Climate variability, change and potential impacts on tourism: Evidence from the Zambian side of the Victoria Falls

Kaitano Dube[a,*], Godwell Nhamo[b]

[a] College of Agriculture and Environmental Sciences Florida Campus, South Africa
[b] Institute of Corporate Citizenship, University of South Africa, Pretoria, South Africa

ABSTRACT

Climate change is one of the most challenging problems facing the world today. Its consequences affect many communities and sectors, with the poor particularly vulnerable. One of the sectors that benefit the poor is tourism, and the sector gets impacted by global warming that causes climate variability and change. This study examined the evidence and potential implications of climate variability and change on tourism in the Zambian town of Livingstone. A mixed methods case study design drew on 40 years of historical meteorological data from the Zambia Meteorological Department (1976 to 2016), an online survey of tourists (n = 369), key informant interviews and remote-sensed data. The Geographical Information System (GIS) ArcView 10.5, Question-Pro Text Analysis and Microsoft Excel Toolpak were used to analyse the data. A Mann-Kendall trend test was run on precipitation and temperature data which pointed to a statistical significant change in annual average temperature and no statically significant change in annual average rainfall. However statistical significant changes were reported for some months for precipitation. The research found evidence of climate variability and change in Livingstone, indicated by an increase in temperature, extreme rainfall patterns, a decline in rainfall and a fluctuation in water flow levels at the Victoria Falls. The changes pose a potential threat to wildlife and the Victoria Falls resort and may undermine future tourism operations and activities. It is recommended that Livingstone adopt a new climate calendar, green tourism, that tourism authorities proactively plan for climate change and that further research be conducted on the impact of changes and variables on flora, fauna and the Victoria Falls resort.

1. Introduction

There has been an increasing debate on the relationship between tourism and the changing climate of late (Hoogendoorn and Fitchett, 2016). Climate and tourism have a complicated relationship as suggestions note that for sustainable tourism to exist there is a need for optimal permitting weather at a tourist destination (Kaján and Saarinen, 2013). On the one hand, climate change is blamed for disrupting the tourism industry, while on the other, tourism is blamed for causing climate change through various activities that emit carbon dioxide, which drives global warming (Becken, 2007; Prideaux and Thompson, 2017). Mounting evidence, however, shows that climate change is one of the biggest threats to this massive global economic sector (Jedd et al., 2017).

Tourism is one of the fastest growing economic sectors in the world, exceeding the macroeconomic growth rate of many countries (Freitas, 2017). In 2015, the sector grew at a global average rate of 2.8% against a global economic average growth rate of 2.3% (WTTC, 2016). Unlike

in the global North, the tourism industry in the global South is heavily based on the rich natural resource base to attract international tourists (Lubbe et al., 2017). The natural resource base includes forests and their vast biodiversity, animals, mountains, rivers, lakes, waterfalls and to an extent its warm predominantly sunny weather (Thapa, 2013).

The tourism industry has been a pivotal focal point for the Zambian government for the past years as it seeks to diversify the economy following the collapse of the mining sector. The tourism industry is touted for employment creation, foreign currency generation, catapulting the local populace into the mainstream economy, social cohesion and sustainable development (Reed and Sikobela, 2017). The benefits of tourism have been most evident in the tourism capital of Zambia, Livingstone, which plays host to one of the seven iconic wonders of the world, the Victoria Falls (McLachlan and Binns, 2014a) that is shared with Zimbabwe along the Zambezi River. As a consequence of tourism activities, Livingstone has witnessed phenomenal economic growth over the past 20 years since 1994. In this town, tourism is credited with getting 57% of the population economically

active (Harnadih and Bwalya, 2016).

Given the fact that tourism is dependent on nature in Africa, any serious threat to nature poses a threat to the wellbeing of the tourism industry. There is a growing concern and awareness that climate change will have a severely negative impact on the vulnerable tourism sector across the world (Rosselló and Waqas, 2015). Climate change is set to disrupt tourism activities, undermine infrastructure, alter destination configurations and reduce tourist comfort, which might result in short-term and, in some cases, long-term cost implications for the tour operators and economies dependent on tourism (Rogerson, 2016).

Climate change has a profound impact on sub-Saharan Africa (SSA), where it is expected to trigger a wave of extreme weather events that include droughts, flooding, heat waves, extreme frost, wildfires and extreme cold. Models and research indicate that global warming is expected to outstrip the global average temperature set at between 1 °C and 2 °C, to grow by between 3 °C and 4 °C at the close of the century (Rogerson, 2016). Such a temperature increase will likely have an impact on flora and fauna. Evidence from other studies shows that climate change is altering the animal migration pattern in the Serengeti National Park whose animals are the bedrock of the tourism in that region and other parts of Africa (Kilungu et al., 2017). A study in African national parks by Creel et al. (2016), noted that an increase in temperature as a consequence of climate change modified the predatory interactions between animals.

Climate change has been reported to have led to erratic rainfall patterns. There has been a noticeable increase in extreme droughts and a greater incidence of extreme rainfall events in southern Africa over the years, with severe consequences for vegetation patterns (Kupiwa and Nhamo, 2017). All of these factors have had an adverse impact on wildlife, threatening biodiversity in flora and fauna in various national parks around the continent (Dillimono and Dickinson, 2015). An increase of drought incidence and aridity due to climate change was subsequently expected to result in the drying up of boreholes and watering points. This was reported to have altered animal distribution in the Kruger National Park (Fullman et al., 2017). Kruger National Park stands out as one of the key regional and global tourist attraction in southern Africa shared by Mozambique, South Africa and Zimbabwe. Hence, a change in the animal distribution pattern due to climate change will most likely affect tourists' enjoyment and access to wildlife viewing spots if negative.

There is mounting evidence that climate change is affecting the various activities and environment in the Zambezi Valley, which is home to the Livingstone and source of water for the Victoria Falls and will continue to do so. Marshall (2017), observed an increase in water temperature that can be traced and attributed to climate change in Lake Kariba, which can affect fish stocks and therefore also spot fishing. Models suggest that climate change will result in increased temperature, reduced rainfall, decreased river flow and increased river flow in the Zambezi basin (Hamududu and Killingtveit, 2016). The changes in climate are also expected to hurt economic sectors such as hydroelectricity generation and other activities such as tourism and farming (Nhemachena et al., 2014). The Zambezi valley is a significant region, and the latest studies have covered large areas. Given the variability that is expected at the micro level, there is a need to research micro scales that cannot be adequately covered by general circulation models (GCMs) (Christensen et al., 2007). Such studies will allow and provide intelligence to the community on how to mitigate and adapt to climate change.

Kajan et al. (2015) argue, therefore, that since climate change is such a threat to the global tourism industry, there is a need for increased investigation and academic focus in examining climate change implications for tourism as a whole. Hoogendoorn and Fitchett (2016) also argue that there has been a considerable concentration of climate change impact studies on tourism in the global North and the Mediterranean with very little research in the South. A call is therefore made for more research focused on examining the evidence and implications of climate change on tourism as the sector is vulnerable, and lacking necessary adaptation capacity. Hoogendoorn and Rogerson (2016) note a gap in tourism and climate change studies in Zambia, Zimbabwe and other southern African countries save for South Africa and Botswana.

The research on which this article is based was aimed at addressing this knowledge gap. Such a study was imperative not only in addressing the knowledge gap but also in equipping government, industry and role players on the state of affairs with regard to climate change to better mitigate and adapt decision-making processes.

This research aimed at examining the evidence of climate variability and change by analysing climate data over the past 40 years in Livingstone, the remotely sensed image at the Victoria Falls using GIS ArcView 10.5 and examining the related physical evidence of such changes on the environment. The second objective of the research was to examine how such changes would affect the tourism industry value chain to recommending some adaptation and mitigation strategies to ensure sector sustainability going forward.

The research is divided into five aspects; beginning with the introduction and background literature to the research. This is followed by a brief outline of the research area and why it was chosen for this research followed by the research design. The next section is the presentation and discussion of research findings. The research findings are divided into three subsections namely: evidence of climate change; variability in temperature on rainfall; and the physical aspects of the area including water flow. The article ends with a conclusion and recommendations section.

2. Study region, material and methods

Fig. 1 shows Livingstone town which is in Zambia, in SSA within the southern African region. It is located on the banks of the Zambezi River, north of the Victoria Falls World Heritage Site. The Livingstone town is considered the tourism capital of Zambia due to its prominence in Zambia's tourism industry. It shares the Victoria Falls World Heritage Site with Victoria Falls town, which is located on the southern side, in Zimbabwe. The Victoria Falls receive an estimated 600,000 tourist per annum. Livingstone was chosen for this study because of the centrality of the Victoria Falls to the tourism economies of Zambia, Zimbabwe, Botswana and South Africa, which directly and indirectly benefit from the attraction. Victoria Falls and the surrounding areas are fast becoming a regional tourism hub for the African tourism market whose sphere of influence spans the world's seven continents. The recent news reports and social media reports of Victoria Falls drying up, especially on the Zambian side, gave credence to this research (Dube, 2016) since the ramifications of climate change pose a threat to the regional tourism narrative and prospects.

A constructivist paradigm was employed in this research to inform the methodology, and data analysis (Frels and Onwuegbuzie, 2013). The approach allowed the researchers to explore various interdisciplinary aspects of meta-science. The study adopted a mixed methods case study approach, which sits well within the constructivist paradigm. The case study allows for an intense focus on a phenomenon, in this study the area of Livingstone (Creswell and Poth, 2018). The use of multiple methods of data collection enabled triangulation. In order to assess and investigate the evidence of climate change, meteorological data (monthly precipitation in mm and maximum temperature in °C) between 1976 and 2016 sourced from the Zambia Meteorological Department were collected and analysed using Microsoft Excel Analysis ToolPak. A Mann-Kendall trend test was also run for the annual data to ascertain the significance of change (if any) over the period in question. Regardless of its limitations in that it does not give the structure of the trend since the negatives tend to cancel the positives, the Mann-Kendall trend test is widely used and accepted for use in detecting a change of environmental parameters such as hydrology and climate data (Pohlert, 2018). A sequential was applied to individuals to produce a graph to be able to detect and get a clearer picture of the events under investigation