Impact of Climate Change on Ecotourism for Wildlife Conservation, A Case Study At Aburi Botanical Gardens, Ghana

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***Abstract*: The preservation of ecotourism sites worldwide has become an issue of importance. Ghana, like other developing countries, has renowned ecotourism sites such as the Kakum National Park, Buabeng Fiema Monkey Sanctuary, and Aburi Botanical Gardens, among others. Rainfall and temperature are known to play a vital role in supporting plant growth and the survival of animal species, and these form a major part of ecotourism. The problem of anthropogenic climate change and its impacts on ecotourism has been measured in some countries except in Ghana. Capitalizing on the gaps in studies on climate change, this research was conducted to ascertain the effects of the impacts of anthropogenic climate change on ecotourism, with a specific focus on the Aburi Botanical Garden. The comparison of the garden's potential was measured against a 30-year data using rainfall and temperature as the variables of measurement from 1989-2018. The measurements were obtained from the Ghana Meteorological Agency. Changes in minimum and maximum temperature, as well as the depreciation in rainfall amounts, were measured. Study participants included workers of the garden who expressed their observation in the trends of rainfall and temperature and how it has affected ecological tourists' visits to the garden via researcher-administered questionnaires. The study confirmed the changes in patterns of rainfall and temperature but revealed that these changes had insignificant impacts on the garden. Thus, its ecotourism potential remains intact despite climate change. It is recommended that the garden properly maintains the standards and upgrades its systems to promote tourism.**

Keywords: **Ecotourism, climate change, biodiversity, anthropogenic**

I. INTRODUCTION

Parks and gardens constitute a greater and essential proportion of ecotourism across borders and thus have become necessary in discussions of ecotourism. Parks and gardens are important for protecting the natural ecosystem. They provide supporting services that include serving as a natural habitat for different wildlife and absorbing pollutants to increase air quality. Parks and gardens are also known to protect communities against flooding by serving as a reservoir for storm water [1]. This is a very important role especially for cities where flat paved surfaces tend to dominate. The paved lands prevent infiltration from surface runoff and increase the potential for flooding [1]. In addition to this flood prevention function of parks and gardens, they moderate urban heat island effects while providing avenues for ecotourism [1]. Any conscious travel made to a natural area, suitable for conserving the environment, educating tourists, interpreting culture, and sustaining the well-being of the local people is known as ecotourism [2]. The International Ecotourism Society and International Union for Conservation of Nature have established standards for ecotourism. In trying to define it, they say trips must involve visiting natural environments, doing nothing to change or adversely affect these areas, and providing cultural and economic advantages to local communities [3].

The ecotourism industry has become one of the fastest-growing industries in Africa and contributes to the development of many countries. Ecotourism has been growing at rates of 10%-20% each year, which is a three times faster growth rate than the tourism industry in general [4]. It is largely perceived to safeguard primeval environments and contribute to the conservation of biodiversity [5], [6], [7]. These sites provide revenue for the country through foreign exchange [2]. There are several ecotourism sites in Ghana which attract tourists, day-in-day-out to catch a glimpse and feel the natural beauty of sceneries. They include Kakum National Park, BoabengFiema Monkey Sanctuary, Wechiau Hippo Sanctuary, Mole National Park, Aburi Botanical Gardens, Paga Crocodile Pond, Amedzofe, and Tano Sacred Grove amongst others [8].

Ghana is undoubtedly one of the best places for tourists who love and delight in nature due to the favorable sunny equatorial climate and a vast selection of wildlife and tree of different species [8]. There is an indication that climate and ecotourism are related and dependent on each other. Climatic situations at destination areas act as pull factors [9]. Whilst ecotourism also regulates the water and carbon cycle which directly affects climate. Most ecotourism sites in the country are however confronted with many challenges including impacts from climate change on the biological diversity of these sites. Aside

heavy pollution from industries in the developed world, carbon footprints from extensive air and vehicle travel over the years have also contributed to the climate change happening in these remote areas [3].

Climate change again is increasingly recognized, along with habitat destruction, as one of the most serious and widespread threats to biological diversity [10]. Climate change irreversibly harms species beyond a certain threshold. An increase in temperatures may cause many species of plants and animals to rapidly become extinct, a decrease in tree density and floristic richness, a drastic reduction in the rate at which new species of plants and animals show up in the ecosystem, the disruption and reduction of the fruiting intensity of some trees, the aberration in animal mating and changes in bird and animal migratory pattern [11]. A whole new reconfiguration of the ecosystem is ongoing due to the aggravation in the spread of invasive species, the changes in modes of interaction among species and their environment, and the reduction in ecosystem productivity brought about by climate change [12]. All these points to the fact that climate change on environmental reserves is likely to fail ecotourism systems. The natural attractions also suffer from overuse as the destination area gains more popularity (Woods, 2018). The habitation, feeding, and mating patterns of wildlife change due to the influx of human visitors [3]. These in addition to disruptions to the cultural and indigenous productive systems in the hosts' areas, situations, where the accrued revenue is repatriated or lost through corruption, leave little or nothing for the development of the local economy [3]. These factors in addition to climate change impacts if not well-managed will compromise the future of the ecotourism industry.

Ghana's tourism sector heavily depends on ecological assets and the built environment, both of which are vulnerable to climate change impacts such as temperature rise and rainfall changes. Climate change is predicted to affect all ecological regions in Ghana. Its effects on biodiversity, specifically plants, and animals, are negative [14]. Aburi Botanical Garden serves as a habitat for various species of biodiversity which are therefore likely to be affected negatively by the current climate change, particularly the rising temperature and probably less rainfall. Several research works have been carried out to identify the effects of climate change on biodiversity in general [12], [14], [13], yet little has been done on how the modification in the life-forms and habitat changes of biodiversity in an ecological region like Aburi Botanical Garden, have affected the region's ability to serve its ecological purpose, specifically ecotourism. This research, therefore, seeks to come out with findings on the extent to which climate change has transformed and modified the garden by changing its observed temperature and rainfall patterns, and its long-term impact on the ecotourism potential of the garden.The conceptual model of the relationship between human activities, climate change, and biodiversity reduction is shown below:

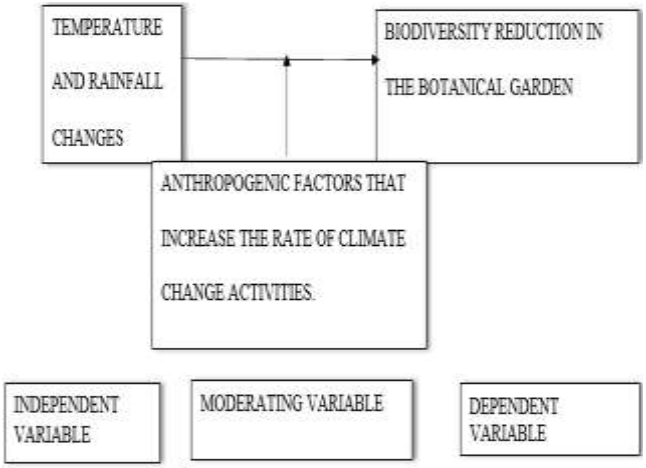

Figure1: A framework diagram showing the relationship between human activities (moderating variable), climate change (independent variable), and the reduction in biodiversity life forms (dependent variable) at the Aburi Botanical Gardens.

Source: Academic library of AAGBS International Conference on Business Management 2014.

II. METHOD

Study site

The area under study is the Aburi Botanical Gardens located in the Eastern region of Ghana. It is located about 38 kilometers northeast of Accra along the old Accra - Koforidua road, 22 kilometers from Nsawam and 48 kilometers from Koforidua. It overlooks the coastal plain, rising to an elevation of 370 to 460 meters above sea level [15]. Located on the Akwapim Togo Ranges of Ghana, it takes approximately three-quarters of an hour drive from Accra to get there[16]. The area falls between the Akwapim North and South Districts. Geographically, these districts lie within the west semi-equatorial climate and have a bi-modal rainfall pattern. The area is described as having a tropical climate because of its location in the forest zone [15]. The average temperature is about 23.7℃. The mean annual rainfall is about 1278mm, occurring within the two rainy seasons. The first season which accounts for 67% of the annual rainfall begins in March and ends in mid-July, whilst the second rainy season commences in mid-August and ends in October. The driest month is January with about 25mm of rainfall. Most of the rainfall is received in June with an average of 220mm.

August has the lowest average temperature, 21.7℃ in the whole year. March has the warmest temperature of about 25.1℃ (Meteorological Services Department, 2012).

It is one of the world's 2500 botanical gardens and between them grows the largest array of plant diversity outside nature and receives over 150 million visitors every year. The Garden was opened in March 1890 by the British colonial government in Ghana[17]. It covers an area of 64.8 hectares (160 acres) but only 12.2 hectares (30 acres) have been developed into a formal garden with the remaining 52.6 hectares forming the Botanical reserve. The map below shows the area of this study.

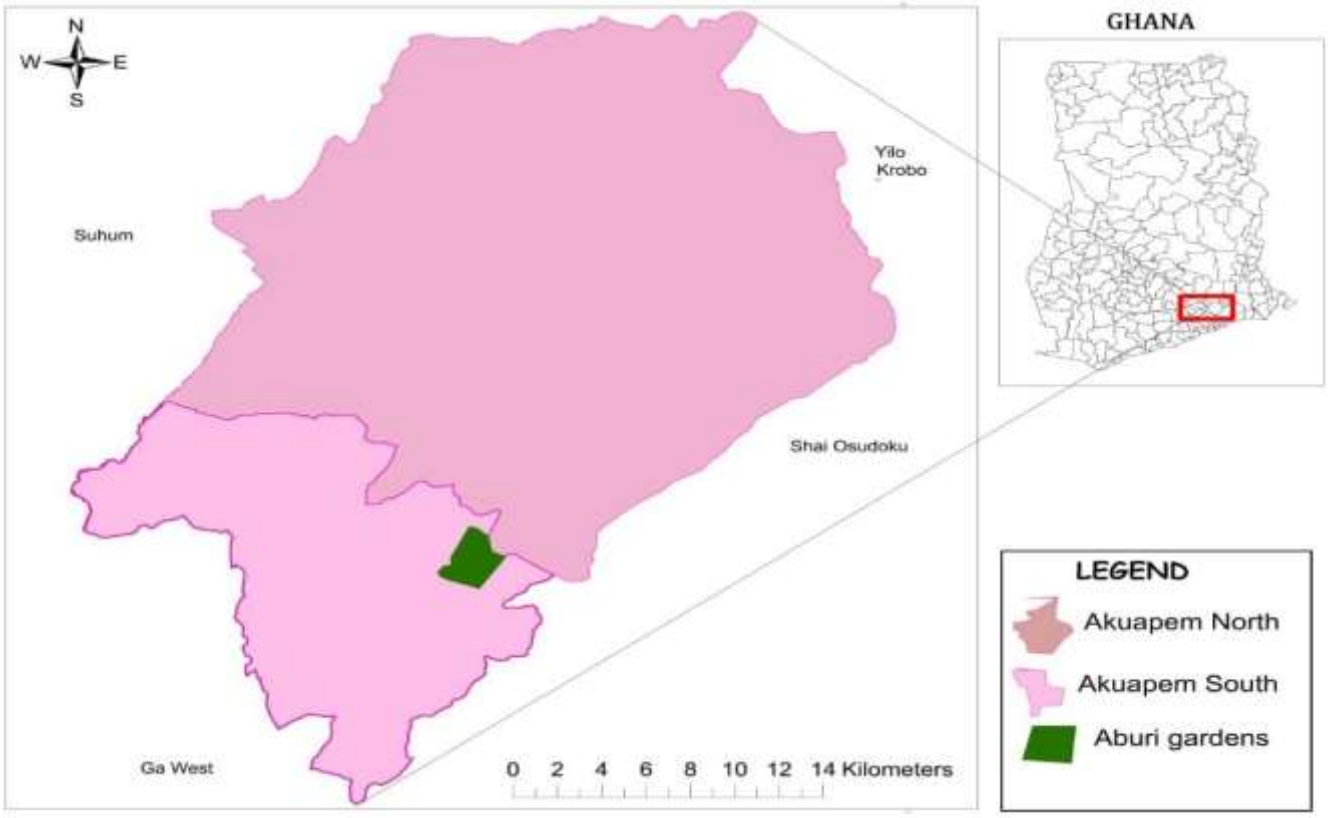

Figure 2: A map showing the location of the study (Aburi Botanical gardens)
Source: Author's Own Construct, 2019

Method of Data Collection

A mixed-method approach was used to acquire data for this work. A seven paged questionnaire with 28 questions based on the research objectives was designed to collect data from the workers at Aburi botanical garden. A purposive sampling method, specifically the snowball method was used in getting workers with relevant information about this research to fill theQuestionnaires. The initial respondent contacted, brought on board other respondents who had some good knowledge about the historical and present state of the garden. Only eleven workers fit the study criteria as the other workers were either not directly involved with the work in the Garden or had been there for only a short period. Four of the questionnaires were self-administered while seven were researcher administered. The disparities in the style of data collection using the questionnaires was because of the differences in literacy levels among the workers. The questionnaires required their knowledge on how changes in the two basic elements of climate, temperature, and rainfall had affected the state of the garden currently.

An in-depth interview was conducted with the curator of the Garden to know the different phases of change in the Garden's life forms and get a more extensive view and explanation on the causes of the change that had been recorded in the Garden. His knowledge of climate change impacts on the garden was tested during the interview. This lasted for 34 minutes and the interview was recorded with the curator's permission. Notes were also taken where necessary. The interview was guided by a one-paged 17 questions interview guide.

In addition to this data, historical data for the daily rainfall from January 1989 to October 2018 was acquired from the Bawaleshie synoptic station of Ghana Meteorological Agency. Figures for the daily minimum temperature for the same time frame of the area were collected. The daily maximum temperature data for January 1989 to October 2012 was also collected. This dataset was collected mainly to examine the changes in rainfall and temperature patterns of the Aburi Botanical Garden over the last 30 years.

Data Analysis

The temperature and rainfall data collected from the Ghana Meteorological Agency was analyzed using Microsoft Excel. Individual values for both rainfall, minimum and maximum temperatures were imputed into Microsoft Excel, after which excel formulas were used in computing aggregates and averages. The product of the average computations was represented in charts. Minimum and maximum temperature averages, as well as rainfall amounts, were represented with linear graphs, respectively.

The IBM SPSS (Statistical Package for Social Scientists, version 20) was used to analyze responses from the questionnaire survey conducted. Responses were analyzed using descriptive statistics. The interview conducted with the curator was transcribed manually. Information from the interview was written down from the recording. The vital information about the objective of this work was taken out for analysis and conclusions.

III. RESULTS AND DISCUSSIONS

Socio-Demographic Characteristics of Respondents

The research questions were responded to by all workers of the Aburi Botanical Garden except janitors, petty traders, food vendors, drivers, security personnel, receptionists, and waiters. Workers in direct contact with the garden were interviewed as well as the curator of the garden popularly known as 'chief'. Thus, the total number of respondents was 11. Out of this number, 8 were males while the remaining 3 were females. Again, 8 of these respondents fell under the category of permanent staff while 1 was noted to be a seasonal worker. The other 2 didn't disclose what type of workers they were.

Five (5) out of 11 respondents had between 5 to 10 years of work experience in the garden. Two (2) had worked in the garden for about 11 to 15 years, 1 had between 16 to 20 years of work experience and only 1 respondent had been working for more than 31 years in the garden. The remaining 2 respondents failed to indicate the number of years they had worked in the garden.

Temperature and rainfall trends at Aburi Botanical Garden

The Aburi Botanical Garden has been a good site for research and ecotourism in Ghana. With current changing patterns in rainfall and temperature, the functions of the Garden are likely to be compromised. The temperature trends from the central synoptic station at Bawaleshie for Aburi is shown in Figure 4.1. Temperature averages fall within the ranges of 23℃ to 26℃ from 1989 to 2013. A sharp drop in temperature to 20.3℃ was experienced in 2013, rising to 23.6℃ in 2018. Data sets from2014 to 2017 were unavailable at the Ghana Meteorological Agency, thus accounting for the sharp decrease seen in the curve. Within the averages, 1998 had the highest temperature of 26.1℃ and the year with the lowest value was 2006, recording an average of 23.9℃, followed by 24.8℃ in 2012. In some years, temperature averages were constant, indicating that temperature changes over a long period, precisely 30 years. Trends of temperature within these 30 years describe temperature variability. Temperature values shown on the graph are generally characteristic of either a+/- 0.1℃, 0.2℃, 0.3℃, or a 0.4℃ change, which in one way or the other affect the biodiversity in the garden. Seasonal temperature variation is however minimal in most tropical forests, but recent studies have suggested small temperature changes have the likelihood of affecting the distribution patterns of species [18].

The rainfall patterns from 1989 to 2018 are also shown in Fig 3. From the figure, rainfall patterns can be described as inconsistent. Amounts of rainfall are not static. From an interview with the garden's curator, he indicated that rainfall is not exactly less, but it fluctuates, with less fog in recent years compared to the '90s. Figure 4.2 also shows both appreciations and depreciation in rainfall amounts as the years go by. Most years recorded more than 1000mm of annual rainfall. Out of the 30 years dataset, only a handful recorded figures below 1000mm as seen in the years 1990, 1992, 1994, 1998, 2000, 2009, 2012, 2013, 2016, and 2018. 2016 recorded the lowest amount of rainfall of about 31.1mm. This low figure is because ofthe incomplete data provided by the synoptic station for that particular year. 1999 recorded the highest amount of rainfall of about 1668.4mm.

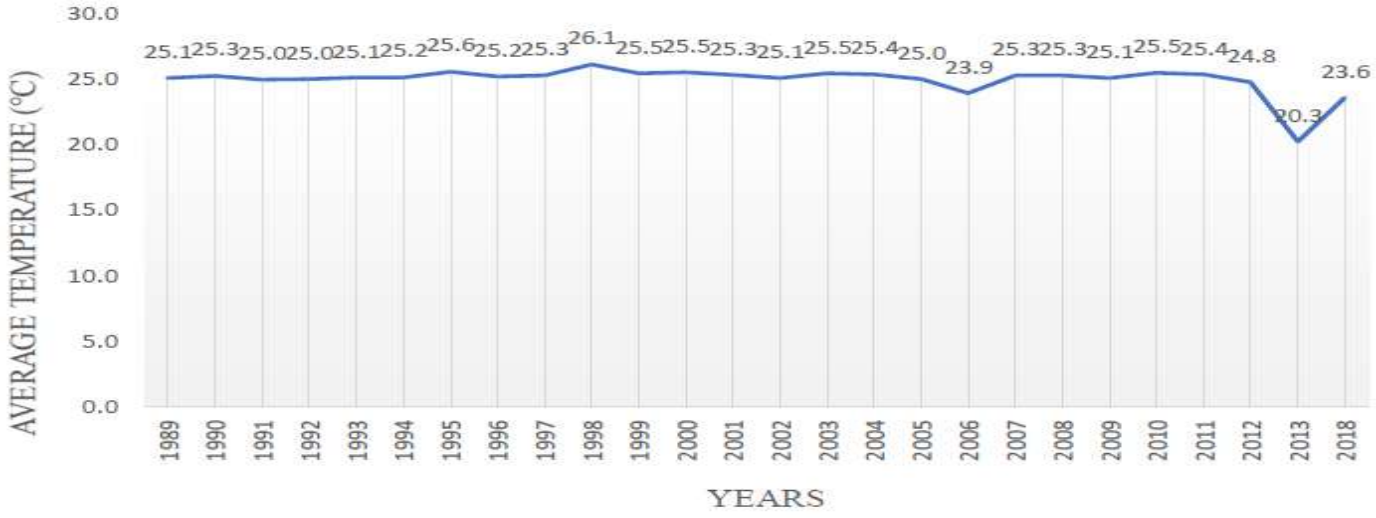

Figure 3: A graph showing the average values of temperature from 1989 to 2018.
Source: Ghana Meteorological Agency, 2018.

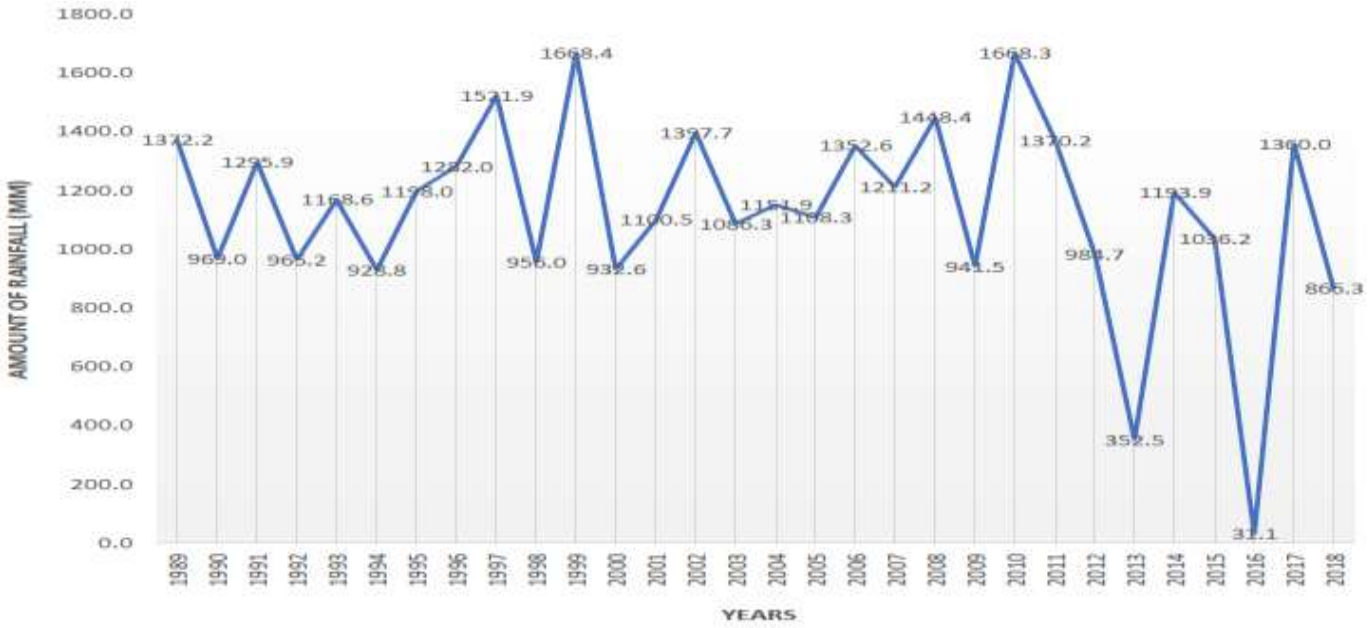

Figure 4: A line graph showing the total amount of rainfall for Aburi from 1989 to 2018 Source: Ghana Meteorological Agency, 2018

Table 1: Respondents' perception of changes in the amount and distribution of rainfall.

Observed changes in rainfall	Frequency	Percent (%)
Yes	13	59.1
No	7	31.8
Unanswered	2	9.1
Total	22	100

Source: Fieldwork, 2019

From Table 1, a greater percentage of workers who responded to the questionnaire, represented by 59.1%, are of the view that rainfall patterns and amount have changed over the past 5 years. Some years see an increase whilst other years see a decrease in the quantum of rainfall. Because of this, some stated emphatically that the past two years has experienced a great change in rainfall, especially in October 2015. It even rains heavily in November, extending to December in the past year. These patterns defy the normally observed patterns of rainfall distribution especially in December which is characterized by the dry season generally known as Harmattan. Despite observations made which indicate that patterns of rainfall distribution have been inconsistent over the years, its distribution is rather prolonged. For instance, in the latter part of 2018 to date, the amount of rainfall has decreased beyond the usual. About 31.8% of respondents' population however think that rainfall patterns and amount have not changed in anyway. These responses represent the minority. Customarily, June to July record the highest amount of rainfall in the Aburi Botanical Garden. The curator of the garden also confirmed this claim in his response, including August. However, a little shift from the norm has been observed. According to the curator, rains initially started in March – April but now they start on days and months that are not expected. Rains started as early as January through to February this year. He also noted that there is either too much rainfall or too much drought now. He attributed these rainfall changes to high temperatures. Other responses also indicated variations in rainfall months. In 2014, the month of June recorded the highest amount of rainfall of 230.4 millimetres. The trend changed in 2015, with March recording 290.9 millimetres of rainfall. In 2016, September recorded the highest with an amount of 263.2 millimetres. May 2017 recorded an amount of 260.8 millimetres whilst September again recorded the highest rainfall amount in 2018 with a rainfall figure of 185.4 millimetres. Although it virtually rained throughout the year in 2018, there was a decrease in the amount of rainfall compared to past years. This was emphasized by the curator as well. The trends in the months with the highest rainfall from 2015 to 2018 point to the fact that the amount of rainfall has reduced. Generally, rainfall is known as having a great influence on species richness, composition, and distribution [18].

Table 2: Responses showing the character of rainfall over thepast 5 years.

Characteristic of rainfall change	Frequency	Percent (%)
Increased amount of rainfall	5	45.5
Decreased amount of rainfall	5	45.5
Unanswered	1	9.1
Total	11	100

Source: Fieldwork, 2019.

Table 3: Temperature changes

Observed temperature changes	Frequency	Percent
Yes	5	45.5
No	4	36.4
Unanswered	2	18.2
Total	11	100

Source: Fieldwork, 2019

From table 3, Five (5) out of 11 respondents agree to changes in temperature. This was supported by the curator of the garden, who per his knowledge on ozone depletion and global warming, indicated that there is too much penetration of the sun's rays, increasing temperature and changing the state of the atmosphere. Four (4) out of the 11 respondents thought otherwise that temperatures have changed while two left the question unanswered.

Table 4: Description of temperature changes

Type of temperature change	Frequency	Percent
Increasing temperature	4	36.4
Decreasing temperature	1	9.1
Unanswered	6	54.5
Total	11	100

Source: Fieldwork, 2019.

From Table 4, the temperature has been inconsistent with more records of it increasing. Seasonality in temperature is relevant for the growth of species and their distribution as most annual net primary production of trees in seasonal forests are concentrated in months recording high rainfall and growth is likely to be most sensitive to temperature variability during such times of the year [18].

Table 5: Respondents observation of rainfall changes in animal species

Observed rainfall changes	Frequency	Percent (%)
Yes	2	18.2
No	6	54.5
Can't tell	3	27.3
Total	11	100

Source: Fieldwork, 2019

Table 5 paints a picture that animal species have not been affected by rainfall changes. This is observed by the 2 yes responses out of a total of 11 respondents, representing 18.2%. A greater proportion of the respondents are either of the views that rainfall changes have not affected the animal species in the garden or unaware of the presence of animals in the garden, to even observe how rainfall pattern changes affect them. This second group of respondents accounts for 81.8% of the total responses, forming the majority. However, according to the initial two respondents, rainfall has caused migration and extinction in some animal species in the garden, such that, most are usually outside during the rainy seasons and indoors in times of less rain. Examples of such species are birds; snails; insects and mammals.

Table 6: Effects of observed rainfall changes in plant species

Effects of rainfall changes	Frequency	Percent
Yes	4	36.4
No	5	45.5
Unanswered	2	18.2
Total	11	100

Source: Fieldwork, 2019

Responses from Table 6, show that almost half of the sample population, representing 45.5% disagree with the fact that rainfall changes have had any impacts on plants and their behavior.about 36.4% of the population attested to rainfall changes having an impact on plants. Rainfall changes have affected each tree differently because each tree has its behavior. Through experimental studies on the greenhouse effect, it has been discovered that seasonal drought has a strong effect on the growth and survival of individual tree species [18]. Some points were raised by the workers to support their attestation. A couple of them indicated that they had observed a drastic decline in the viability of seeds; their germination; growth; flowering and seeding of some plant species in the garden over the years, leading to their extinction. Species would go extinct when they exceed the adaptive capacity that enables them to adjust to climate change [12]. Some plants have not produced fruits or flowered over the period. The curator added that while some fruit earlier than their season, others fruit later. In years of local drought, some trees produce flowers alright but do not fruit. Years with long periods of droughts experience no fruiting at all.

Other workers were also of the view that plants lose the green state of nature. Usually, when there is low or no rainfall, the leaves of plants get dry and fall off hence keeping some areas less attractive as compared to when it rains. This is an indication of less moisture or water saturation in the atmosphere. Drier climate coupled with other human activities may result in incidences of fire which will cause further changes in the composition of the forest [18].

Table 7: Effects of temperature changes on animal species

Temperature changes effect	Frequency	Percent (%)
Yes	1	9.1
No	4	36.4
Can't tell	3	27.3
Unanswered	3	27.3
Total	11	100

Source: Fieldwork, 2019

Table 7 shows that workers in the garden seem to be unsure about the existence of animals, thus, most of them responded no, cannottell, or selected no response at all. Only one out of the total number of respondents answered yes to the question onthe effects of temperature changes on animal species. Again, animals migrate which is an indication of an adaptive capacity to climate change [12], and some are forced out of existence, generally resulting in their extinction because of temperature changes. Local and global extinctions are highly possible when climate change outpaces the capacity of species to adapt [12]. Some of these animal species include birds, mammals, snails, and insects.

Table 8: Effects of temperature changes on plant species

Effects of temperature changes	Frequency	Percent (%)
Yes	3	27.3
No	4	36.4
Can't tell	2	18.2
Unanswered	2	18.2
Total	11	100

Source: Fieldwork, 2019

It has been observed that some plant species have been faced with a drastic decline in the aspects of germination; growth; flowering; seeding and the viability of seeds. Some plants have therefore experienced late flowering; thereby affecting their seeding and fruiting. Examples of plant species that have gone extinct due to temperature changes are algae, mosses, wild orchids, and ferns. Besides, cayota urens and apple tree other trees that could be found in the garden in the mid 19's are no longer in existence.

Table 9: Reduction in eco-tourism potential of the garden due to temperature and rainfall changes.

Ecotourism potential	Frequency	Percent (%)
Yes	5	22.7
No	11	50.0
Unanswered	6	27.3
Total	22	100

Source: Fieldwork, 2019

Separate responses from the garden's inability to fully serve its ecotourism potential amidst temperature and rainfall changes have been collated in Table 9, producing 22 responses in all from 11 respondents. 11 out of the 22 responses show that the garden's eco-tourism potential has not reduced, representing the majority group. They stated with reasons like, despite the reduction in annual rainfall, it can refresh or nourish the plants and the trees. This is further explained that the changes in rainfall amounts and patterns have rather encouraged the performance of other species (flora and fauna), therefore enhancing the biodiversity task. The curator explained that the presence of the botanic garden, however, with several trees has regulated the amount of rainfall despite the increase in the penetration of the sun's rays. Effects of high temperatures are not felt that much because winds blow from the west to the east, thus most trees are titled towards the east, resulting in the place being cool all the time.

Potential remains intact because tourists don't usually schedule their visits during rainy seasons. People still visit in their numbers during the peak periods of tourism especially during festivals and summer times. Some maintenance practices are also being carried out on a routine basis. Throughout the year, there are replacement plantings, enrichment plantings, and ceremonial plantings. Volunteer plant species are encouraged as well, with frequent monitoring to ensure their survival. Nurseries are also maintained, and weeds cleared constantly with some form of small scale internal irrigation project ongoing to maintain the state of the garden, as stated by the garden's curator.

On the other hand, a few out of the minority made it known that during the harmattan season, the green grass gets dry and as a result, they cannot be marketed and sold as ecotourism products. Addressing the issue of temperature changes and ecotourism potential, people still visit despite temperature changes. The garden is always normal and if even it changes, it also serves in a good way by regulating the cold in the garden and its environs. The siting of the garden on a hill in tandem with the presence of several tall trees generally keeps the weather of the garden cooler than its surroundings. Temperature changes are therefore not felt significantly. Furthermore, temperature changes also have a positive effect on some species (flora and fauna), which is especially obvious in the flowering; pollination: seeding and germination of rare plant species.

Other Key Findings

- The trees that are lost in the garden are mainly because of aging. Some trees have been standing strong since 1875.
- Others are lost due to encroachment by the town's people.
- The place started as an agricultural research centre in 1890 but due to unfavourable conditions, plants and animals reared in that space were not doing well, thus, its transformation into a botanic garden in 1928.
- The botanical garden is strictly not an ecotourism site but over the years, people visited the place just because of its natural setting, thus considering the garden as one.

IV. SUMMARY OF FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Finding

All findings point to the fact that there has been a significant change in global climate, however, the impacts of the changes in rainfall and temperature have not been significant in the

Aburi Botanical garden. The garden remains strong with good ever-green vegetation that can carry out its manifest function of being a botanic garden, and still fulfilling its latent aim of being an ecotourism site. A conclusion can therefore be made that these changes are viable factors for the garden's growth. Amidst the other challenges which are non-climatic, the current climate change has enhanced and promoted growth in the garden. At the global scale, rainfall is known to have an enormous influence on species richness, composition, and distribution [18].

Conclusion

This study aimed at identifying the direct link between climate change and ecological regions and how these changes have affected biodiversity at the Aburi Botanical Garden, which serves as an ecotourism site. Rainfall and temperature specifically, were the variables used to determine the rate and impact of the phenomenon of climate change on the garden. A 30-year data set for rainfall and temperature respectively were collected from the synoptic station at Bawaleshie. Changes in rainfall and temperature were measured using these data sets. The resultant changes were used as yardsticks for measuring the ecotourism potential of the garden now, compared to times past. Questionnaires were given out to workers of the garden who had relevant knowledge of the study. An in-depth interview was also conducted with the curator of the garden. The total number of respondents was 11 based on the requirements of the study. The study made some findings that rainfall had decreased, and temperatures had increased, although these changes had little impact on the garden. The garden acted as an anti-climate change site since it was able to nourish itself and create more rainfall with the existence of numerous trees. Its location on a mountain ridge also reduced the influence of climate change impacts on it. The outcome of the study, therefore, satisfied the null hypothesis which stated that "Climate change in the Aburi Botanical Garden would promote plant growth through more photosynthesis, thus increasing the biodiversity (species richness) of especially plants in the garden and enhance its ecotourism potential".

Recommendation

Based on the findings of the research, the study makes the following recommendations:

- The government should lift the ban on employment to ensure that there are enough workers to carry out various maintenance practices to keep the garden in existence amidst the impacts of climate change.
- Workers should also be well-groomed and educated about the livelihood in the garden.
- Management of the garden should allow some fallow period in the garden. These are periods where no ecotourism activities or even learning activities would go on, but rather, the garden would be shut down temporarily to visitors to allow effective maintenance practices and to ensure that trees recover and grow very well.
- New varieties of plants and animals that are resistant to climate change should be introduced into the garden as an adaptive measure to future adverse impacts of climate change.
- The garden should be barricaded with security surveillance to check encroachment by community people. Demarcations should be clear enough to avoid conflicts over the land bearing the garden.

REFERENCES

[1] Cassandra. 8 Reasons Why Parks are Important. 2013. Retrieved from http://www.gardinergreenribbon.com/why-parks-are-important/. Accessed 2018/10/10

[2] Otoo, B. The impacts of ecotourism on Ghana's growing economy. 2017 Retrieved from https://www.myjoyonline.com. Accessed 2018/10/14

[3] Woods, A. Problems with Ecotourism. Travel Tips - USA Today. 2018. Retrieved from https://traveltips.usatoday.com/problems-ecotourism-108359.html. Accessed 2018/11/05

[4] Edgell DL, Allen MD, Smith G, Swanson J. Tourism policy and planning: Yesterday, today, and tomorrow. Routledge; 2008 Sep 10.

[5] Groom MJ, Podolsky RD, and Munn CA. Tourism as a sustained use of wildlife: a case study of Madre de Dios, southeastern Peru. Tourism as a sustained use of wildlife: a case study of Madre de Dios, southeastern Peru... 1991:393-412.

[6] Munn CA. Macaw biology and ecotourism, or" When a bird in the bush is worth two in the hand". New world parrots in crisis: solutions from conservation biology. 1992.

[7] Ceballos-Lascurain H. Tourism, ecotourism, and protected areas: The state of nature-based tourism around the world and guidelines for its development. Iucn; 1996.

[8] Neequaye, I. Top five Ecotourism Sites in Ghana to Visit in 2018. 2017 Retrieved from https://www.tourismologist.com. Accessed 2018/10/10

[9] Becken S. The importance of climate and weather for tourism. Land Environment and People (LEaP) background paper, Lincoln University. 2010 Feb: 4-13

[10] S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor& H.L. Miller (Eds.). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

[11] Ijeomah, H. M., &Aiyeloja, A. A. (2009). Impact of Climate Change on Sustainable Tourism Management in Plateau State, Nigeria. Journal of Sustainable Development in Africa, 11(1), 23-34.

[12] Carter, S., Peterson, J., Lipton, D., Rubenstein, M.A., Weiskopf, S.R., Crozier, L., Fogarty, M., Gaichas, S., Hyde, K.J., Morelli, T.L. and Morisette, J., Ecosystems, Ecosystem Services, and Biodiversity. 2018|: pp259–312.

[13] Carter, S., Peterson, J., Lipton, D., Rubenstein, M.A., Weiskopf, S.R., Crozier, L., Fogarty, M., Gaichas, S., Hyde, K.J., Morelli, T.L. and Morisette, J., Ecosystems, Ecosystem Services, and Biodiversity. 2018|: pp259–312.

[14] Convention on Biological Diversity. Climate Change and Biodiversity. 2018. Retrieved from https://www.cbd.int/climate/intro.shtml. Accessed 2018/11/05

[15] Department of Parks and Gardens. (2018). Retrieved from http://parksandgardens.gov.gh/2018/05/07/aburi-botanic-garden/. Accessed 2018/10/10

[16] Asamoah-Boateng, N.K. Experience the Best Eco-tourism in Ghana. 2018, August 10

[17] Africa Ghana Travels. Aburi Botanical Gardens. Retrieve from https://www.flyingfourchette.com/2013/10/03/aburi-botanical-gardens/. 2013 Accessed 2018/10/10

[18] Amissah L, Mohren GM, Bongers F, Hawthorne WD, Poorter L. Rainfall and temperature affect tree species distribution in Ghana. Journal of Tropical Ecology. 2014 Sep; 30 (5):435-46.