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CLIMATE CHANGE, ENERGY DEMAND AND TOURISM IN AFRICA

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Abstract

Globally, the demand for fossil fuel is one of the greatest threats to climate change and tourism. Sequel to this, opposing strands of literature exist on the impact of climate change on economic growth. However, economic implication of climate change is beyond economic growth as it affects other sensitive African reliant sector like tourism. Also, checkmating fossil fuel consumption has been consistently advocated as a viable response to containing climate change to mitigate its effect on the tourism but, there is paucity of research to this fact especially in African continent. It is against this backdrop that this paper investigated climate change, energy demand and tourism in Africa. This objective was achieved using two stage system generalized method of moment (2SSGM) and Dynamic Correlation Common Effect (DCCE) mechanisms. The findings from the analysis suggests that while precipitation (PREP) and temperature (TEMP) are significant climate change variables influencing tourism arrivals in Africa, carbon monoxide CO2 emission is insignificant statistically in influencing tourism arrivals in the region. On this note, the study recommends that cleaner energy that will reduce climate change so as enhance tourism arrivals in Africa should be incorporated in the regional energy plans.

Keyword: Climate change, Energy demand, Tourism Africa

JEL Classification: Q54, Q42, G11, L83.

1. Introduction

Tourism is one of the fastest growing industries in the world, providing 235 million jobs globally and contributing about 5% to global gross domestic product (WDI, 2022). However, tourism arrivals in Africa have been on the decline especially in the past twenty years. This decline is orchestrated by climate change brought about by huge emissions of greenhouse gases (GHGs) into the atmosphere via the burning of conventional fuels and non-conventional fuels. Thus, the global atmospheric composition has changed owing to increased usage of these fuels with CO_2 accounting for more than 50% of all global GHG emissions and contributing to the increase in long-lived gases (Apergis, Gavriilidis, & Gupta, 2022). Consequently, given the growing concentration of these GHGs longer wave radiation from the Earth is absorbed, hence reducing the energy lost to space and altering the natural balance between in and out sun radiation which alters the climatic settings of the earth plus the economy (Bishoge, Kombe, & Mvile, 2020).

Africa is currently facing the adverse effects of climate change that is seriously affecting the continent in every dimension. For instance, Mount Kilimanjaro one of the highest mountains in the world is now being affected by global warming as glaciers are gradually disappearing. In a related development, the current weather phenomena are affecting other glaiers high peaks in the African continent such as Ruwenzori in Ugada and Mount Kenya in Kenya. Also, Lake Chad is rapidly receding up because of climate change as its original size of 1963 has now been reduced to mere 5% (Chenchireddy, Jegathesan, & Kumar, 2020). Furthermore, unparalleled floods in Western Africa, prolonged and increased droughts in Eastern Africa, in Central Africa lengthier and more recurrent heat waves (1.5-2) °C, dwindling tropical forest cover in Central Africa and an upsurge in wet extremes. Besides, around the Southern Africa coast, an upsurge in ocean acidity with recurrent droughts experienced in the Sudano-Sahelian belt have increased the worries and impact of climate change (Bishoge, Kombe. & Mvile, 2020). Consequently, tourism destination such as beach

destination, ski resorts, wildlife are affected by climate change through global warming, extreme weather, rising in sea level and ocean acidification and disruption of ecosystem. Despite these dire consequences on African tourism and the impact projected to be more with a 2-3°C rise by 2050 and 2-5°C by 2100 on average temperature, there seems not to an end to this as the key producers of GHG such as Republic of China, India, and the United States are undecided to practically commit to binding commitments or agreement to cutting their GHG emissions (Chenchireddy, et al 2022).

These impacts are vital to assess since a large segment of African population is reliant on climate-sensitive sectors especially tourism. It is against this backdrop that this paper investigated the effect of climate change on energy demand and tourism in Africa using panel data techniques. The rest of the paper is structured into 4 Sections. Section 2 reviews relevant theoretical and empirical literature. Section 3 outlines the methodology while Section 4 presents and discusses the results. Section 5 provides the conclusion and policy implications.

2. Literature Review

2.1 Theoretical Literature Review

The study is anchored on Anthropogenic Global Warming Theory propounded by Arrhenius (1896), Tourism – led growth hypothesis formulated by Cantavella – Jorda (2002) and the push – pull theory of tourism. The Anthropogenic Global Warming Theory has it that burning from conventional and non – conventional fuel produces CO2 that cause climate change. That is climate change is caused by human beings unchecked consumption of fossil fuels that gradually led to rises in atmospheric greenhouse gases, mostly called carbon dioxide CO2 that lead to global warming. This situation is acerbated by persistent consumption of fossil fuel and deforestation that double the level of CO2 emission into the atmosphere. The tourism – led growth hypothesis developed by Cantavella – Jorda (2002) stressed the crucial role played by tourism in the economic growth process. Thus, harnessing the tourism sector potentials is a key lead way to sustainable economic growth as exemplified by the case of United Arab Emirate. Consequently, climate change caused by increased energy demand affect tourism sector which ultimately retards economic growth. Finally, the push – pull theory developed by Everett Lee (1966) has it that tourism is either forced or captivated to leave a given place to another place. Thus, the urge for tourism involves choosing between a tourist attraction that suits your desire and be captivated towards moving to the place because of what they can avail of called the pull factors or be pushed away from the tourism centres due to conditions not attractive to tourists called the push factors. Therefore, the pull forces are fundamental in choosing a tourist service. Consequently, the greater the pull forces the more in the number of tourism arrivals. Finally, push forces on the other hand such as poor climate pushes tourists away.

2.2 Empirical Review

Bekun et al., (2022), conducted a study on Tourism-induced emission in Sub-Saharan Africa: A panel study for oil-producing and non-oil-producing countries using cross section dependence (CD) test which is use for either first generation or second-generation panel data econometric techniques. The result from the CD will be bias if the test is not done, to avoid such issues the author employed three test such as pesaran (2007) CD test, the Pesaran (2015) scale LM TEST, and Breusch-pagan (1980) LM Test. From the non-oil countries, a positive and statistically significant relationship exist between tourism arrival and carbon emission. While in the oil sector there is unidirectional transmission is found passing into carbon emission from tourism arrival. It is recommended that there should be increase in sustainable, cleaner energy sources for economies in order to reduce the continent's dependency on fossil fuel emissions.

Abbass, et al., (2022), looked at a review of the global climate change impacts, adaptation, and sustainable mitigation measures. By employing a standardized method to investigate hypothetical scenarios of climate variability. The findings demonstrated that government involvement is vital for the country long-term development through strict accountability of resources and regulations implemented for cutting edge climate policy. Therefore, the founding suggested that government should inculcate policy that has positive impact with global commitment to address it negative effect of climate change in the world.

Kang, et al., (2020), examined energy systems for climate change mitigation using bibliometric method to

exploring the structure, features and evolution of energy system. This is because global climate change involves diverse challenges including scientific, technology, political and economic dimensions the between energy system and climate change. Therefore, it was recommended that increase in technology advancement will help in climate change mitigation.

Khan, et al., (2020), evaluated Natural resources, tourism development, and energy-growth- CO_2 emission nexus: A simultaneity modeling analysis of (BRI) countries using four system equations are income, CO_2 emission, energy use and tourism as the dependent variable. The system GMM diagnosed feedback effect between energy use and income validated energy push emission in collaboration with Environment Kuznet Curve (EKC) for Belt and Road Initiative (BRI) countries. The causality result showed bidirectional relationship between tourism and income, likewise, tourism push emission hypothesis validated for BRI countries. Consequently, natural resources have negative and significant impact on income. However, there is a positive and significant relationship between tourism and carbon dioxide emission. The study recommended the allocation of funds on green infrastructure are required to enhance the environmental quality and improve output production.

Isik, Dogru, and Turk, (2018), the purpose of this study is to analyze the nexus of linear and non-linear relationships between tourism demand, renewable energy consumption, and economic growth in United States, France, Spain, China, Italy, Turkey and Germany. The study utilized the use of different causality techniques like the Bootstrap, granger causality to check for relationships among the variable which are economic growth (EG) as the dependent variable, while renewal energy consumption (REC) and Tourism arrival (TA) as the independent variables. From the result of the finding EG and REC has a bi-directional relationship, also GDP and TA are both having a bi-directional relationship. Consequently, tourism development influences economic growth in China and Turkey. Nevertheless, the reverse is real in Spain. Therefore, it was recommended that countries can achieve growth in tourism and renewable energy industries by designating primary renewable energy industry zones and subsidizing the traditional energy sectors can gradually shift to renewable energy production.

Grimm, Alcântara and Sampaio (2018), carried out an investigation on tourism under climate change scenarios: impacts, possibilities, and challenges. The study employed bibliometric and documentary analysis on the relationship between tourism and climate change in collaboration of a panel experts composed of scholars using descriptive statistics. The result shows the effect of climate change by showing direct and indirect of tourism in conservative areas. It is recommended that the whole tourism system can take step to alleviate GHG emissions associated with less polluting mean of transport, look for products and activities with no carbon emission.

Governments and communities should seek to develop a normative framework policy that enhances energy efficiency and water transportation for tourism development.

Fant, Schlosser and Strzepek, (2016), reviewed the impact of climate change on wind and solar resources. The study used risk-based climate projection from the integrated Global System Model, which recognize emissions and global climate sensitivity uncertainty with more regionally climate information from 8 Global Climate Model (GCMs) were used as a case study. The result shows that median change close to zero by 2050 in the long term mean both wind speed and Global Horizontal Irradiance (GHI), which is used as indicators of changes in electricity production potential. A statistical model was used to increase a hybrid method which includes wind and solar parameter estimations, efficiently productive outcomes. The result shows that change in wind and solar are detrimental by the year 2050 because of variation in emission while change in windspeed is highly justified. The study recommended that government should increase renewable energy in the same direction with windspeed that can affect productivity increase and boost economy positively.

Danish and Wang, (2018), asserted to examine the dynamic relationship between tourism, economic growth, and environmental quality applying panel estimation method to check cross-sectional dependence and heterogeneity. The result showed that investment in tourism improves economic growth and alleviates the level of CO_2 emission. Also, tourism sector stimulates economic growth but impairs environmental quality.

Finally, tourism revenue and expenditure Granger cause each other. It is recommended that the BRICS government should launch more energy efficient green transportation schemes and green mass bus transit project in areas that has more tourism that via internet and television to send positive message to tourist destination that is clean and environmentally friendly. More so, negative externalities in form of waste dumping and has negative effect to the environment should be levies.

Sajjad, Noreen and Zaman (2014), conducted a study to examine the long-run and causal relationship between Climate change and air pollution jointly creating nightmare for tourism industry using Autoregressive distributed lag model (ARDL) Techniques. The result shows that climatic factors and air pollution have a negative influence on tourism in deforestation and natural resources depletion, the impact is clear because of systematic eroding of tourism sectors that affect climate change in collaboration of air pollution. It is recommended that there should be cross country research, technical assistance and knowledge sharing on climate change that can bring economic development.

Although extant studies abound on climate change and tourism, however, this mainly in developed countries with paucity of it in developing countries. Methodologically, extant studies are deficient as they fail to account for heterogeneity in panel unit that is most common in larger panel data. Also, most of reviewed existing studies assumes cross – sectional independence, however, in the presence of several shocks such as technological, productivity or economic, the assumption of cross – sectional independence is erroneous. To cure these deficiencies, the study made use of dynamic common correlation effect (DCCE) mean group estimator that incorporates heterogeneity cross – sectional dependence and structural breaks as analytical techniques.

3. Methodology

3.1 Method of Data Analysis

The analytical framework of this study is anchored on push – pull model developed by Lee (1966). This is found appropriate for two reasons. First, tourism sector is a dynamic – complex sector incorporating several factors with inherent cause and effect links. These dynamic factors are both endogenous (ecosystem) and exogenous (energy consumption). Second, the study pertinent variables are analyzed within the purview of push – pull model. This is because climate change variables are fundamental in influencing the choice of tourism or vacations.

3.2. Data and Sources

Table 1: Variable and Sources

Variable	Definition/ Measurement	Source
Precipitation	Condensation descends due to gravitational attraction. It is measured in millimeter (MM)	WDI, 2022
Carbon monoxide CO_2	This is emissions due to fossil energy consumption. It is measured in metric tons	WDI, 2022
Tourism	This is measured by the number of tourist's arrivals	WDI, 2022
Temperature	This is degree of hotness or coolness of an object. It is measured in Celsius	WDI, 2022

Source: Authors' computation, 2024

3.3 Model Specification

The model of this paper is anchored on push – pull model. Thus, algebraically, the push – pull model is stated thus:

$$\gamma_{ij} = \left(\frac{R_i E_i}{Kij}\right) \text{ i } \neq \text{j} \quad (1)$$

Where γ_{ij} = Tourism arrivals in time intervals, Kij = Distance in kilometers between the tourists' place of residence and the tourist place, R_i = the push factors and E_i = the pull factors.

Thus, $T_{ij} = f\ (\ R_{i,j}, E_{i,j)}$ (2)

Where, T_{ij} = The number of tourism arrivals, $R_{i,j}$ = Are the push variable, E_{ij} = The pull variables.

Re specifying equation (2) into econometric models gives

$T_{i,j} = \propto_0 + \propto_1 R_{it} + \propto_2 E_{it} + \cup_{it}$.(3)

Where $\propto_0$ = The intercept, $\propto_1$ and $\propto_1$ = Regression coefficient parameters, t = time and $\cup$ = Error term.

However, equation (3) is a static model as such cannot estimate the dynamics in tourism variables modelling. Thus, specifying the push and pull model using system generalized method of moment (SGMM) gives

$$T_{i,t} = \beta_0 + \beta_1 T_{i,t-j} + \beta_2 CV_{i,t-j} + \sum_{j=1}^{4} \beta_j V_{i,t-j} + \propto_i + \cup_t + \cup_{i,t-j} \ldots\ldots(4)$$

Where, T_i = Tourism arrivals, C = Climate change variables such as precipitations, temperature and carbon monoxide, V = Control variables, $\cup_t$ = Time specific constant and $\cup_{i,t}$ = Error term,

$T_{i,t-j}$ = First lag operator of $T_{i,t}$, β_1 and β_2 are dynamic impacts

It is expected that the effect of climate change variables on tourisms be negative That is and < 0.

4. Results and Discussion

4.1 Descriptive Statistics

The table on descriptive statistics show the mean, minimum and maximum values of the variables employed in the model. The result is presented on table

Table 2: Descriptive Statistics Result

Variable	OBS	Mean	Minimum	Maximum	STD
Temperature (TEMP)	161	24.1	11.8	29.4	3.5
Precipitation (PREP)	161	76.9	1.6	26.8	47.0
Carbon monoxide (C02)	161	1.3	0.1	10.0	2.1
Terrorism (TORM)	111	14.3	4.5	16.8	25.5

Source: Authors' Computation, 2024

The findings from the descriptive statistics reveals that for 51 African countries for the period under scrutiny, the tourists' arrival rate on average is 14.3%. This is very low compared to global projection of 57% by 2030 of tourists' arrivals emanating from Africa. This implies that although, the African region recorded growth in tourism arrivals, however, in real terms, African tourism rate performance lags global projected average of 57% by 2030. Similarly, the findings from the descriptive statistics shows that different sources of climate change have varying effect on tourism arrivals. For instance, while precipitation on average accounts for almost 77% influence on tourism arrivals, carbon monoxide CO2 which supposedly ought to account most in influencing tourism arrivals to region has the least influence.

To ascertain the inter correlation among the variables used in estimation, the paper conducted correlation coefficient matrix and the resulted is presented on table 3

Table 3. Correlation coefficient Matrix Result

	TORM	PREP	TEMP	CO2
TORM	1.00			
PREP	-0.44*	1.00		
TEMP	-0.39**	-0.2**	1,00	
CO_2	-0.36	-0.2	-0.25**	1.00

Source: Authors' Computation, 2024 Note * =1% and ** = 5% level of significance

The findings from the correlation coefficient matrix shows no substantial correlation among the variables used for the estimation. This implies that multicollinearity is not an issue in the present inquiry. However, indicators of climate change are highly correlated and therefore will be treated separately. The findings also show that indicators of climate change are inversely correlated with the indicators of tourisms.

Given that the pre-condition for the use of system generalized method of moment (SGMM) and Dynamic Common Correlation Effect (DCCE) requires the existence of cross–sectional dependence among the variables employed in the estimation, the paper utilized Pearson (2015) cross – sectional dependence test. This is found appropriate because it is robust for an unbalanced panel such as the one used in this paper. The result of the utilized Pearson (2015) cross – sectional dependence test is presented on table 4

Table 4: Cross – Sectional Dependence test Result

Variable	Test Value
Tourism	41.6***
	(0.000)
Precipitation	15.1***
	(0.000)
Temperature	10.1***
	(0.000)
Carbon monoxide	2.6**
	(0.008)

Source: Authors' computation, Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

The findings from the cross - sectional dependence test result reveals a significant existence of cross – sectional dependence for each of the variable of interest to the paper at 1% and 5% respectively. Thus, the presence of cross – sectional dependence suggests that conventional generalized panel estimators such as fixed and random effect among others which major assumption depends on the supposition of cross – sectional independency becomes grossly inappropriate in this paper. To this effect, SGMM and DCCE becomes most appropriate. The result is presented on table 5

Table 5: SSGMM and DCCE Results on Tourism and Climate change variables

	African countries	**North Africa**	**East Africa**	**West Africa**	**South Africa**
Variables	**SGMM**	**DCCE Estimator**			
TORM	0.9*	0.4*	0.5*	0.3*	0.08
	(0.04)	(0.06)	(0.08)	(0.07)	(0.30)
CO2	-0.004	-0.8	-0.52	1.0	-0.05
	(0.01)	(0.60)	(1.42)	(2.20)	(0.05)
PREP	-0.001**	0.04	-0.001	-0.001	-0.03
	(0.004)	(0.03)	(0.002)	(0.01)	(0.002)
TEMP	-0.02**	0.30	0.02	-0.22	-0.04
	(0.006)	(0.30)	(0.10)	(0.20)	(0.22)
OBS	935	146	292	296	123
Long run TORM – 1.37*					
Num of instru. 33 (0.05)					
AR1 0.01					
AR2 0.04					
Sargan 0.6					
Hansen 0.20					

Source: Authors' computation, 2024.

The findings from two stage system generalized method of moment (2SSGM) analysis indicates that while precipitation (PREP) and temperature (TEMP) are significant climate change variables influencing tourism

arrivals in Africa, carbon monoxide CO_2 emission is insignificant statistically in influencing tourism arrivals in the region. In terms of effect, the findings imply that in the short run while one-degree Celsius change in temperature brings about 2% decline in tourism arrivals in Africa, one metric ton's per capita change in CO_2 emission and one-millimeter change in precipitation bring about 0.4% and 0.1 % decline in tourism arrivals respectively in Africa. In the long run, the negative influences of temperature (TEMP) on tourism arrivals becomes even worse as one-degree Celsius change in temperature brings about 14% decline in tourism arrivals. These finding buttress the finding of Grimm, Alcântara and Sampaio (2018) who found that higher global temperatures impact negatively on global tourism arrivals.

5. Conclusion and Recommendations

Although, the drive towards climate change mitigation is a global concern, however, the key countries in CO2 emission are reluctant to binding agreement on cutting down CO_2 emission. This necessitates the motivation for this paper. Applying 2SSGMM and DCCE modellings, the study conclude that African tourism arrivals are significantly influenced by global climate change. Based on the above findings, the study recommends that:

i. There should be change from fossil fuels to renewable energy which include solar, wind to decrease the effect of greenhouse gas.
ii. Develop heatwave early warning systems and good planning to reduce the effect of global warming.
iii. There should be recycle of waste to reduce the negative impact of carbon emissions.
iv. cleaner energy that will reduce climate change so as enhance tourism arrivals in Africa should be incorporated in the regional energy plans.

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