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Climate change effects on natural resources availability and tourism sustainability in Maasai Mara National Game Reserve, Kenya

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Abstract

The purpose of the study was to determine the effects of natural resources on tourism sustainability in Maasai Mara National Game Reserve, Kenya. The study adopted explanatory research design. The target population was 169,220 household in Narok County, 300 tourists and 18 experts. The sample size was 507 respondents comprising of 399 households, 90 tourists and 18 experts selected by simple random sampling, convenience sampling and snowball sampling respectively. Structured questionnaires collected data from the host community which was analyzed using Pearson product moment of correlation, linear and multiple regressions. Data analyses were done through quantitative techniques of descriptive and inferential statistics with the aid of SPSS V.23. The processes Macro were used to test the mediation effects. Results indicated that there was a positive significant relationship between climate change and natural resources (β=0.286 and p=0.000). Moreover, climate change affects natural resources positively as there was a positive significant relationship between natural resources and tourism sustainability (β=0.393 and p<0.000). The natural resources controlling for climate change predicts 42.3% of tourism sustainability. In conclusion, natural resources mediate the relationship between climate change and tourism sustainability. Despite moderate adaptive capacity to climate change effects, the study raises urgent interventions for the tourism industry stakeholders on rainfall and temperature variations that positively contribute to influence the decline in wildlife populations and natural vegetation. Tourism operators have no choice but to adopt mitigation and adaptation strategies. It is crucial that policies aimed at strengthening climate change mitigation and adaptation strategies should

be enacted at the same time full implementation of the Climate Change Act of 2016. A need exists for future research to use other climate change indicators other than rainfall and temperature.

Keywords: Climate change, natural resources, tourism, sustainability, Kenya

Introduction

Tourism depends on natural resources, such as water, coastlines, landscapes and biodiversity that influence the potential attraction of destinations as inputs for the production of tourism services and goods. This implies an input-output relationship where natural resources form part of the raw materials for the production process. Natural resources therefore are the impetus of the tourism industry especially in developing countries like Kenya. These changes affect the natural systems for example; warming of lakes and rivers due to rising temperatures, bird migration, biodiversity decline, pole ward and upward shifts in ranges in plants and animal species (IPCC, 2007). Climate change threatens the loss of some of these relevant natural resources (Gösling & Hall, 2006). What is not clearly known is whether the tourism industry will achieve its sustainability with the changes in climate that affects natural resources. Projects such as the destruction of habitats as a result of land use changes may readily interrupt the interconnections between species and can transform current communities, and display variable species motion through ecosystems, leading to many localization extinctions. Increased vulnerability of ecosystems to natural and anthropogenic disturbance could lead to reductions in species diversity when plant species can not react to climate change (Malcolm, Markham, Neilson & Garaci, 2002) hence affecting the tourism industry through reduced floral and faunal populations. This could mean reduced numbers of visitors to certain tourism destinations experiencing the climate change conditions.

The UNWTO (2008) estimated that about one-fifth of all known plant species, mammal, bird, and a half of amphibian and reptile species may be affected by African emissions. The Savannah, tropical forests, marine and fresh-water marine coral reef habitats, wetlands and mountain ecosystems are among the most varied and organic ecosystems in the world. The economic foundations, particularly for the tourism industry in Kenya, are these ecosystems of worldwide significance. However, it's not clearly known how climate change would affect these natural ecosystems in terms of their quality, abundance and distribution.

Literature review

The world's tourism sector is an incredibly important global source of income and jobs. It generates 1 in 11 jobs indirectly globally, and contributes 5 percent of the world's GDP, with a total turnover of US$ 1.260 billion (UNWTO 2016). The global tourism industry has exhibited remarkable growth over the years in terms of arrivals and revenue. The growth has been attributed to several factors such as rising economies and incomes across the world. According to UNWTO, (2016), 2016 was a momentous year for tourism where international tourist arrivals continued their upward trajectory in their seventh straight year of above-average growth despite many challenges reaching 1.2 billion representing 4% per growth foe seven straight years. The United Nations World Tourism Organization (UNWTO) estimates that international tourist arrivals worldwide will reach 1.8 billion by 2030 at an increase of 3.3% a year from 2010 to 2030 (WTO, 2011).

The concept of Sustainable Tourism

According to UNWTO (2005), tourism is a social, cultural and economic phenomenon that spurs economic growth, social development and fosters mutual understanding globally and therefore it is vital that the sector sustains the basis of its prosperity in all its dimensions. In fact tourism is mentioned in three of the seventeen sustainable development goals (SDG's) in line with sustainable economic growth and decent employment, sustainable consumption and production and the conservation and sustainable use of oceans. The term "sustainable tourism" is interchangeably used with responsible tourism, ecotourism and ethical tourism (Cater, Garrod & Low, 2015). The sustainable tourism discourse is based on the Sustainable Development paradigm which was popularized by the Brundtland Commissions' report known as "Our Common Future" in 1987 (Saarinen, 2006). Sustainable development calls for the utilization of natural resources along equity lines, where future generations would have equal opportunities to the resources. In other words, it is a discourse that promotes inter-generational equity for continued ecological, socio-cultural and economic benefits (Saarinen, Becker, Manwa & Wilson, 2009).

Communities in tourist areas must be well established in the following issues pivotal to sustainability: wealth creation, stewardship, empowerment and revelation. That is, communities must be enabled to generate wealth through tourism while at the same time taking care of the environment upon which they depend (Hambira et al., 2013). This can be achieved through developing their self-respect and confidence, leading to the realization that a sustainable future is attainable through collective visioning. However, such a vision would not be realized as long as human activities which results in the emission of Green House Gases are not curbed (Hambira et al., 2013).

Scott and Becken (2010) asserted that climate change is the greatest challenge to sustainable tourism in the twenty first century. According to Viner and Agnew (1999), the location of parks and reserves is based on animal distribution and climate conditions, which means that the effects of climate change such as the frequency of floods, drought, and land degradation could affect vegetation, ecological zones and, consequently, the distribution of wildlife. This would ultimately reduce the viability of recreation activities such as wildlife safaris. This scenario is likely to be an impediment to sustainable tourism (Saarinen et al., 2013).

One of the most widely adopted strategies to curb climate change effects in the tourism industry is to adopt adaptation strategies that would enable communities and economies to cope with the results of climate change. The adaptation measures may be technical (e.g. rain water collection and recycling systems, access to early warning systems); managerial (e.g. water conservation plans, product and market diversification); policy related (e.g. complying with regulations concerned with environmental protection and building codes and lobbying for the reduction in GHG emissions); research (e.g. site location in terms of slopes and elevation etc.); education (e.g. conservation education for staff and guests as well as public education campaigns); and behavioural (e.g. GHG emissions offset programmes and conservation initiatives) (United Nations World Tourism Organisation-United Nations Environment Program-World Meteorological Organisation (Simpson, Gossling, Hall & Gladin, 2008). It is not known whether such strategies are effective and yielded expected results.

Mather, Viner, and Todel, (2005) suggested that governments could encourage tourism establishments to adapt to climate change by promoting traditional building designs and

alternative methods of cooking; introducing man-made attractions in the face of diminishing natural attractions; passing legislation to change planning policies, changing use priorities as necessary. Traditional building designs such as thatched roofs provide natural cooling and could save more energy compared to air conditioning also some man-made attractions provide very good alternatives to natural ones if they are designed well thus this could reduce the number of tourists that could be lost completely if a natural attraction loses its value (Hambira et al., 2013).

The outcomes of such initiatives need to be identified and well assessed if any for the case of Kenya's tourism industry. This will definitely be a key ingredient for developing future tourism destinations. It is worth noting that planning and zoning policies would be informed by the anticipated effects of climate change on a given geographical area and, as such, the tourism product adopted for a particular area would be commensurate with the likely impacts of climate change (Hambira et al., 2013).

Kenya, with an area of 582 646 km^2, is home to some of the richest biodiversity and most striking landscapes in Africa, ranging from the Indian Ocean coast to the peaks of Mt. Kenya, the second highest mountain in Africa (Weru, 2016). Kenya ranks highly as one of the biodiversity rich countries' in the world, with the iconic wildlife and the diverse conservation areas are among the countries most valuable assets where Wildlife is a source of national pride, the foundation for the tourism industry that contributes 10% of National Gross development project (GDP) and 11% of total formal workforce (MoTW, 2018).

Natural resources and tourism

There exists a well-established positive relationship between rainfall and primary production of vegetation especially grass in the semi-arid tropics. During drought periods which are a significant indicator of climate change, primary production of vegetation is low hence affecting wildlife population (Ottichilo et al., 2000). More importantly, Prins and Olff's (1998) research demonstrated that herbivores population dynamics are determined by food amount and quality for a sufficient time to allow the animal to dispose of reserves of body energy and protein.
Food quantity and quality in semi-arid habitats have mainly an effect on pluvial rainfall, which is expected to adversely influence wilderness populations by lower reproductive and survival rates on frequent droughts in the Mara ecosystem (Ottichilo et al, 2000).

The population of buffalo has decreased in the Reserve from 10 000 to 2 400 in Dublin, (1994) while ranches range from 2,240 to 730 in 1993 owing to serious droughts. The 1993 drought was revealed to be the worst since 1938 in the neighboring national Park of Serengeti, which resulted in a substantial decrease in population of wild beasts (Mduma et al*.,* 1998).

This study points to a likelihood of climatic changes coupled by rapid changes in rainfall patterns manifested through flooding and drought events resulting in vegetation decline as well as wildlife decline in Maasai Mara National Game Reserve (MMNGR). Ottichilo (2000) study argued that an important relation exists between the trends in wild strain populations and the precipitation in the Maasai Mara National Game Reserve, which appears to have increased the precipitation total (up to 1000 mm), and vice-versa. Furthermore Philipson (1975), states that the rainfall-primary grass production in semi-arid tropics has a well-developed relation with each other up to about 1000 mm per year.

However, wildlife decline in Maasai Mara National Game Reserve (MMNGR) could be attributed to other many factors such as poaching and land use dynamics. Ottichilo *et al*., (2000) argues that poaching remains difficult to assess because most of the evidence put forward is circumstantial. However, Drummond (1996) reports unabated commercial poaching of wildlife on the group ranches in the Mara, while Sitati (1997) reports increasing subsistence poaching of wildlife by the Maasai Mara. Additionally, a recent socio-economic survey conducted by Kenya Wildlife Service (KWS) indicated that poaching was more rampant in the ecosystem in late 1970s and early 1980s than now (Ngene & Kariuki, 1999).

Methodology

The study adopted explanatory research design. The target population was 169 220 households in Narok County, 300 tourists and 18 experts. The sample size was 507 respondents comprising of 399 households, 90 tourists and 18 experts selected by simple random sampling, convenience sampling and snowball sampling respectively. Key informant interviews were used to collect data from climate change experts and tourists. These data were analyzed qualitatively using content analysis. Changes in vegetation cover were determined from satellite imagery using normalized difference vegetation index (NDVI) method.

Structured questionnaires collected data from the host community which was analyzed using Pearson product moment of correlation, linear and multiple regressions. Data analyses were done through quantitative techniques of descriptive and inferential statistics with the aid of SPSS V.23. The processes Macro were used to test the mediation effects. Based on the regression model (R squared) of .395 shows that 39.5% of the variation in tourism sustainability in MMNGR can be explained by availability of natural resources.

Results and discussion

Natural Resources

The mediator variable of the study was the natural resources with two variables, wildlife and vegetation cover, that were measured using population and Normalized Difference Vegetation Index (NDVI) respectively. Normalized Difference Vegetation Index (NDVI) measured change in vegetation cover as questionnaires, interviews and secondary data measured rainfall, temperature, wildlife population and tourism sustainability variables.

Normalized Difference Vegetation Index (NDVI)

Satellite images of the study area were obtained in order to calculate vegetation cover changes due to climate change. The images were obtained from a Landsat Satellite and used for calculation of Normalized Difference Vegetation Index (NDVI) that measures change in vegetation cover. Several Satellites capture data in form of row and paths of up to 15-meter resolution. MMNGR lies on path 169 row 061 of the satellite. This image was downloaded from the United States Geological Survey (USGS) GLOVIS. The images were obtained in the raw nature in form of bands. Layer stacking was important to combine band three and band four, needed for NDVI calculation. Image geo-rectification was done after band combination. Image subset for the area of interest (AOI) is clipped by the boundary of MMNGR shape file.

Band four captures the near infrared used for mapping vegetation and band three used to map layer stacking is done using ERDAS IMAGINE software, due to its powerful ability to work on raster dataset. NDVI is calculated by the formula:(Band 4-band 3)/ (band 4+band 3). This calculation is done in ERDAS IMAGINE and a graphical representation of the NDVI is produced by ArcGis. Satellite images were processed on a 10-year band from 1970-2018. The following figures indicate vegetation cover changes of the study area from 1970-2018.

Change in vegetation cover of MMNGR between 1970 and 1980

The color ramp shows the level of vegetation for each location. A green color depicts high amounts of vegetation cover, yellow depicts medium amounts while red depicts there is little or no vegetation at all. During the period 1970-1975 and 1975-1980, vegetation abundance as well as distribution in MMNGR was generally high, though the period 1975-1980 had more vegetation compared to the period 1970-1975 as shown in figure 1 and 2. These findings agree with calculated mean average annual rainfall of 1351.68mm between 1970-1975 and 1398.3mm.

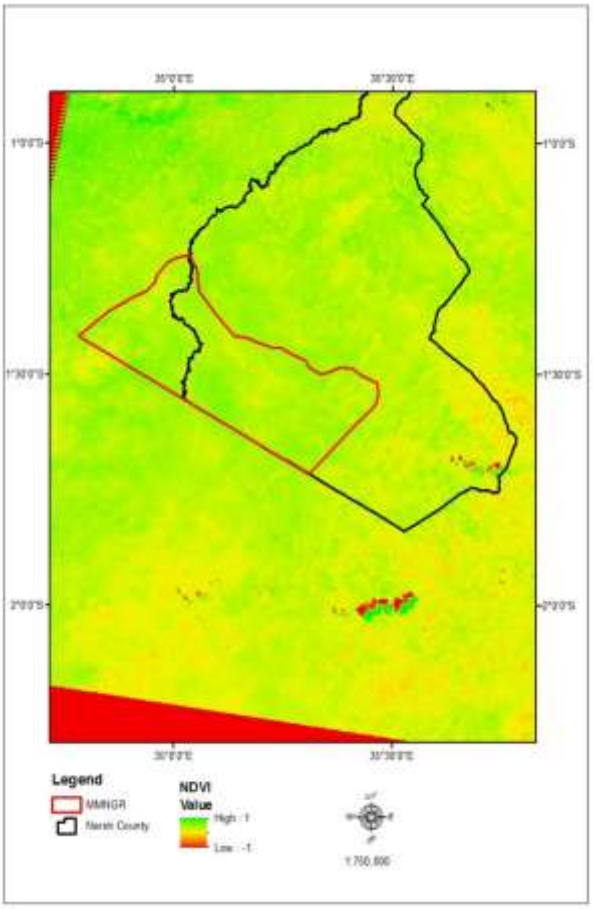

Figure 1. NDVI value for the year 1970
Source: Author (2019)

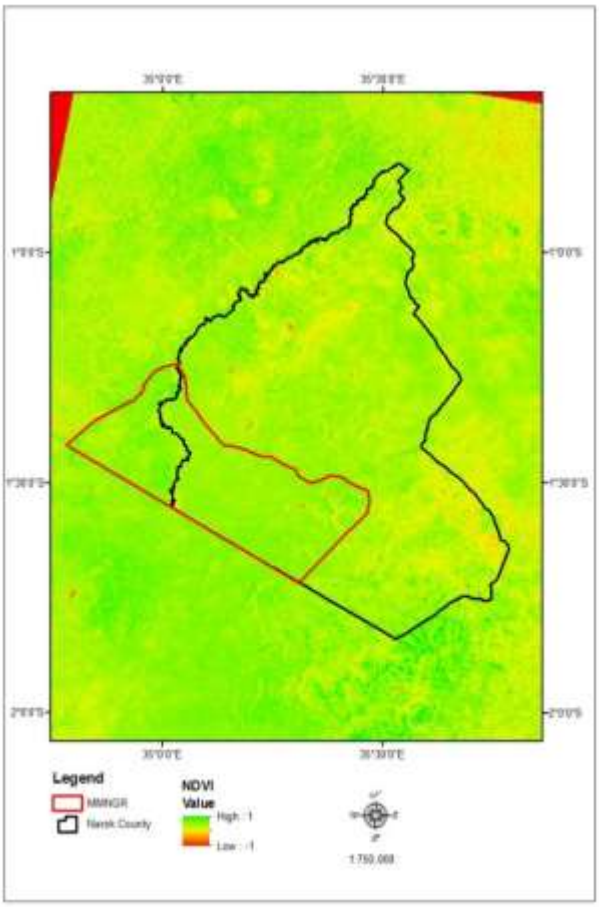

Figure 2. NDVI value for the year 1975
Source: Author (2019)

The value ranges from -1 which is no vegetation, to zero very little and 1 very high amounts of vegetation. For the year 1970 - 1974 as well as 1975 - 1980, the vegetation cover ranged from

medium (0 value) to high (1). This vegetation distribution was evenly spread throughout the MMNGR.

Vegetation cover changes between 1980 to 2000

Ten years later the vegetative value of the game reserve had changed drastically. During the period 1980, there was reduced vegetation depicted by the yellow color. Yet there was enough vegetation in the park. There was specifically high vegetation alone the boundary of Narok County, because of the presence of the river that gives rise to riverine vegetation. The figure 3 and 4 graphically shows the NDVI distribution within the game reserve.

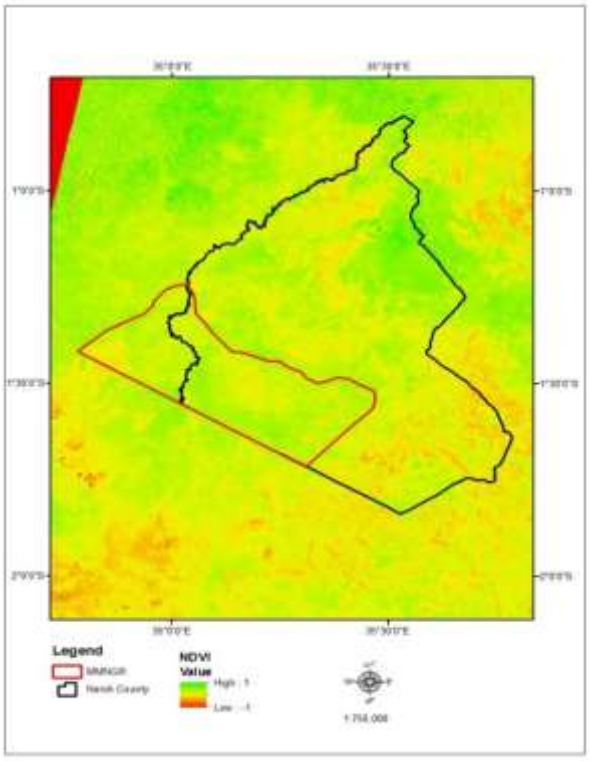

Figure 3. NDVI value for the year 1980
Source: Author (2019)

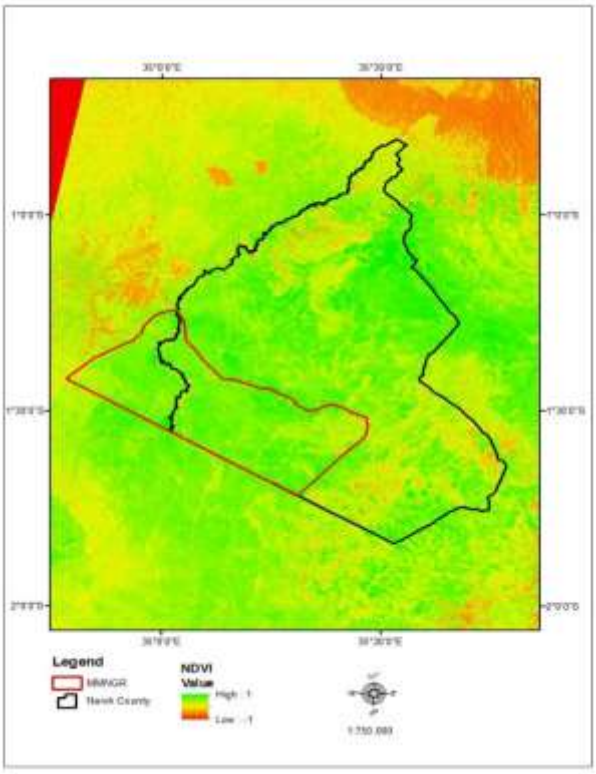

Figure 4. NDVI values for the year 1985
Source: Author (2019)

Vegetation cover changes between 1990 and 2000

For the subsequent years there seems to have been an increase in vegetation cover within the park. The vegetation was moderately high with equal distribution throughout the park. The figure 5 and 6 shows the distribution of vegetation. This can be attributed to an increase in rainfall pattern as recorded by weather station.

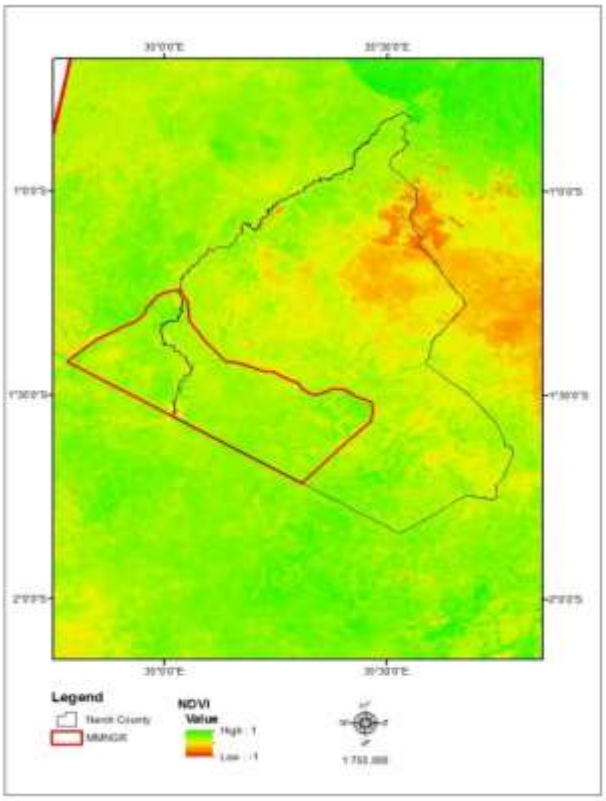

Figure 5. NDVI for 1990
Source: Author (2019)

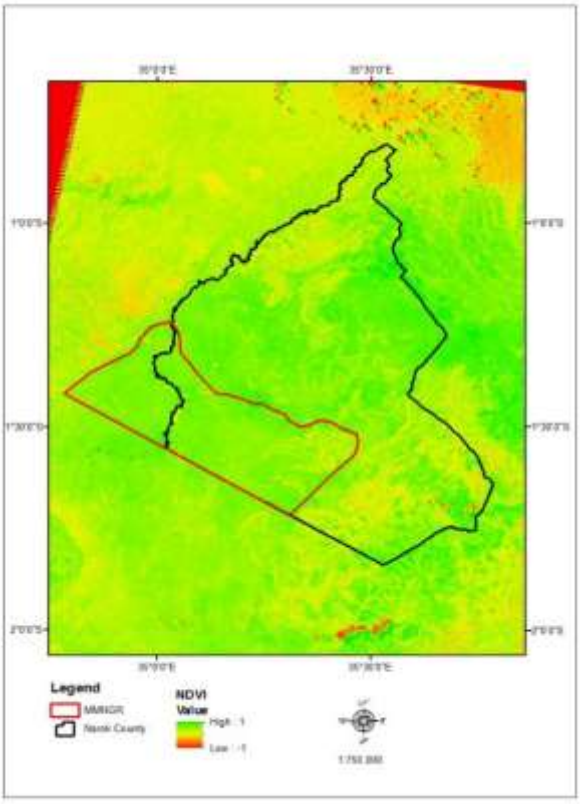

Figure 6. NDVI for the year 1995
Source: Author (2019)

Vegetation changes between 2000 - 2010

From the climate change in the country, 2000 was hit hard by drought and famine. This led to a decrease of vegetative nature in high amounts. The area had less than average vegetation (less than 0 value), with vegetation along the river being moderate in amounts. This is depicted in the figure 7 and 8.

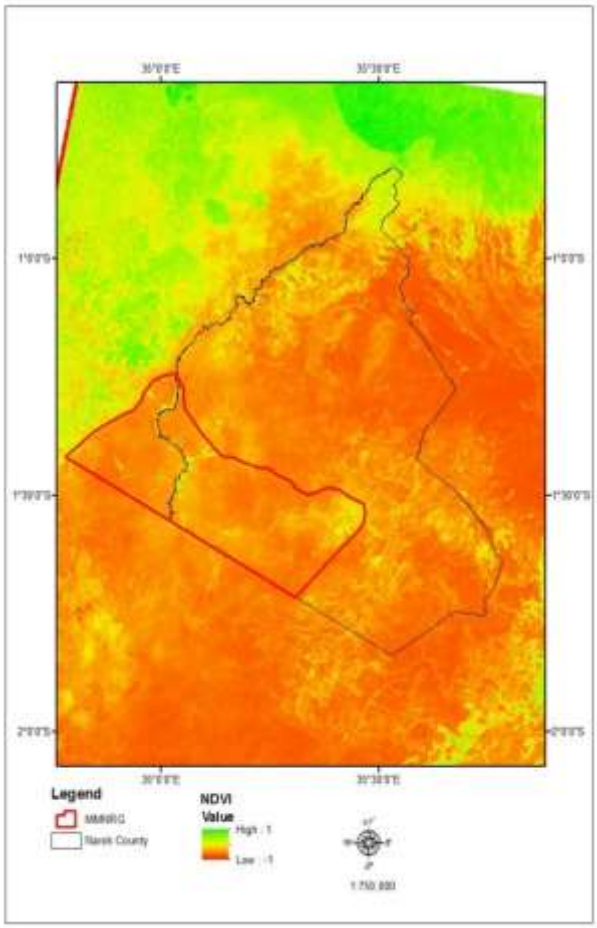

Figure 7. NDVI value for the year 2000
Source: Author (2019)

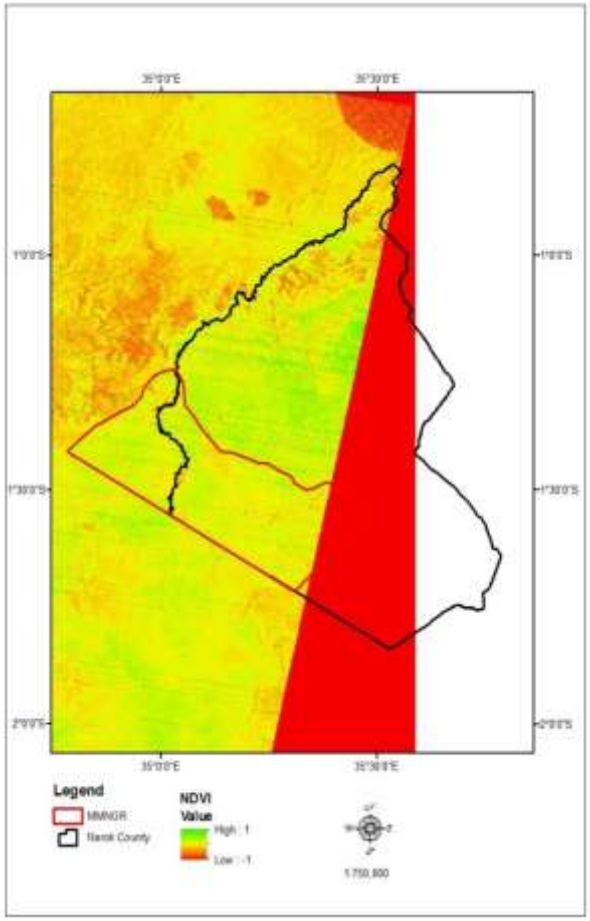

Figure 8. NDVI value for the year 2005
Source: Author (2019)

Vegetation cover changes between 2010, 2015 and 2018

There was a general reduction in vegetation cover from the year 2010 to 2018 as indicated in figures 9, 10 and 11. There is fair growth and cover of vegetation. This increase is moderate in value. While in 2018, there was fair distribution of vegetation with both high and very low aspects. On the south eastern part, there is a high amount of vegetation unlike the north western part. The north western part has very little vegetation except for the riverine vegetation along the river at the border of Narok.

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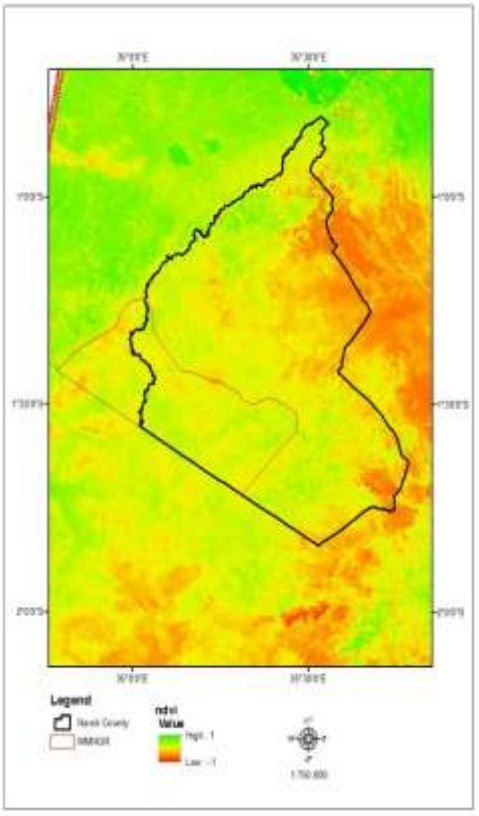

Figure 9. NDVI value for the year 2010
Source: Author (2019)

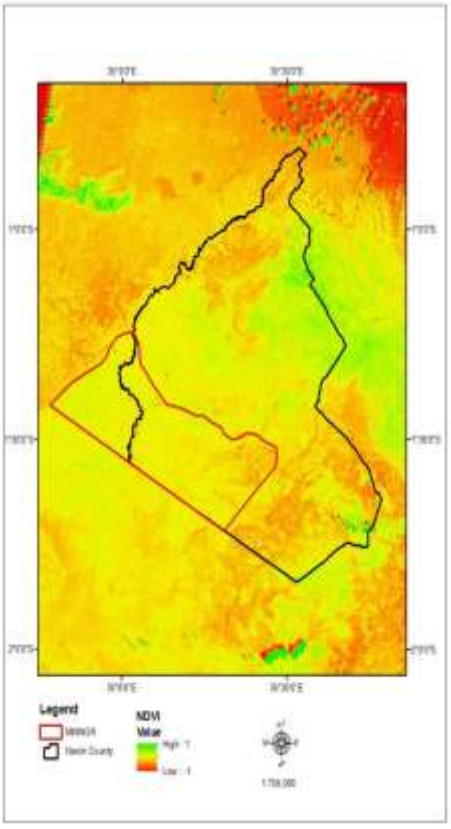

Figure 10. NDVI value for the year 2010
Source: Author (2019)

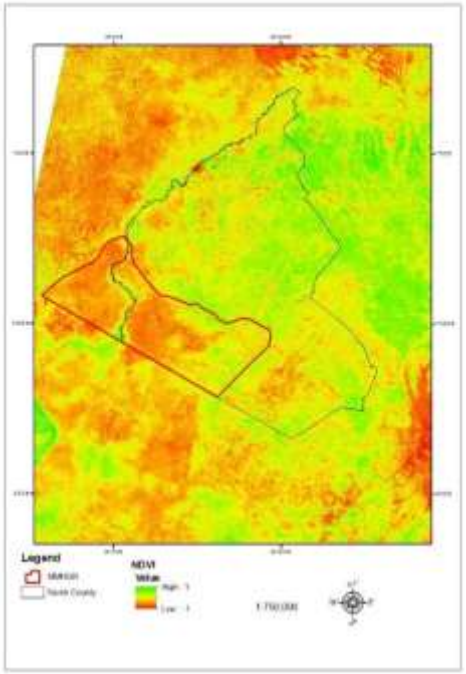

Figure 11. Showing the NDVI value for the year 2018
Source: Author (2019)

Based on these results, one can conclude that MMNGR vegetation cover has undergone variations of low and high vegetation, undoubtedly due to rainfall as well as temperature variations. From the year 2000 to 2018, vegetation cover in MMNGR has drastically declined compared to previous years. These findings agree with the World Bank (2013) that projects aridity in sub-Sahara Africa will increase due to these temperature and rainfall changes. The projected declines in long rainy season and short rainy season, an increase in spatial and temporal variability of rainfall and increase in both maximum and minimum temperatures will have impact of the both vegetation and livestock and wildlife (Aduma et al*.,* 2018).

Availability of forage for wildlife will reduce, hence a decline of most herbivore species as temperature would have surpassed species thresholds temperatures as indicated in the recent studies on potential impacts of climate on wildlife in the savanna ecosystems of Kenya (Aduma et al., 2018; Piniewski, Mezghani & Szcze, 2017). Other studies such (Gundula et al., 2016) observed declines in Normalized Difference Vegetation Index (NDVI) the Mara region of Kenya between 1984 and 2003. These observations comply with the current study results depicting a generally decreasing NDVI. Therefore, a decline in vegetation will result in decline in wildlife population as vegetation is the key source of food for wildlife survival. The tourism industry will undoubtedly be affected by dwindling wildlife populations. Protected areas may cease to exist and hence the collapse of the tourism industry.

Perception of Community on Natural Resource

The perception of community members about natural resources (wildlife and vegetation) was measured on a five-point Likert Scale on their level of agreement on several statements describing natural resource. A total of 7 statements were used to determine the community member's perception on the natural resources and their responses summarized using a 5-point Likert scale. Descriptive statistics which include mean and standard deviation were used to summarize the responses as presented in Table 1.

Table 1. Perception of Community on Natural Resource

	SA		A		N		D		SD		Mean	SD
Statement	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**		
Tree population in Maasai Mara has reduced	40	13.6	87	29.5	48	16.3	98	33.2	22	7.5	**3.08**	**1.21**
Big five population has reduced in MMNGR	37	12.5	146	49.5	67	22.7	35	11.9	10	3.4	**3.56**	**0.97**
There is a change in vegetation cover in MMNGR	74	25.1	153	51.9	41	13.9	21	7.1	6	2.0	**3.91**	**0.92**
Wildlife and livestock conflict for water in the reserve	69	23.4	148	50.2	49	16.6	22	7.5	7	2.4	**3.85**	**0.94**
Wildlife and livestock conflict for pasture in the reserve	31	10.5	84	28.5	112	38.0	62	21.0	6	2.0	**3.24**	**0.97**
The vegetation and grassland species have declined in the Mara	56	19.0	138	46.8	63	21.4	26	8.8	12	4.1	**3.68**	**1.01**
There is a shift in grassland and habitats distribution in Mara	110	37.3	127	43.1	36	12.2	19	6.4	3	1.0	**4.09**	**0.92**
Mean											**3.63**	**.573**

Source: Author (2019)

Based on these results, majority of the respondents 183 (62%) seemed to agree that the Big Five population had reduced, with 22.7% undecided and 15.3% disagreed (*M=3.56; SD=0.97*). Furthermore, majority of the respondents 227 (77%) gave the impression they agreed that there is a change in vegetation cover, with 13.9% undecided and 9.1% disagreed (*M=3.91; SD=0.92*). What is more is that, most of the respondents 217 (73.6%) appeared to agree that available

resources such as space and water control wildlife and livestock population dynamics, with 16.6% undecided and 9.9% disagreed (*M=3.85; SD=0.94*). Also, the majority of the respondents 194 (65.8%) seemed to agree that vegetation and grassland species has declined in the Mara, with 21.4% undecided and 12.9% disagreed (*M=3.68; SD=1.01*). Furthermore, most of the respondents 237 (80.4%) gave the impression to agree that there is a shift in grassland and habitat distribution in the Mara, with 12.2% undecided and 7.4% disagreed (*M=4.09; SD=0.92*).

The study findings also suggest that majority of the respondents 127 (43.1%) agreed that tree population has reduced, with 40.7% disagreed and 16.3% undecided (*M=3.08; SD=1.21)*. Additionally, the findings indicate that at least 115 (39%) of the respondents seem to agree that conflict arises as a result of herbivore wildlife and livestock grazing on pasture, with 38% undecided and 23% disagreed (*M=3.24; SD=0.97*).

From the study, the seven statements used to measure natural resource had an overall mean of 3.61 associated with a standard deviation of 0.573. The findings reveal that most community members agree on the statements used to measure natural resources. Additionally, the results suggest that the community perceive natural resources to have reduced the population of the Big Five, changes in vegetation cover, wildlife and livestock conflict for resources such as vegetation and water, vegetation and grassland species decline and a shift in grassland and habitats distribution. However, the respondents were not certain whether tree population had reduced.

The study sought to identify the reasons for visitor choice of MMNGR in order to establish the popularity of the park and consequently ascertain the level of climate change impact. The tourists interviewed identified various reasons for visiting MMNGR and this was summarized into the following dominant themes; accessibility, natural resources, wild life, hospitality and scenic factors. Based on the results, majority of the local tourists visit MMNGR because of its accessibility, good road network and available Big Five wildlife. Additionally, the results suggest that tourists appear to have visited MMNGR because it is rated among the best tourism attractions, with the yearly migration pattern of wild beast known as 7th wonder of the world. This opinion is supported by one tourist who stated that *"the main reason I visited the Maasai Mara is the crossing of the River Mara by wild beasts."*

The study also sought to establish factors that prompt tourists to visit MMNGR. Based on the results, majority of the tourists reported that MMNGR remains accessible at all times and had a variety of lodges and hotels and wildlife. The good roads, the big five, available tented camps and lodges, security within the reserve attracts tourists to the MMNGR. Furthermore, the findings indicate that the majority of the tourists gave the impression that they were attracted by the great migration of wild beasts and available Big five wildlife together with the good roads. Additionally, the results show that the tourists seem to be attracted to MMNGR due to touristic services offered by the camps and lodges that were reported as being awesome and more attractive than others.

Based on the findings during the tourist's interviews, the tourist's opinion on wildlife population especially the big five during their visits to MMNGR appear varied. The results indicate that the Big five appears to be the most attractive wildlife mainly because it's the most preferred during a safari by most visitors. One of the tourists reported that *"during his forth visit; it was a big struggle for me to see the big five compared to my earlier visits".* The interview results with tourists suggest that majority of the tourists are likely to have experienced reduced vegetation

cover. Grounded on these findings, one can conclude that the reduced vegetation cover could be attributed to the effects of climate change on natural resources.

Conclusions and Recommendations

Climate change affects natural resources positively, and in turn natural resources influence tourism sustainability positively. Biodiversity loss due to prolonged drought and rapid rainfall patterns will have a negative effect on tourism destinations attractiveness and operations including tourism activities that are dependent on weather conditions. The study findings strongly suggest that there exist attempts to conduct sustainable tourism practices in MMNGR through conservation education programs amongst both the employees and tourists. Further, the tourism industry has unified the local Maasai community as they are able to generate a variety of benefits from tourism including creating wealth. Additionally, the tourism industry brought a number of benefits; it has enabled construction of social amenities for local use, the tourism industry has also strengthened preservation of the Maasai culture, development of public facilities, improved local livelihoods through creation of job opportunities, improvement of the local economy and consequently increased urban development.

Natural resources is not the only dominant mediator, there may be other mediating variables through which climate change influences tourism sustainability. Natural resources mediate the relationship between climate change and tourism sustainability. Climate change is one of the most serious threats to tourism sustainability and is likely to have the greatest long-term impact. The current tourism product based on wildlife and nature should be diversified given the climate change threat on wildlife population as well as the natural environment. It is high time to diversify the tourism product away from nature-based products and a focus on other non-nature-based products developed such as Kenya's rich heritage and culture. The new tourism products should also have low carbon footprint because the tourism industry contributes to climate change through carbon emissions. Therefore, tourism products that have a low carbon footprint will slow the climate change effects. There is a case for the notion that tourism market diversification should be initiated along tourism product diversification.

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