesses reliant on tourism activities. The study reveals a weak correlation between rainfall and tourist numbers, suggesting that as rainfall decreases during the dry season, there is a slight increase in tourist activities. This could be due to better wildlife viewing and good accessibility. Additionally, revenue from tourism activities tends to increase during drier periods.

The findings imply that park management strategies should be adjusted to optimize visitor experience during dry seasons. This includes enhancing infrastructure, improving wildlife viewing facilities, and ensuring water availability. However, sustainable tourism practices should also be emphasized to minimize negative impacts on the park's ecosystems and wildlife. Balancing economic gains and environmental conservation is crucial for the long-term sustainability of RUNAPA.

The study found a negative correlation between rainfall and tourism in RGRs over 18 years, with increased rainfall reducing the number of tourists (r =-0.595, P=0.009) (see Fig. 7 A and C). This suggests that heavy rainfall limits wildlife attractions' accessibility, affecting infrastructure, terrain, and overall safety in the area. The reserve's accessibility is hindered by soil saturation, muddy roads, and hazardous barriers like swollen rivers and flooded crossings.

A key implication of heavy rainfall can lead to vegetation growth, causing dense vegetation cover and obstructing visibility, especially for wildlife-viewing tourists. This affects safari experiences and photographic tourism, affecting aesthetics and opportunities. Hunting tourism also faces challenges due to reduced visibility, affecting the success of expeditions. Adaptive management strategies, seasonal planning, and diversification of activities can help address these issues. Providing bird watching, educational programs, or nature-based

experiences during high rainfall periods could be potential solutions, promoting sustainable tourism practices while maintaining the integrity of the natural environment.

The negative correlation between tourism and economic growth could impact local communities, necessitating diversified economic strategies. Collaborative efforts between park authorities, local communities, and the tourism industry are crucial for sustainable development. Alternative income-generating activities like agriculture and small-scale industries could provide resilience against fluctuating tourism dynamics.

Climate conditions significantly impact Ruaha-Rungwa ecosystems' tourism, with dry months attracting high tourist numbers and wetter months have low tourist numbers due to dissatisfaction. Increased rainfall and shortened dry season have impacted tourism activities in the RGRs. RUNAPA's longer dry seasons and increased budgets for tourism infrastructure and promotion strategies have led to increased tourist visitation despite decreased tourist numbers due to cancellations and postponements.

The study highlights the impact of rainfall variability on Tanzania's RGRs region's tourism season, highlighting increased rainfall leading to reduced revenue and early closure of tourism-related businesses. The seasonality of tourism has been affected by climate change, resulting in unpredictable times for the wildebeest migration [11]. Despite Tanzanian Hunting Regulation allowing for year-round hunting, there have been few hunting operations in RGRs areas [39]. This has an effect on managing resources, especially protecting wildlife. Variations in seasonality can offer both advantages and disadvantages for outdoor leisure. For example, warmer months may attract older tourists or families with small children [40-43].

3.2.3 Destructions of infrastructure

This study observed from FGDs and interviews reveals climate-related challenges affecting tourism infrastructure in southern Tanzania PAs, including bridge destruction, river and dam overflows, settlement damage, hotel and lodge destruction, and increased inaccessibility. Heavy rains and floods damaged 10 bridges, 1 curvet, and 4 drifts during 2019/2020, destroying 20 bandas, three tented camps, and 5 ranger post houses (Fig. 8). RUNAPA's tourism infrastructure was destroyed by increased rainfall and extreme events, despite Tanzania National Parks (TANAPA) Authority efforts to allocate budgets for infrastructure development, with most bridges, drifts and culverts washed out.

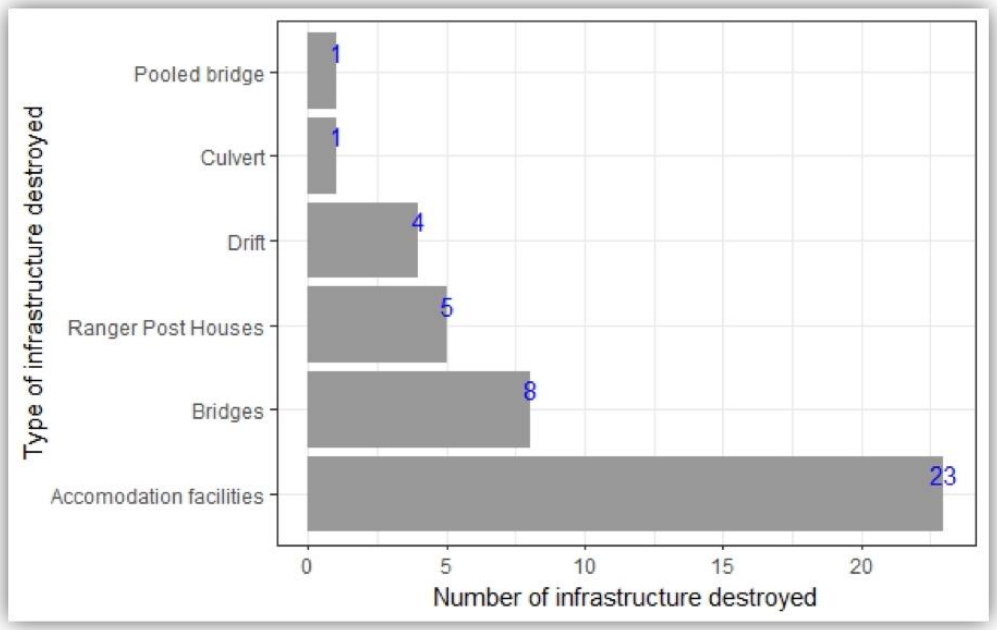

Fig. 8. Damaged infrastructures due to floods in 2019/2020
Source: Field Data Collection, (2020)

Adjacent communities and PAs management are unaware of the influence that climate change has on tourism development, despite the obstacles they face. Although few people are aware of the direct effects of climate change and variability on tourism, the majority of respondents think these factors have no direct consequences on tourism visitation as illustrated in Table 1.

The study reveals that communities primarily engaged in crop production, such as Mwamagembe (96.2%) and Rungwa (88.2%), believe climate change doesn't affect tourism activities. However, Kitisi (16.6%) and Tungamalenga (32.9%) villages, where households participate in tourism activities, believe heavy rains and flooding events have led to low participation in tourism activities due to damaged infrastructure. The destruction of a polled bridge and major drift at Mzombe river and Makwasa area have affected tourism performance and protection operations. Road networks have also been affected, leading to inaccessibility for more than 6 months and closure of hunting activities.

Heavy rainfall in 2019-2020 negatively impacted RUNAPA's infrastructure, including tourism-related and administrative facilities. Major effects included the destruction of roads, bridges, and flooding of old tourist facilities. The importance of tourist infrastructure is evident as it enhances service delivery and distribution, especially in isolated destinations. The park's annual budget and operations plan show that only 1/3 of the total area has been developed for tourism activities since its gazettement in 1964. The connection between tourism development and infrastructure is crucial, as infrastructure is less resilient to severe drought and floods.

The study emphasizes the need for climate resilience in park infrastructure development to reduce environmental stress and improve tourism. Similar study recommends proactive measures like maintenance schedule adjustments, bridge height increases, and improved natural drainage systems [44].

3.2.4 Eruption of wildlife diseases and decline of wildlife population

The study reveals that diseases, such as Anthrax and Giraffe Skin Disease, are causing biodiversity loss in the RUNAPA. In 2016, 64 hippos died from Anthrax where the bacteria Bacillus anthracis was the causative agent, while 5 giraffes died from Giraffe Skin Disease [45]. In 2019, 63 wild animals died due to Anthrax, mainly along the Great Ruaha River, during the peak dry season months of February, August and September (Fig. 9) [45].

Generally, this study found that rising temperatures in the RUNAPA have led to an outbreak of anthrax, likely due to prolonged dry periods, heavy rains, and flooding. Anthrax outbreaks are rare in both rainy and dry seasons [46]. The 2017 anthrax outbreak particularly in the month of February was likely triggered by the excessive drying of the great Ruaha River, which may have been flushed into aquatic systems like Jongomero and Nyamakifu dams. Increased irrigation agriculture, cattle grazing, and illegal fishing have also contributed to the spread of diseases and vectors, affecting wildlife.

Climate change triggers diseases outbreaks, but mechanisms are debated [47] may be facilitated by close grazing, nutritional stress, water hole congregation, and land use changes. Decreased animal species and wildlife mortality impact tourism experiences, with some activities suspended during dry seasons, including sport fishing.

Table 1. Perceived impacts of climate change on tourism expressed in percentage

Effect on tourism	Village				Total N=234
	Kitisi n = 24	Mwamagembe n = 52	Rungwa n = 76	Tungamalenga n = 82	
Tourists increased	58.3	0	0	12.2	10.3
Tourists decreased	0	0	6.6	0	2.1
No effect	0	96.2	88.2	48.8	67.1
Infrastructure destruction	16.7	0	3.9	32.9	14.5
Biodiversity decreased	25.0	3.8	1.3	6.1	6.0
Total	100	100	100	100	100

Source: Field Data Collection (2019)

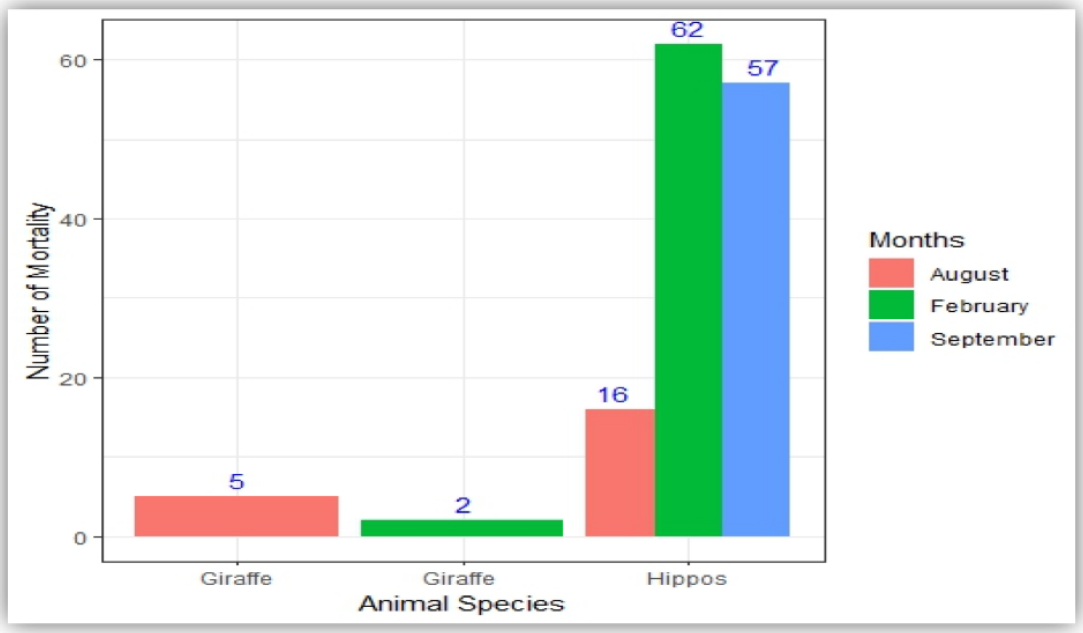

Fig. 9. Wildlife Mortality from 2017 – 2020
Source: Ruaha Veterinary Office (2021)

4. CONCLUSION

This paper explores the impact of climate change on tourism development in PAs in Southern Tanzania. It underscores the fact that tourism is a climate sensitive economic sector, with five key activities, including cultural tourism, beekeeping, hunting, photographic tourism, and sport fishing, which all contribute to community livelihood. Overall, the study's conclusions indicated that variations in weather patterns, in particular decreased precipitation, irregular rainfall patterns, the occurrence of extreme weather events, and an increasing trend in temperature, affect vegetation, water availability, and wildlife distribution, which in turn affects tourist attractions and the growth of the tourism industry as a whole. Tourism development in the Southern Circuit is adversely affected by climatic factors, resulting in low growth and economic contribution. Wildlife diseases, population decline, disruption of tourism seasonality, distruction of tourism infrastructures and revenue loss due to climate-related events constrain tourism performance. Furthermore, non-climatic factors, such as budget constraints, inadequate investments, poor infrastructure, and uncompetitive position, contribute to the underdevelopment of the tourism sector in the region. The paper calls for enhanced collaboration between stakeholders, Government, and local communities to implement sustainable practices, invest in resilient infrastructure, climate adaptive plans and foster conservation efforts to safeguard tourism future and protect fragile ecosystems. Overall, the enhancement of sustainability in tourism development within the context of a changing climate in the southern Circuit of Tanzania necessitates concerted efforts from the various conservation stakeholders. The impact of climate change on tourism development underscores the need for a comprehensive and proactive approach to mitigate observed consequences. Infrastructural development must adhere to the principles of resilience, incorporating designs that factor in flooding and extreme weather conditions. Further, community support would play a pivotal role in fostering climate resilience within the tourism sector. It is therefore imperative to enhance climate awareness among local communities regarding the potential impacts of climate change on tourism development. Simultaneously, promoting community participation in diversified livelihood options so as to reduce the vulnerability to climate change-induced disruptions. Lastly, establishing connectivity with other protected areas and enhancing ecosystem conservation efforts and tourism potentials in wildlife corridors and dispersal areas are essential components of a comprehensive strategy. The synergy between

protected areas and conservation initiatives would contribute to the protection of biodiversity as well as enhance the overall attractiveness of the region as a climate-smart tourism destination.

5. RECOMMENDATIONS FOR FURTHER RESEARCH

Assessment of comparative perspective of the southern circuit of Tanzania tourism destination competitiveness with other destinations in the country. Such a study will provide practical understanding of the destination and how it can sustainably survive in a competitive environment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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