



A Decade of Climate Change and Tourism Research in Tanzania: Where are we?

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ABSTRACT

Tourism is highly vulnerable to climate change impacts, yet many countries in the global South have the lowest capacity to adapt. Given the urgency of adapting tourism to climate change, this study brings to the fore the state-of-the-art on climate change and tourism research in Tanzania through a review of the literature published between 2014 and 2023, using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement 2020. The study is the first to comprehensively compile unsurpassed scholarly work on climate change and tourism covering the period between IPCC-AR5 and AR6. The assessment identified 85 publications, of which 16 addressed climate change and tourism. Of the 16 articles, 78 percent assessed impacts, 11 percent adaptations and 11 mitigations. The study exemplifies inadequacies in research on climate change and tourism linkages, builds a solid ground for research, and informs policymakers about the fate of tourism development in a data-scarce situation. With the vast land devoted exclusively to conservation and tourism, and numerous higher education institutions committed to research and consultancy, the assessment demonstrates that Tanzania's understanding of tourism in the face of climate change is insufficient. More adaptation and mitigation research are, therefore, pertinent.

Keywords: Tanzania -Climate Change - Tourism in Tanzania - Mitigation – Adaptation.

INTRODUCTION

Tourism is one of the fastest-growing sectors in the world and in 2019 alone, the sector generated 330 million jobs, which is approximately 10.3% of global employment and contributed 10.3% (US\$ 8.9 trillion) of the global Gross Domestic Product (GDP). Moreover, US\$1.8 trillion or 6.8% of total exports was realized from international visitor expenditures in 2019 (WTTC 2022). The role of tourism in emerging nations is undisputedly imperative. In Tanzania, for instance, tourism is an economic venture with a substantial contribution to the economy. Prior to the advent of COVID-19 in 2019, travel, and tourism contributed 10.6% of the GDP, 25% of the export earnings, and 5.3% of the total employed labour force (WTTC 2022). This contribution is, however, in jeopardy given that tourism is one of the six economic sectors heavily relying on nature for the production of over 80% of its goods and services (WTTC 2022), and because nature-based tourism is remarkably sensitive to the catastrophic effects of climate change (Bushesha 2018, Dube and Nhamo 2018, Dube and Nhamo 2019, Dube and Nhamo 2020, Dube *et al.* 2020, Kilungu 2019, Kilungu *et al.* 2017, Kilungu *et al.* 2019, Munishi *et al.* 2010). Consequently, in order to advance the industry towards sustainability, it is imperative to adopt climate-smart tourism. This can only be accomplished by creating informed adaptation and mitigation strategies.

Climate change refers to long-term shifts in temperatures and weather patterns. These changes have become equivocal as such



tourism stakeholders in the COP26, therefore, declared the urgent need of decarbonizing the sector, and it is projected that by the year 2050, net zero emissions should be reached (WTTC 2021). The urgency of adapting and mitigating climate change impacts on tourism is more evident than ever, as emphasized by the 2021 Intergovernmental Panel on Climate Change (WTTC 2021). The report further observes that the Travel and Tourism industry is not only affected by its impacts but is also a major emitter of greenhouse gas (GHG), thereby actively contributing to climate change. The Glasgow Declaration, therefore, requests signatories to make tangible commitments around measuring, regenerating, collaborating, financing and reporting climate action towards achieving the Paris Agreement which is likely uncertain in Africa. Hoogendoorn and Fitchett (2018) argue that despite Africa apparently having the lowest capacity for adaptation and projections of severe impacts of climate change on one tourism sector from rising global temperatures, changes in precipitation, and sea level rise, Africa generates noticeably limited research linking tourism to climate change in comparison to other countries (Latin America, Asia and Oceania) in the global South.

The forecasted net zero emission by 2050 requires strong mitigation and climate-smart adaptation strategies that are informed by comprehensive assessments and reporting on climate actions. According to the Intergovernmental Panel on Climate Change (IPCC) description, adaptation in human systems implies the process of adjusting to actual or expected climate change and its effects, to minimize harm or exploit beneficial opportunities therein. However, adaptation in the context of natural systems connotes the process of adjusting to the actual climate and its repercussions. In the case of tourism, both definitions apply since tourists need to adapt to the changing climate in terms of comfort and involvement in attractions, which are similarly expected to

adapt to changes. It is evident that Africa's capacity to adapt the tourism sector to the impact of climate change is uncertain due to a lack of comprehensive tourism-climate data coupled with inadequate research funding (Hoogendoorn and Fitchett 2018, IPCC-AFRICA 2022). In this study, tourism climate data refers to statistics (e.g., data on rainfall amount and tourist arrivals collected on the same dates, or number and types of attractions in a given destination, etc.) that can be directly integrated into tourism. For instance, studies on the number of tourists blocked to access certain destinations as owed to climate change in Africa is significantly lacking (Kilungu *et al.* 2017) and yet, the IPCC-AR6 report showed that mean temperatures, hot extremes, marine heat waves, and sea levels have considerably risen in Africa in the 21st Century (IPCC-AFRICA 2022). The observation published in this report is evidenced by the recent climate change repercussions experienced in East and Southern Africa, where Tanzania is located, as featured by decreased rainfall, high temperatures and increased pluvial flooding (Gebrechorkos *et al.* 2023, Mwabumba *et al.* 2022, USGS 2022). Comprehensive integration of these changes in tourism is key to devising adaptation and climate-smart mitigating strategies in the sector, although climate change-tourism research is inadequate in Africa (Bushesha 2018, Daly *et al.* 2022, Daly *et al.* 2015, Hoogendoorn and Fitchett 2018).

The main thrust of this study is to emphasize the significance of expanding research on the threats that climate change presents to tourism in Africa and to propose potential future research paths by utilizing Tanzania as a case study. The integration of such information will likely contribute to the creation of specific adaptation and mitigation strategies for the most vulnerable tourism economies. This pertinent data is lacking in Tanzania (Bushesha 2018) and hence, regional information, which is also incomprehensive is being utilized. For instance, in the AR6-Africa chapter,



information about observed impacts of climate change on species range shifts and phenology, the basis of nature-based tourism, is missing in both freshwater and terrestrial ecosystems (IPCC 2022). Species range shift information in tourism is likely informative to understanding the changes in destinations' appeal. Kilungu *et al.* (2017) studied the climate-driven change in wildebeest migration and its effects on Tanzanian and Kenyan tourism. The study concluded that the ongoing delayed March-June rainfall that distorts the wildebeest migratory patterns makes wildlife tourism a chaotic experience in the Serengeti National Park, for both tourists, accommodation owners and tour operators as they must incur extra costs in searching for the migration. On the other hand, changes in phenology (i.e., the study of life cycle events of living organisms on earth) are important in tourism as climate change may alter, for example, the plant phenology (e.g., flowering and leaf colouring season). Flowering, and or leaf colouring is a prerequisite for floristic tourism memorable experiences (Liu *et al.* 2019, Mosia *et al.* 2022, Wang *et al.* 2017, Zang *et al.* 2020).

The dire need for Tanzania to adapt and mitigate climate change impacts on tourism is emphasized in various government documents (e.g., Tanzania Development Vision 2025 and National Five-Year Development Plans 2021/22- 2025/26 (FYDP III). Nevertheless, inadequate climate-change tourism information (Bushesha 2018) is likely to jeopardize the national efforts to decarbonize the sector and contribute towards achieving the forecasted net zero emission by 2050. The knowledge gap is broad, as evidenced in various national and international reports. For instance, Tanzania ratified the United Nations Framework Convention on Climate Change in 1996 and the Paris Agreement in 2018. Article 4.2 of the Paris Agreement stipulates an obligation that requires “each Party to prepare, communicate and maintain successive nationally determined

contribution (NDC) that it intends to achieve”. The Tanzanian NDC 2021 page 9-11 detailed several adaptation and mitigation strategies for key economic sectors (agriculture, energy, and livestock). Unfortunately, tourism is inadequately presented. Lack of detailed climate-tourism adaptation and mitigation information persists in vital government documents such as the National Tourism Policy 1996, the Tourism Master Plan 2002, the National Adaptation Programmes of Action (NAPA) 2007, the Zanzibar Climate Change Strategy (2014), the National Five-year Development Plan 2021/2026, MKUKUTA II 2011, and the National Climate Change Response Strategy 2021-2026. All these documents lack a section devoted to detailing how the tourism sector will adapt or mitigate the impact of climate change.

Inadequate information on tourism in the face of climate change is likely attributable to fragmented climate change-tourism information and inadequate research or limited professionals in the area. Few, if any, climate-tourism impact studies have been conducted in Tanzania to bridge the knowledge gap. Bushesha (2018) attempted to collate tourism-climate change knowledge, and one of the key findings was that existing literature richly identifies the impact of climate change on the natural resources base however, it was not integrative enough to inform the tourism sector. The review, is nevertheless, systematic as it did not indicate (i) the timeframe of the review, (ii) how many studies were covered, and (iii) what was covered in terms of impacts, adaptation, and mitigation.

A comprehensive literature review will aid in improving and linking the three knowledge gaps simultaneously. The systematic and detailed analysis to cater from IPCC-AR5 to AR6 is likely to provide detailed literature on climate-tourism developments in terms of impacts, adaptation, and mitigations in Tanzania. Such data is vital for mainstreaming climate-smart adaptation and



mitigation measures to achieve the projected Net Zero emission by 2050. Such data will also comprehensively inform decision-makers and the community, since Tanzania has secluded over a quarter of her land area for conservation and tourism (URT 2009, p. 7), amidst a situation where the adverse impact of climate change on tourism is apparent.

This study, therefore, aimed to systematically review the available literature for the past decade (between 2014 and 2023) and to document all studies on climate-change impacts, adaptation, and mitigation measures tailored to tourism in Tanzania. This was achieved by collating the literature on climate impacts addressed, attractions and activities considered, the geographic area covered, and key findings and conclusions drawn. The recent decade (2014 -2023)

represents an important climate-change research timeframe where the IPCC reporting system has appreciated high climate research in the world and it is the time when many countries started to submit their NDC, and Tanzania had submitted the first NDC in 2015 and the most recent in 2021.

METHODOLOGY

The current study focuses on Tanzania, a country in Sub-Saharan Africa with a vast population of 61 million inhabitants (URT 2022). Figure 1 exemplifies the study area showing its location in Africa map and its enormous tourist attractions including wildlife, coral reef, clean beaches, and snow in the tropic.

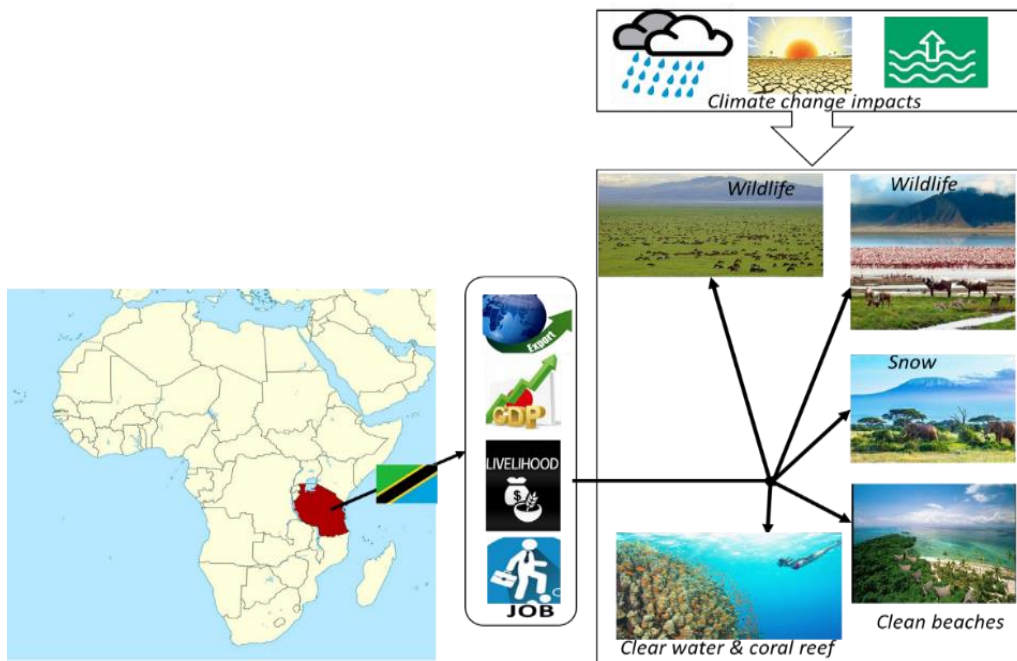


Figure 1: A Map of Africa highlighting Tanzania (red inset) and how its economy highly depends on climate-sensitive tourist attractions (i.e., wildlife, snow, and water).

The study employed the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 statement to cover publications between IPCC 2014 (AR5) and 2022 (AR6). The PRISMA approach aids in systemically reviewing and transparently reporting the justification for a review, and its findings (c.f. Page *et al.* 2021). The

review commenced with a search for keywords including: ‘*climate change and tourism in Tanzania*’. Five scholarly search engines (i.e., Google Scholar, Web of Science, ScienceDirect, Emerald Insights, and Scopus) were used. Unpublished reports were excluded in this review as it was tasking to collate. Publications in print format



journals also met the exclusion criteria in the review as they were considered out of scope in the digital era and mass dissemination of research findings. Using the search engines, keywords were typed in, and the timeframe filter was set between 2014 and 2023. Duplicates were eliminated through data cleaning thus, although a total of 85 articles were retrieved, 69 articles were eliminated owing to four main reasons; (i) some articles addressed climate change without a direct link to tourism. In these articles, climate change covered many other sectors, and tourism was vaguely mentioned. (ii) some

articles' scope was too general, in most cases, the articles covered either the whole of Africa, Sub-Saharan Africa or other East African countries except Tanzania. (iii) other articles explored all economic sectors even though the focus was Tanzania. (iv) some articles covered developed nations like Canada and Europe with some vague mention of Tanzania. Therefore, 16 publications met the inclusion criteria for this study and were grouped into three themes: impacts, adaptation, and mitigation by reviewing either their abstracts or entire article (Figure 2 and Appendix 1).

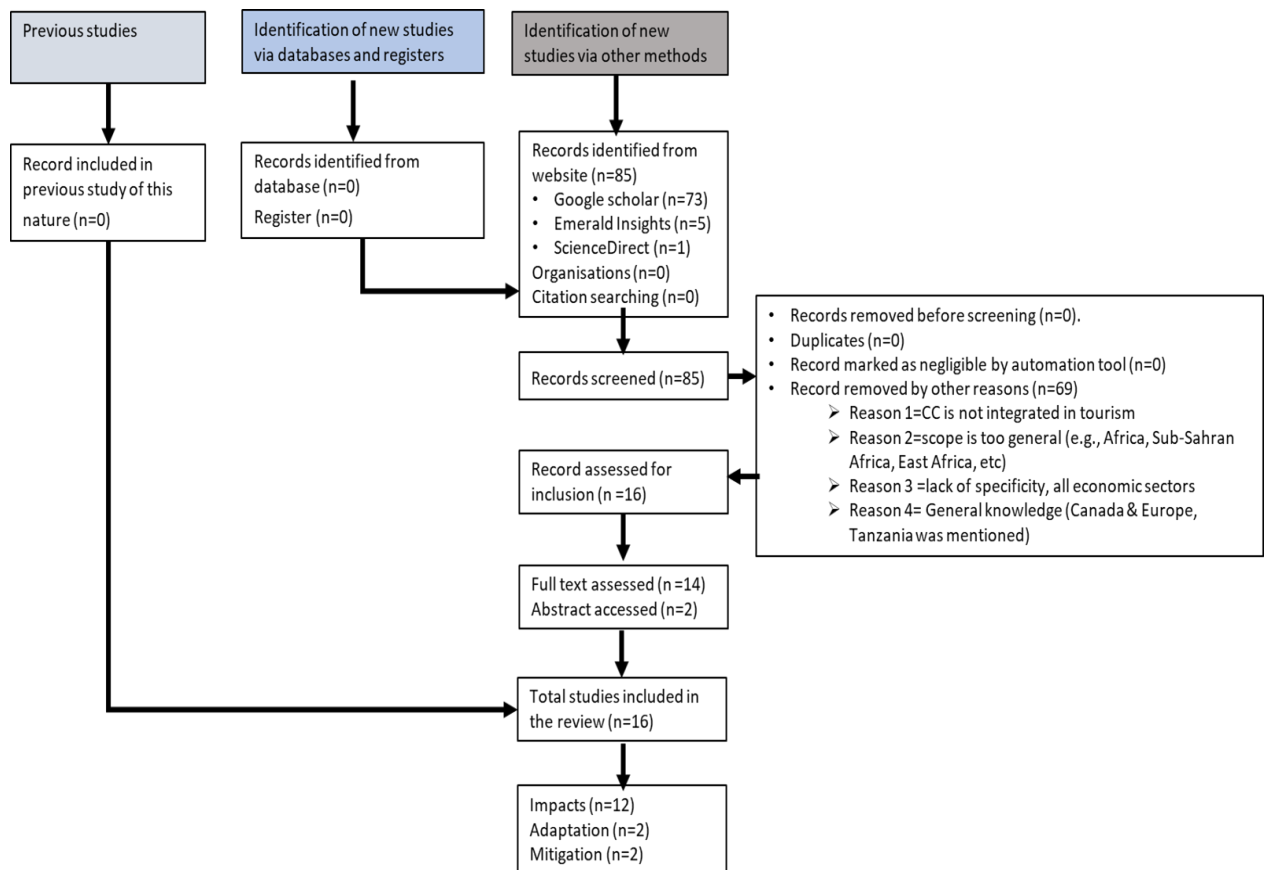


Figure 2: The PRISMA 2020 statement as applied in this study.

This approach is comprehensive yet systemic as it provides insights in a tabular form into why the previous studies were conducted, their findings, and conclusions drawn to inform the scientific arena and policymakers on the knowledge gap regarding climate change and tourism. It also summarises the case studies covered, type of climate change impacts assessed and tourism resources

considered. This unsurpassed information is likely to aid a country to define its research trajectory, and in formulating practical adaptation and mitigation strategies and mainstreaming climate change in tourism across relevant national policies.



RESULTS

The review identified only 16 articles that integrated climate change with tourism and of these, 12 (78%) assessed impacts, 11 percent addressed adaptations, and 11 percent focused on mitigation issues (Figure 3).

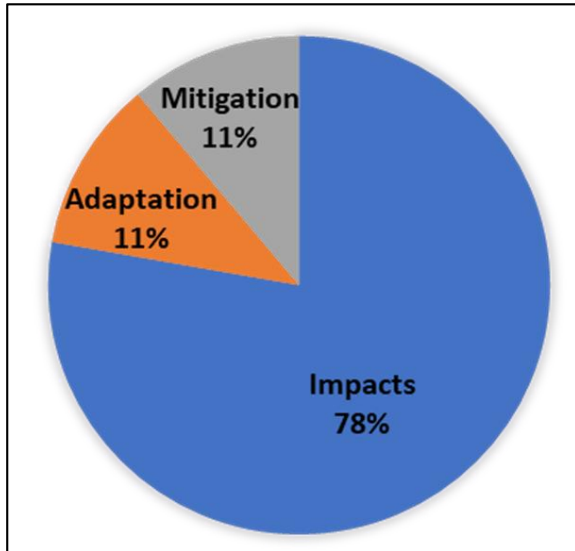


Figure 3 Percentage distribution of climate change-tourism research coverage in Tanzania from 2014 to 2023

Table 1 summarizes the 12 publications that assessed impacts and further details the rationale for each research, the nature of attractions covered, the type of climate change impacts, where the study was conducted, key findings, conclusions, and a synthesis of the research gap. Out of the 12 impact assessment publications, the majority (53%) focused on terrestrial attractions (e.g., wildlife, glacier) and tourism activities (e.g., wildlife viewing and trekking). The remaining percentage covered marine tourism and its attractions (coral reef and fish) and Maasai culture as an attraction. Key

climate-change impacts assessed were sea-level rise, increased water temperature, extreme temperature, changes in rainfall patterns and amount, and droughts. The impacts of these changes on tourism were coral reef bleaching that affected snorkelling in marine tourism; changes in rainfall amount and patterns, droughts, and land cover that affected wildlife tourism; extreme temperature that likely eased trekking but negatively impacted sightseeing for mountain tourism due to loss of wildlife habitats and change in the phenology of flowering plants.

Furthermore, Table 2 shows that two publications were found to focus on climate change adaptation in Tanzania for the past ten years. Of these articles, one developed a Wildlife Tourism Climate Change Adaptation Framework (WTCCAF) and reviewed reviewing existing climate change adaptation frameworks for tourism in general by using the Ngorongoro Conservation Area as a model. The second article provided an overview of the literature on the adaptation strategies of tourism sectors and participants in African countries.

Research that focuses on climate mitigation for tourism sector was found to be scarce despite its importance. The review identified two publications (Table 3). Of these publications, one assessed key interventions that the Tanzanian tourism sector had put into practice so far. These were finance, political will (i.e., government), and local community willingness and technical experts. The second publication provided a brief overview of climate change governance in Tanzania, focusing on challenges and opportunities.



Table 1: Publications on impacts of climate change on tourism in Tanzania between 2014 and 2023.

SN	Authors [year]	Title	Tourism resources covered	CC impact covered	Geographic area	Methods of assessment	Key findings	Key conclusions	Gap
1	Dimopoulos, Dimitri; Queiros, Dorothy; van Zyl, Ciné; [2022]	Exploring Indirect Environmental Risks That Impact Coral Reef Tourism in the East African Marine Ecoregion	Coral Reef Tourism	Climate change, industrialization of coastal regions, increased shipping and boating activities, as well as marine and land-based pollution	East Africa marine eco-region- Kenya, Tanzania, Mozambique , and South Africa	Perception of 34 dive operators from Kenya, Tanzania, Mozambique, and South Africa	CC-extreme weather events, coastal development, and industrialization along the coast have been attributed to marine pollution & coral bleaching	The continued environmental disturbances will impact the tourism business in future	How much the impact affected the number of tourist arrivals or loss of revenue is not covered. No quantitative assessments of coral reef degradation to justify the conclusions. Tourists, the key user of the service were excluded. CC was taken in general no specific impacts were addressed
2	Lwoga, Noel Biseko; Asubisye, Edwin; [2018]	Effects of drought on cultural tourism: selected cases of Maasai tourism groups surrounding Tarangire National Park in Tanzania	Maasai culture- Cultural tourism	Drought	Maasai adjacent to Tarangire NP	Semi-structured interviews and observations were used for 30 Maasai women and 30 tourists	Intermittent climate induced Drought interferes with the development and delivery of tourist products, thus destroying their quality of life and service delivery	Drought affects key livelihood options: tourism	No mention of the number of cultural tourism products affected, thus could not tell how severe the impact is to quantitatively inform immediate adaptation and mitigation measures
3	Bushesha, Magreth; [2018]	Climate Change and Tourism in Tanzania: Identifying the Gaps	General tourism resources	Not specific	Tanzania	Literature review	The literature richly details the impact of climate change on natural resources base, in relevance to tourism	The impacts are not integrated into tourism, thus difficult to analyze the actual impact on the operations and performance of the tourism sector.	The study did not show specific literature review methods used and how many articles were covered. It is thus not systematic; it is hard to conclude on its comprehensiveness and representative for the presented knowledge gap
4	Yong, Enn Lun; [2021]	Understanding the economic impacts of sea-level rise on tourism prosperity: Conceptualization and panel data evidence	Coral reef	Sea Level rise	Data from 48 countries (incl Tanzania) in three continents (Africa, Asia, and South America)	Panel data regression based on the proposed climate impacts from 2001 to 2100	Sea-level rise has severe effects on tourism	Adaptation measures must be in place to mitigate rising sea levels and their attributed effects	The study is too general to inform Tanzania's adaptation strategies.
5	Kilungu, H; Leemans, R.; Munishi, P.K.T; Amelung, B.; [2017]	Climate change threatens major tourist attractions and tourism in Serengeti National Park, Tanzania	Wildlife	Droughts, changes in rainfall amount and patterns, changes in land-cover	Local destination: Serengeti National Park	Inferential statistics, land cover data	Increasing rainfall and temperature variability, and associated land-cover change include disruption of tourism seasonality, wildebeest migration patterns, and reduced diversity of tourist	Adapting tourism to climate-change impacts requires active and integrated management approaches that improve the park's attractiveness by	The study also did not tell if the impacts had reduced the number of tourists already or if the attractiveness has been reduced already and by how much to inform specific adaptation /mitigation measures.



SN	Authors [year]	Title	Tourism resources covered	CC impact covered	Geographic area	Methods of assessment	Key findings	Key conclusions	Gap
							attractions. Both negatively affect tourism by reducing park's attractiveness	maintaining habitat integrity.	
6	Daly, Meaghan E; Yanda, Pius Z; West, Jennifer Joy; [2015]	Climate change policy inventory and analysis for Tanzania	General policy - CC does not cover tourism	CC awareness in Tanzania	Tanzania	Policy analysis. Fifteen (15) key policy documents relevant to economic development, climate change and environment, agriculture and food security, disaster management and risk reduction, and health planning were analyzed	CC is addressed in several policy documents, nevertheless, the concept of climate services did not feature. CC awareness has increased	The analysis highlighted efforts to manage short and long-term climate risks	The assessment did not cover issues specific and related to tourism policy directly, though a policy that safeguards natural resource base for tourism was assessed
7	Kilungu, Halima; Pantaleo, Munishi; Leemans, Rik; Amelung, Bas; [2014]	Wildlife safari tourist destinations in Tanzania: Experiences from colonial to post-colonial era	Tourism resources	Sea level rise, drought, changes in rainfall amount and patterns, and increased temperature	Tanzania	Literature review	CC affects tourism in Tanzania as droughts kill wildlife: the very attractions. Has there been a significant change in the types of tourism over time driven by conservation obligations and aspirations?	No solid conclusion regarding climate change and tourism	CC is not comprehensively covered. The literature review was not systematic; no starting or ending date
8	Kilungu, H; Leemans, R., Munishi, P.K.T.; Nicholls, S.; Amelung, B.; [2019]	Forty years of climate and land-cover change and its effects on tourism resources in Kilimanjaro National Park	Wildlife tourism resources and hiking tourism activities	Effects of observed changes in rainfall, temperature, and land cover on the physical and sightseeing aspects of trekking in Kilimanjaro National Park	Kilimanjaro National Park	Hazard Activity Pairs	-Higher temperatures and reduced rainfall have lowered the risks of landslides, rock fall, and mountain sickness, improving physical trekking conditions. -Changes in land cover have affected sightseeing: currently, there are more flowers and groundsels to admire and less wildlife, waterfalls, and snow	In the short term, the disappearing snow may give rise to "last chance tourism", increasing visitation, but eventually, the loss of snow and forest cover will likely decrease the number of tourists	What attractions/ features will take over to enhance tourism on the mountain after the disappearance of snow
9	McGaurr, L and Lester, L, edited by Peter Lang Inc, B Brevini and J Lewis (ed)	See it before it's too late? Last-chance travel lists and climate change	Mount K'njaro mentioned	Loss of glacier	The ice-capped peak of Mount Kilimanjaro in Tanzania, the glaciers	Literature review	Many last-chance destinations and experiences are threatened by climate change—polar bear viewing in Canada, the ice-capped peak of Mount	The concept of last-chance tourism is used to lure visitation but not to cover issues related to CC. For instance, a 2015 survey of visitors to the Great	The concept does not necessarily explain CC impacts but rather may increase the effect through tourism's carbon footprint.



SN	Authors [year]	Title	Tourism resources covered	CC impact covered	Geographic area	Methods of assessment	Key findings	Key conclusions	Gap
	[2018]				of Greenland, and Australia's Great Barrier Reef		Kilimanjaro in Tanzania, the glaciers of Greenland and Australia's Great Barrier Reef are all at risk.	Barrier Reef found that most had developed their perceptions of it from the media, and nearly 70% were motivated to see the Reef before it was too late	
10	Minja, Gileard S; [2015]	Ecological and Socio-Economic Implication of Climate Change and Variability on Tourism in Kilimanjaro Mountain National Park, Tanzania	Mt Kilimanjaro	CC- in general	Mount Kilimanjaro and adjacent communities	Focus Group Discussions (FGD), key informants, and timeline	CC and variability affect socio-economic and ecological resources in diverse ways	General conclusions, Education, capacity building, soft loans, and grants were adaptation strategies adopted	The study is too general covering everything. CC&V concepts mixed.
11	Kilungu H. [2019]	Effects of Changes in Climate and Land Cover on Tanzanian Nature-Based Tourism in National Parks: How Are Tourist Attractions Affected?	Wildlife and wildlife viewing	Changes in rainfall amount and patterns, increased temperature, drought, fire, snow melts, and land cover change	Tanzania	Literature review, Hazard activity pairs, inferential statistics, and eco-parcel approach	In Tanzania, some environmental impact assessments are available, but these do cover neither NBT nor specific attractions and destinations	the impact of environmental change not only changes the types and distributions of tourist attractions but also, interfere with tourists' comfort and safety	
12	Mkiramweni, NP; DeLacy, T.; Jiang, M.; Chiwanga, F. [2016]	Climate change risks on protected areas ecotourism: shocks and stressors perspectives in Ngorongoro Conservation Area, Tanzania	Tourism resources-wildlife	Identifying climate-related shocks and stressors and implied effects on ecotourism	Ngorongoro Conservation area	Focus group discussions and Semi-structured Interviews	Recurrent droughts, political unrest in a neighboring country, global terrorism, and disease outbreaks have been the key shocks. Others: water shortages, vegetation change, biodiversity loss, and recurrent livestock and human diseases are key stressors	The study provided a ground for conducting an in-depth vulnerability assessment and developing adaptation strategies for ecotourism.	General impacts assessed but not specific to tourism



Table 2: Publications on adaptation to climate change by Tanzania’s tourism between 2014 and 2023

SN	Authors [Year]	Title	Tourism resources covered	CC impact covered	Geographic area	Methods of assessment	Key findings	Key conclusions	Gap
1	Mkiramweni, N [2014]	Sustainable wildlife tourism in the context of climate change: The case study of Ngorongoro conservation area, Tanzania	Wildlife tourism	Adaptation	Ngorongoro Conservation Area (NCA)	Wildlife Tourism Climate Change Adaptation Framework (WTCCAF) - reviewing existing climate change adaptation frameworks for tourism more generally -To test a newly developed framework in the field	The framework provides wildlife tourism managers with a supplementary tool for managing nature resources and wildlife tourism, especially in the context of climate change	No concrete conclusion made	The study reviewed adaptation strategies in general, but it did not explain how many adaptation strategies have been put in place in Tanzania as some are specific to area and time
2	Hoogendoorn, Gijssbert; Fitchett, Jennifer M; [2018]	Tourism and climate change: A review of threats and adaptation strategies for Africa	Policies	Adaptation	Africa	Literature review on the adaptation strategies of tourism sectors and participants in African countries.	A need to upsurge research into the threats of climate change to tourism in African countries, and identify future research trajectories	The development of such knowledge would assist in the development of adaptation and mitigation strategies for these most vulnerable tourism economies	Given the fact that tourist attractions differ in spatial and temporal scale, the study did not identify specific adaptations for specific destinations

Table 3: Publications on mitigation to climate change by Tanzania’s tourism between 2014 and 2023.

SN	Authors [Year]	Title	Tourism resources covered	CC Mitigation covered	Geographic area	Methods of assessment	Key findings	Key conclusions	Gap
1	Thani <i>et al.</i> ; [2018]	Climate change and tourism in Zanzibar: interrogating Impacts and interventions	Marine	Coastal management	Zanzibar	Interview (16 key informants from government ministries and institutions and 34 interviews with NGOs and CBOs.	Key interventions are monetary/finance, government, and local community willingness and technical experts.	Increased collaboration between government, private sector, and community is a key intervention to adapt tourism to climate change impacts	Types and extent of the mitigation implemented so far are not explicitly covered. Effectiveness of mitigation actions if any not presented
2	Nachmany, Michal; [2018]	Policy brief Climate change governance in Tanzania: challenges and opportunities	Nil	Climate change knowledge	Tanzania	Review of policies	Climate change is not high on Tanzania’s development agenda	Climate governance would be strengthened by the improved coordination, information flows and resource allocation	



DISCUSSION

This study assessed climate change-tourism research (i.e., impact, adaptation, and mitigation) in Tanzania for the past ten years dating back to 2014. The assessment is in line with climate change reporting in Tanzania. The timeframe within which Tanzania submitted its Nationally Determined Contributions (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC). The first NDC was submitted in 2015 and the second was in 2021. The assessment shows research that integrates climate change into tourism in Tanzania is inadequate given the vast land reserved for conservation and tourism, with several institutions of higher learning dedicated to research and consultancy in tourism. It was anticipated that over 100 articles would be dedicated to the topic since tourism is Tanzania's economic pillar that is currently under threat of climate change and its grievous impact. The findings are in line with Bushesha (2018) who argued that research on climate change's impact on the natural resource base in Tanzania has increased, but not integrated into the tourism sector. Climate-change impact assessment is a prerequisite for informed adaptation and mitigation, both of which are knowledge-intensive. IPCC (2014) identifies two options for climate change management and these include: mitigation of climate change by reducing greenhouse gas emissions and enhancing sinks, and adaptation to the impacts of climate change. To align with the IPCC (2014) and since Tanzania's tourism largely depends on long-haul tourists, it was anticipated that numerous articles would be dedicated to documenting efforts made by the sector in minimizing greenhouse gas emissions or enhancing the sink as well as adapting to the already identified impacts. Nevertheless, Nachmany (2018) who reviewed several policies concluded that climate change knowledge is poorly covered in Tanzania's development agenda. Climate change policies should therefore be informed by science, and systematic methods of

assessing the impacts (IPCC-SP 2014) as recommended. This assertion amplifies an excerpt in the Glasgow Declaration hence, bridging this knowledge gap in the tourism sector is imperative.

Adaptation is a five-stage process that includes: (a) awareness, (b) impact assessment, (c) planning, (d) implementation, and (e) monitoring and evaluation (IPCC 2022). In this spectrum, where is the Tanzanian tourism sector? This question is yet to be answered as research that integrates the impacts of climate change on tourism is limited. It is imperative also to understand that the tourism sector can adapt but cannot mitigate climate-change impacts in isolation from other sectors. Nevertheless, specific climate change-tourism assessments are likely to inform the sector's specific adaptations. For instance, climate-change impacts studies have already shown that sea-level rise (Daly *et al.*, 2022; Dimopoulos *et al.*, 2022), land-cover change, droughts, and increased temperature (Dube and Nhamo 2018, Dube and Nhamo 2019, Dube and Nhamo 2020, Dube and Nhamo 2020, Dube and Nhamo 2020, Dube *et al.* 2020, Hoogendoorn and Fitchett 2018, Kilungu 2019, Kilungu *et al.* 2017, Kilungu *et al.* 2019, Kilungu *et al.* 2014) negatively affect tourism. Developing science-based adaptations of already known impacts would likely inform policymakers. In South Africa, for example, Dube *et al.* (2020) identified adaptation measures in the drought-related Day-Zero water phenomenon in the Western Cape province. The Author argued that the South African tourism sector adopted several adaptation measures (e.g., no swimming during the day, washing should be monitored, smart toilets, wastewater recycling policy, among others) to avoid taps running dry at some point. This adaptation measure aimed at saving water, thereby easing the sector's water demand: a situation that would lead to a drastic decline in tourist arrivals. Studies of this nature would benefit the Tanzania tourism sector as most tourism and hospitality establishments are located in



remote areas where water is an issue of concern, especially in critical dry seasons.

Although few studies addressing the climate-change impact on the Tanzanian tourism sector were identified during this study, climate mitigation and adaptation cannot be overemphasized since the country largely depends on long-haul tourism. Air travel has been identified as one of the main environmental polluters Larsson *et al.* (2019) and in response to this, the International Civil Aviation Organization (ICAO) set up a Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) in 2016. This consequently may result in some environmental enthusiasts' tourists being hesitant to use air travel. The repercussions of the carbon offsetting policy for the long-haul tourism in Tanzania are likely impactful. Thus, as Tanzania, like many other countries, aspires to decarbonize the tourism sector and contribute towards achieving net zero emission by 2050, extensive research to inform sector-specific adaptation and mitigation measures is required to avoid potential negative consequences.

Than *et al.* (2018) observes that adapting tourism sector to the impact of climate change needs a strong financing mechanism, political will (i.e., government), Non-Governmental Organisation contributions and willingness, local communities support, and technical experts, to mention a few. Of these, a political will should not be overemphasized as some of the adaptation measures might lead to changes in policies. Thus, key stakeholders should be vested in mitigating the adverse impact of climate change on tourism. Nevertheless, according to Nachmany (2018) climate change-tourism research does not feature adequately in Tanzania's development agenda, thus, it is challenging to devise comprehensive mitigation strategies. The results signify the importance of understanding the complexity and sectoral interdependence of mitigation actions.

The findings in this study are in line with Hoogendoorn and Fitchett (2018) and as well signify that increasing research into the threats of climate change to tourism in Tanzania and the need to identify future research trajectories that will enable informed adaptation measures is imperative. This implies that currently, climate change-tourism information is inadequate to support the implementation of informed adaptation and mitigation measures. Mkiramweni *et al.* (2016) had identified this knowledge gap and developed a framework to equip wildlife tourism managers with a supplementary tool for adapting natural resources and wildlife tourism to the impact of climate change, nevertheless, the framework is yet to be adopted.

The findings in this study draw attention to the critical issues of integrating the effects of climate change and adaptation strategies for tourism. Although this assessment does not review unpublished and non-online published articles, it provides pertinent information that is likely to help Tanzania to know where it is in terms of climate change and tourism research in the global arena. In the digital era, online publications should be highly encouraged to fasten the dissemination of research findings and reduce research costs. The study is the first to comprehensively compile unsurpassed scholarly work on climate change and tourism covering the important period in the Intergovernmental Panel on Climate Change reporting system (i.e., IPCC-AR5 and AR6) where the World struggles to use research to inform adaptation and mitigation measures to keep the global warming below the 2-degree Celsius. Therefore, the findings revealed several research trajectories that Tanzania must take, to mention a few, the issues of climate change on coastal and mountainous tourism (i.e., impacts, adaptation and mitigation) is inadequately covered despite their attractions being highly sensitive to climate change.



CONCLUSION

This study assessed climate change-tourism knowledge in existence for the past ten years since 2014 using the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) 2020 statement. The assessment identified 14 articles and of these, 10 articles (71.4%) assessed impacts, 14.3 percent addressed adaptations and 14.3 percent assessed mitigation (cf. Figure 2). With these findings, the study concludes that climate change and tourism research in Tanzania is inadequate given the enormous land solely reserved for conservation and tourism. It is thus recommended that more research on adaptation and mitigation measures is pertinent. The assessment recommends more research to help the Tanzanian tourism sector to devise scientifically grounded approaches to decarbonize its sector and contribute towards achieving net zero emission since adaptation and mitigation measures are knowledge intensive.

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Appendix 1: Summary of publications covering Tanzania’s climate change-tourism research between 2014 and 2023

SN	Authors	Year	Title	Publication	CC-research	Coverage	search engine	Text type
1	Mkiramweni, Nickson;	2014	Sustainable wildlife tourism in the context of climate change: The case study of Ngorongoro conservation area, Tanzania	Environmental Science and Policy	Adaptation	Ngorongoro Conservation Area	Google Scholar	Full text
2	Hoogendoorn, Gijsbert; Fitchett, Jennifer M;	2018	Tourism and climate change: A review of threats and adaptation strategies for Africa	Current Issues in Tourism	Adaptation	Africa, Tanzania included	Google Scholar	Abstract
3	Minja, Gileard;	2014	Vulnerability of tourism in Kilimanjaro national park and the livelihoods of adjacent communities to the impacts of climate change and variability	European Scientific Journal	Impact	Kilimanjaro National Park	Google Scholar	full text
4	Kilungu, Halima; Pantaleo, Munishi; Leemans, Rik; Amelung, Bas;	2014	Wildlife safari tourist destinations in Tanzania: Experiences from colonial to post-colonial era	International Journal of Current Research and Academic Review	Impact	Tanzanian national parks	Google Scholar	full text
5	Kilungu, Halima; Leemans, Rik; Munishi, Pantaleo KT; Amelung, Bas;	2017	Climate change threatens major tourist attractions and tourism in Serengeti National Park, Tanzania	Climate change adaptation in Africa	Impact	Serengeti national park	Google Scholar	full text
6	Lwoga, Noel Biseko; Asubisye, Edwin;	2018	Effects of drought on cultural tourism: selected cases of Maasai tourism groups surrounding Tarangire National Park in Tanzania	Journal of Tourism and Cultural Change	Impact	Maasi in Adjacent Tarangire national park	Google Scholar	Full text
7	Bushesha, Magreth;	2018	Climate Change and Tourism in Tanzania: Identifying the Gaps	Journal of African Politics, Development, and International Affairs	Impact	Tanzania	Google Scholar	Full text
8	Yong, Enn Lun;	2021	Understanding the economic impacts of sea-level rise on tourism prosperity: Conceptualization and panel data evidence	Advances in Climate Change Research	Impact	Partly, Tanzania	Science Direct	full text
9	Dimopoulos, Dimitri; Queiros, Dorothy; van Zyl, Ciné;	2022	Exploring Indirect Environmental Risks That Impact Coral Reef Tourism in the East African Marine Ecoregion	Transcending Borders in Tourism Through Innovation and Cultural Heritage	Impact	Tanzanian Coast is included	Google Scholar	abstract
10	Minja, Gileard S;	2015	Ecological and Socio-Economic Implication of Climate Change and Variability on Tourism in Kilimanjaro Mountain National Park, Tanzania	European Scientific Journal	Impacts	Kilimanjaro National Park	Google Scholar	full text
11	Mkiramweni, NP; DeLacy, Terry; Jiang, Min; Chiwanga, FE;	2016	Climate change risks on protected areas ecotourism: shocks and stressors perspectives in Ngorongoro Conservation Area, Tanzania	Journal of Ecotourism	Impacts	Ngorongoro Conservation Area	Google Scholar	Full text
12	Kilungu, H.; Leemans, R; Munishi, P.K.T.; Nicholls, S.; Amelung, B.;	2019	Forty years of climate and land-cover change and its effects on tourism resources in Kilimanjaro National Park	Tourism Planning & Development	Impacts	Kilimanjaro National Park	Google Scholar	full text
13	Daly, Meaghan E; Yanda, Pius Z; West, Jennifer Joy	2015	Climate change policy inventory and analysis for Tanzania	Centre for International Climate and Environmental Research, Oslo (CICERO)	Impacts	Tanzania	Google Scholar	Full text



SN	Authors	Year	Title	Publication	CC-research	Coverage	search engine	Text type
14	McGaurr, L and Lester, L, edited by Peter Lang Inc, B Brevini and J Lewis (ed)	2018	See it before it's too late? Last-chance travel lists and climate change	Journal of Environmental Science	Impacts	The whole world, Kilimanjaro Mountain is also a part of	Google Scholar	Full text
15	Nachmany, Michal;	2018	Policy brief Climate change governance in Tanzania: challenges and opportunities	Grantham Research Institute on Climate Change and the Environment: London, UK	Mitigation	Tanzania	Google Scholar	Full text
16	Thani <i>et al</i> ; 2018	2018	Climate change and tourism in Zanzibar: interrogating Impacts and interventions	CABI International.	Mitigation	Zanzibar	Google Scholar	Full text