Investigating actual and potential effects of climate change phenomenon on hotels and cultural tourism attractions in Luxor

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Abstract

Climate change, represented in gradual changes in temperature, precipitation, atmospheric moisture, and wind intensity, as well as sea level rise and changes in the occurrence of extreme events, affect negatively tourism and hotel industry in general, as well as cultural heritage sites in particular. This paper aims to investigate the actual and potential effects of climate change phenomenon on hotels and cultural tourist attractions in Luxor governorate. The study used a quantitative approach by distributing a questionnaire to managers in fixed and floating hotels in Luxor, as well as interviews with cultural and heritage sites officials, tour guides, restoration technicians and experts and academic experts, to measure and assess the awareness concerning actual and potential effects of climate change phenomenon on hotels and cultural tourist attractions in Luxor governorate and there point of views concerning the feasibility of mitigation and adaptation policies and procedures. The study concluded that climate change negatively affected tourism and hotels industry, as hotels' and tourism officials' awareness of the phenomenon of climate change contributed significantly to adaptation policies and procedures. As well the study recommended that all tourist formal and informal associations and organizations and employees should stick to develop and implement more effective mitigation and adaptation policies and procedures and awareness campaigns concerning climate change effects on tourism and hotel industry to reduce their severity to the least possible degree.

Keywords: Climate change, Hotels, Tourist attractions, Adaptation policies**.**

Introduction

Tourism is a highly climate-sensitive sector, climate change is not a remote future event for tourism, however, varied impacts becoming evident at destinations. The impacts of climate change on the tourism and hospitality sector are expected steadily to intensify affecting major tourism flows. Moreover, least developed countries and small island developing states might be particularly affected (Lyle, 2013).

Climate change threatens all life, as well as destinations that tourism relies on could be at risk. As the earth warms, snow melts causing rising sea levels, extreme weather, and increasing temperatures which are impacting ecosystems and communities around the world. Beaches are shrinking, coral reefs are bleaching (Sustainable travel international, 2022), and ancient monuments and antiquities are demolishing (Samir, 2022).

Anthropogenic climate change, driven by the increase in CO2 to more than 410 ppm in 2020, has resulted in unprecedented rates of environmental change (Ashtari, 2020). As such, changes to the environment and environmental systems influence and impact

heritage and its associated values. While some of these changes may contribute to or foster cultural heritage values, others may induce, accelerate, or amplify loss (Bayliss & Ligtermoet, 2018). As a result, cultural and heritage tourism destinations will be negatively affected.

This study aims to monitor the effects of climate change on tourist destinations in general, and cultural and heritage destinations in particular, as well as investigate these effects on cultural tourism attractions and hotels in Luxor, as the largest heritage site and open museum all over the world, and clarify adaptation actions and challenges through answering the following questions:

- What is the meaning and scope of climate change phenomenon?
- What is the relationship between climate change phenomenon and tourism industry?
- How can climate change affect tourist destinations?
- What are the negative effects of climate change phenomenon on cultural tourism attractions in Luxor?
- What are the negative effects of climate change phenomenon on land and floating hotels located in Luxor?
- What are the applied adaptation and mitigation action plans to minimize negative effects of climate change phenomenon on cultural tourism attractions and hotels in Luxor?

Drawing from the previous perspectives, the following hypothesis can be given:

- Raugh climate change factors expose hotels and cultural tourism attractions in Luxor to face severe operational and competitional challenges.
- Climate changes awareness influence ideal adaptation and mitigation procedures and plans implementation to minimize the challenges facing hotels and tourist attractions in Luxor.

Literature Review

1– Climate Change Concept and Impact on Tourism Industry

Climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, human activities have been the main driver of climate change, primarily due to burning fossil fuels like coal, oil and gas (IPCC, 2021). Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun's heat and raising temperatures.

Greenhouse gas emissions that are causing climate change include carbon dioxide and methane, which are generated from using gasoline for driving a car or coal for heating a building. Clearing land and forests can also release carbon dioxide. Landfills for garbage are a major source of methane emissions. Energy, industry, transport, buildings, agriculture and land use are among the main emitters (UNEP, 2020). And emissions continue to rise (UNEP, 2021). As a result, the Earth is now about 1.1°C warmer than it

was in the late 1800s (UNEP, 2020). The last decade (2011-2020) was the warmest on record (WMO, 2021).

Many people think climate change mainly means warmer temperatures. But temperature rise is only the beginning of the story. Because the Earth is a system, where everything is connected, changes in one area can influence changes in all others. The consequences of climate change now include, among others, intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining biodiversity (IPCC, 2022).

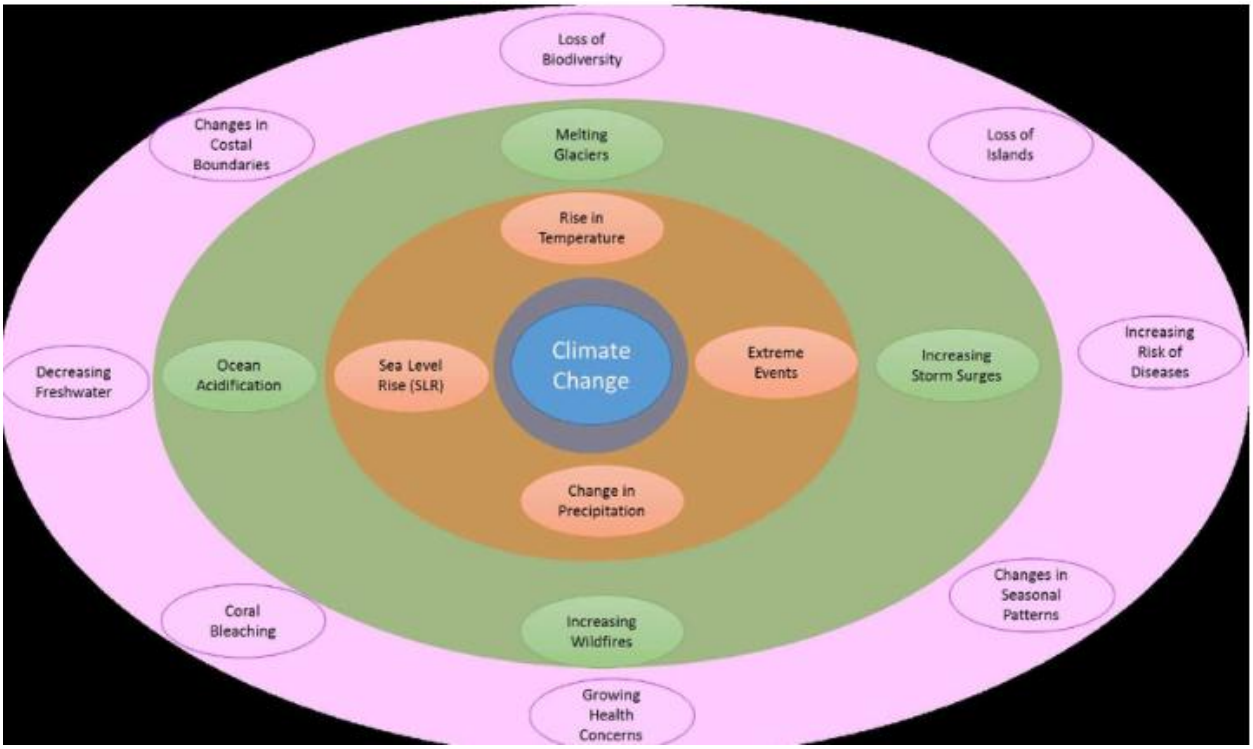

Fig. (1) Climate Change Impacts on Various Biological Physical Processes

Source: Siddiqui (2018).

The tourism and hospitality sector itself is vulnerable to climate change. Threats include more extreme weather events, increasing insurance costs and safety concerns, water shortages, and loss and damage to assets and attractions at destinations. Continued climate-driven degradation and disruption to cultural and natural heritage at World Heritage sites will negatively affect the tourism and hospitality sector, reduce the attractiveness of destinations and lessen economic opportunities for local communities (Viner & Agnew, 1999).

The most serious impacts will result from the effects of sea level rise, the risk of illness in several parts of the world which consequently discourage tourism, more frequent periods of extreme heat that will cause discomfort in many resorts of the Mediterranean, where the number of days above 40°C is estimated to increase. Moreover, decreasing cloud cover will increase exposure to the sun's harmful rays and malaria is likely to re-emerge in European destinations, winter tourism may also be affected, as the Alps and other skiing destinations experience less snowfall and shorter skiing seasons (Viner & Agnew, 1999).

National or international mitigation policies – that are policies that seek to reduce GHG emissions – are likely to have an impact on tourist flows. They will lead to an increase in transport and accommodation facilities operating costs and may foster environmental attitudes that lead tourists to change their travel patterns (e.g., shift transport mode or destination choices). Long-haul destinations can be particularly affected. On the other hand, opportunities may arise for low carbon emission transport modes like coach and rail. This may also help to re-vitalize destinations that are nearer to the main markets (Bartlett, 2007; Boyd, 2007; Caribbean Hotel Association & Caribbean Tourism Organization, 2007).

Climate change is thought to pose a risk to future economic growth and to the political stability of some nations (Barnett, 2001; Stern, 2006; IPCC, 2007; German Advisory Council on Global Change, 2007). The Stern Report on the Economics of Climate Change concluded that although a global warming of only 1°C might benefit global GDP, greater climate change would eventually damage economic growth at the global scale, including the stark conclusion that unmitigated climate change could cause a reduction in consumption per capita of 20% later in the 21st century or early 22nd century (German Advisory Council on Global Change, 2007). Any such reduction of global GDP due to climate change would reduce the discretionary wealth available to consumers for tourism and have negative implications for anticipated future growth in tourism and hospitality industry (German Advisory Council on Global Change, 2007).

Climate change is considered a national and international security risk that will steadily intensify, particularly under greater warming scenarios (Liotta & Shearer, 2005; Feakin, 2005; German Advisory Council on Global Change, 2007). Climate change associated security risks have been identified in a number of regions where tourism is highly important to local/national economies (Barnett, 2001; Feakin, 2005; German Advisory Council on Global Change, 2007). Tourists, particularly international tourists, are sensitive to political instability and social unrest (Sonmez, 1998; Hall *et al*., 2004), and the negative tourism demand repercussions for the climate change security hotspots are very evident (UNWTO, 2003). A security-related decline in tourism would exacerbate deteriorating economic performance in these destinations, potentially undermining development objectives in some LDCs.

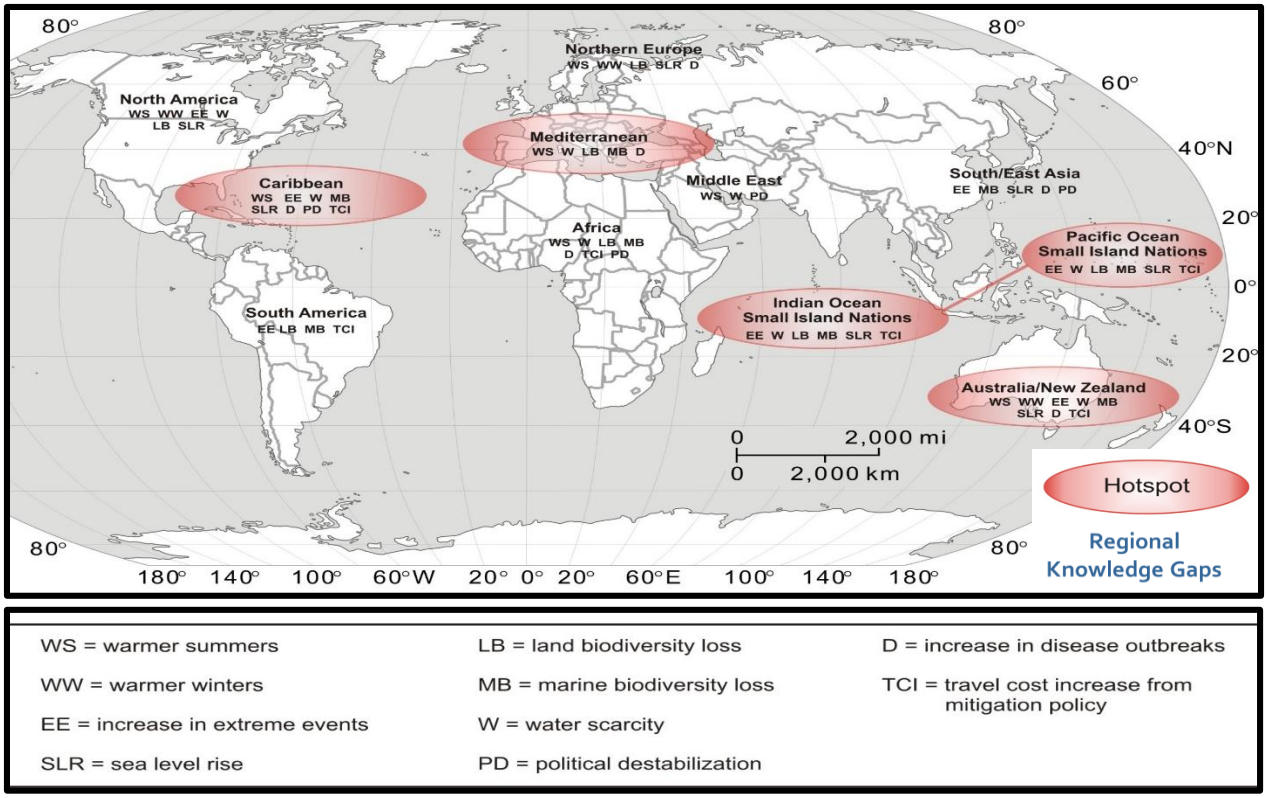

Fig. (2) Tourism Vulnerability 'Hotspots'

Source: UNWTO *et al*. (2008)

At the same time, tourism and hospitality sector is a contributor to climate change, as international and domestic tourism emissions from three main sub-sectors are estimated to represent between 3.9% and 6.0% of global emissions in 2005, with a best estimate of 4.9%. In 2005 transport generated the largest proportion of CO2 emissions (75%) from global tourism, with approximately 40% of the total being caused by air transport alone. Emissions from accommodation and activities were estimated to be substantially lower than transport emissions, but emissions from the accommodation sub-sector are also not negligible (UNWTO *et al.*, 2008).

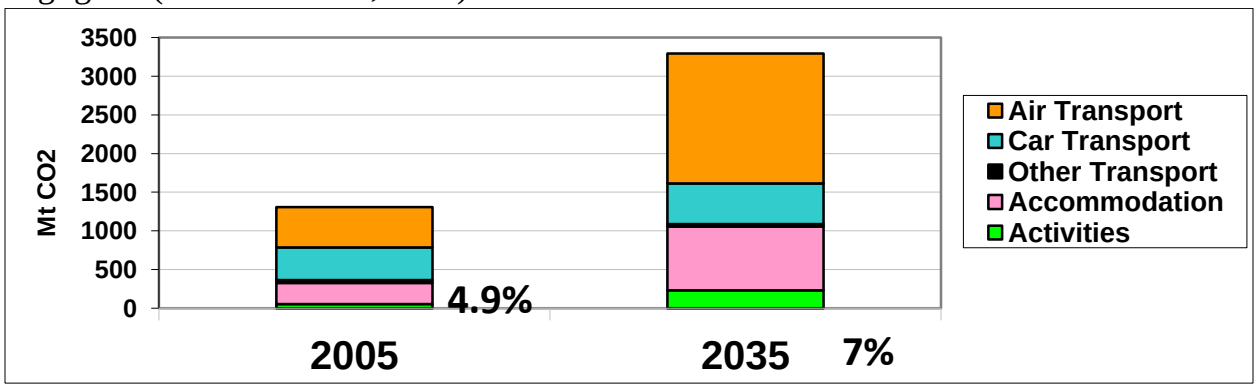

Fig. (3) Estimated Emissions of tourism sectors

Source: UNWTO *et al.* (2008)

2 - The Effects of Climate Change on Hospitality Industry

While the accommodation sector contributes to global warming, it is also affected by climate change. This includes physical assets (e.g. snow) as much as changes in longer-term conditions in a destination, for example in regard to extreme weather patterns (Scott et al., 2012).

Accommodation businesses are exposed to these changes, often with limited opportunities to adapt. For instance, in Austria, heavy snowfalls in January 2019 led to the closure of ski resorts and roads, and a decline in guest nights in January and February compared to the previous year (WIFO, 2019).

Weather extremes are well documented in terms of the damage they cause (Munich, 2018), for instance by storms and heavy rainfall, flooding and landslides, or transport disruptions. All of these have become more prominent. Episodes of extreme drought have also caused fluctuations in water levels (Rivers and lakes) and changes in water quality. Snow certainty is generally reduced at lower altitudes. Forest fire risks have increased significantly (Department of Geography and Regional Science, University of Graz, 2014; Scott et al., 2012; Spinoni et al., 2018; Stevens-Rumann et al., 2018). Directly, or indirectly, they all have relevance for the accommodation sector.

Weather pattern changes have thus led to new vulnerabilities, as tourists may turn to 'weatherproof' destinations, book accommodation at shorter notice, cancel their stay, or switch to replacement destinations (Gossling et al., 2016; Scott et al., 2012).

Risks are generally greater for rural accommodation establishments as cities will offer alternative, weather-independent activities. Urban environments, on the other hand, are more exposed to temperature stress, which can be a deterrent for tourists. This clarifies that accommodation businesses contribute to and are affected by climate change (Gossling & Lund-Durlasher, 2021).

3- The effects of climate change on cultural and heritage tourism and destinations

At many world and cultural heritage sites, the direct and indirect impacts of climate change may present a threat to their outstanding universal value, integrity and authenticity. Climate change is a threat multiplier, and will increase vulnerability and exacerbate other stresses including, but not limited to, pollution, conflict over resources, urbanization, habitat fragmentation, and loss of intangible cultural heritage and the impacts of unplanned or poorly managed tourism (UNESCO. *et. al*., 2016). Heritage and historical sites which are the main attractiveness factors of cultural and heritage tourism, could be severely affected by extreme climate changes as follows:

- Temperature variations: Warmer temperatures could increase the frequency of freeze–thaw cycles, causing structural damage to masonry buildings and can alter the occurrence of thermoclastism, deteriorating buildings' facades, moreover, Changes in temperature and humidity in combination with air pollution or exposure to salts can lead to corrosion of metals and masonry buildings (UNESCO, 2007; ICOMOS, 2019).

- Biological degradation: Increase in biological growth on built heritage in boreal and temperate regions and decrease in the Mediterranean region, the Middle East, the Caribbean, and southern Africa (UNESCO, 2007; Viles & Cutler, 2012; ICOMOS, 2019).
- Crystallization and dissolution of salts caused by wetting and drying and subsequent increase in salt damage in walls, frescoes, wall paintings, mosaics, statues, standing structures, archaeology and other decorated surfaces (UNESCO, 2007; ICOMOS, 2019).
- Impacts on historical buildings, monuments, and archeological sites and rock arts. As wind driven rains erode materials and damage the surfaces of historical buildings and monuments and increase the risk of water penetration into porous materials (UNESCO, 2007; ICOMOS, 2019; Sesana, 2021).
- Damage to hygroscopic wooden materials in the interiors of historical buildings and chemical degradation of collections and archives (UNESCO, 2007; ICOMOS, 2019).
- Flooding can result in damage to / or loss of historic buildings and districts, cultural landscapes, archaeology, and sacred sites. Also, landslides cause either loss of buildings located on slopes or burial and damage of structures due to rocks, mud and debris (UNESCO, 2007; ICOMOS, 2019; Sesana, 2021).
- Rising sea level, together with a higher frequency of storm surges, and the related coastal impacts, can cause inundation and the destruction of heritage structures, buildings and archeological sites (UNESCO, 2007; Berenfeld, 2008; Marzeion & Levermann, 2014; Wright, 2016; ICOMOS, 2019).
- Warmer Sea Surface Temperatures and related changes in water currents, oxygen levels and salinity can affect underwater cultural heritage, such as shipwrecks and submerged archeological sites (Perez-Alvaro, 2016; Wright, 2016; ICOMOS, 2019).
- Warmer climates affect cultural assets that are anchored in permafrost, which will be subjected to annual freeze–thaw cycles and ensuing degradation. Archeological sites located in polar environments can be affected by microbial decay. Permafrost thawing can soften historical building foundations. And droughts and extreme heat can increase the risk of ignition of fires and their propagation (Berenfeld, 2008; ICOMOS, 2019; Sesana, 2021).

Climate change could affect competitiveness and sustainability of tourism destinations through a range of direct and indirect impacts: (West Med Initiative report, 2016; Bocci, *et. al*., 2018).

- Direct impacts: due to changes in operating costs (structural damages, insurance premiums, etc.), as a result of geographic and seasonal redistribution of climate resources (heating cooling degree days, etc.);
- Indirect impacts: due to climate induced changes in assets of the tourism sector (biodiversity loss, decline of landscape aesthetic, increase in vector borne disease), services (water shortages) and damage to infrastructure;

- Broader impacts due to mitigation policies, including changes in tourist flows caused by increased travel prices, alterations to aviation routes, changes in the proportion of short haul and long-haul flights, etc. Such effects are in part already felt but mostly bound to intensify in the coming years.

4- Climate change effect on cultural and heritage tourism and hospitality services in Luxor

Egypt is the 87th most vulnerable country facing the threat of climate change. However, it ranks 73rd in the world when it comes to lack of preparedness to face climate change (Climate Change Profile, 2018). The high population growth and rapid urbanization, together with the climate change arising impacts, put serious stress on water supplies. This leads further to threats towards food security, human health and biodiversity (Hefny *et al*., 2019).

The Sea level rise and the heavy correlation between climate change and the Nile River flow are two of the most significant factors leading to the high vulnerability of Egypt to climate change. The country is surrounded by the Mediterranean Sea to the North, where it lies at a low altitude to sea level, putting the whole area under the threat of Sea Level Rise (SLR). This will consequently give rise to flooding, affecting the groundwater quality in the coastal regions (EEAA, 2016). Furthermore, the increase of soil salinity degrades, its fertile quality and leads to the erosion of coastal barriers. Additionally, an SLR of 0.3 meters will lead to the migration of at least half a million inhabitants and 70,000 subsequent job losses spanning various sectors (Green Climate Fund, 2017). Second, the Nile and its Delta were identified as one of the world's three most extremely vulnerable hotspots under climate change conditions (IPCC, 2007). Its flow is highly sensitive to rainfall and variations in temperature.

The Nile supplies water for domestic activities, industry, power generation, cooling of machinery and power plants and transport between Nile Valley cities (Green Climate Fund, 2017). For such an interconnected role in diverse sectors, the Nile is of great concern when considering the effect of climate change on Egypt. Other impacts include issues regarding the sailing of ferries on the Nile, effects on coral reef growth and integrity, saltwater intrusion and submersion of monuments on the north coast, and socioeconomic losses due to all-mentioned impacts, all of which will negatively impact tourism and biodiversity (EEAA, 2016).

The Governorate of Luxor provides fuel and electricity consumption from hotels and air and land transportation. Total energy consumption in the city of Luxor is estimated to be 4,937 GWh Final Energy/year in 2015, equivalent to 8,61 MWh/person/year. This rate is considered to be high, due to the very important impact of tourism. If tourism consumptions were not considered, energy consumption would go down to 7,14 MWh/person/year (CES-MED, 2017).

A percentage change in average annual temperature by 2100 over the Governorate of Luxor is projected to increase by around 3°C to 3.5°C, as well as a decrease of -5% to -10% in humidity, horizontal radiation, and wind speed (EEAA & UNDP, 2010). Climate change impact in the city of Luxor will be strong in different sectors: agriculture, water,

tourism, urban and health. As for tourism industry, heat waves will affect the city's attractiveness and tourism movement flows (CES-MED, 2017).

Dr. Zahi Hawass - Egypt's former Minister of State for Antiquities Affairs claimed that all open-air archeological sites in Egypt are in danger from stronger winds and humidity, higher temperatures and bigger floods, and he believes that within 100 years all these antiquities will be gone because of climate change (www.arabnews.com. December 2019).

In every archeological site in Luxor, climate change effects could be witnessed; increasingly high temperatures linked to climate change, as well as wilder weather, particularly heavy rains and flooding, are taking a growing toll on the ancient stonework. The changes appear noticeably, in the damage and cracks of the facades of many graves as well as the change of the color of the archaeological stones, as a result of high temperature and humidity. For instance, granite that was once rose-colored has faded to a pale pink or even light grey over the last 15 years (www.arabnews.com. December 2019)

Many archaeological sites in Luxor are located on the two sides of the Nile and only a few meters from the water, such as Karnak Temples and Luxor Temple. The Grand Ethiopian Renaissance Dam and extreme reduction or increase in the Nile water level cause water retention and when the groundwater increases or even decreases it will cause soil disturbance and harm those antiquities. However, the level of water in the soil needs to be measured regularly and to deal with any change immediately (Samir, 2022). According to researchers, just one third of the antiquities Egypt has been unearthed, while the undiscovered antiquities are now exposed to a great danger because of the effects of climate change (Samir, 2022).

Climate change will affect the hospitality industry in Luxor on different levels:

- Direct impacts: climate is the principal driver of tourism demand. It influences the attractiveness of destinations. The weather directly influences operating costs including heating and cooling, food and water supplies etc. (Kyriakidis & Felton, 2008).
- Indirect impacts: these include changes in water availability, biodiversity loss, reduced landscape aesthetic, increased natural hazards, coastal erosions, damage to infrastructure and increased incidence of vector-borne diseases (Radwan, 2012).

5 – Adaptation action plan of tourism and hospitality industry to climate change in Luxor

Luxor Governorate officials are convinced of the necessity to implement an energy and climate strategy that will contribute to climate mitigation while helping the city to adapt to the already visible impact of climate change. Relying on 3 pillars: (CES-MED, 2017).

- Reduce energy consumption in all type of energy services (heating and cooling, mobility, industrial needs, specific electricity usage for lighting and electric equipment);
- Develop the production of energy from local and renewable resources; and
- Adapt infrastructures and human activities to already visible and foreseeable impacts of climate change.

This strategy will accomplish the following benefits:

- Reduce expenses generated by energy consumption, and as a consequence allow reallocation of Governorate's resources to public services and equipment;
- Generate new revenues from the production of energy based on local and renewable resources: sun, wind, bio-waste, and the Nile River;
- Promote a more strategic development of the city taking into account constraints and opportunities brought by a more sustainable approach of climate and energy challenges;
- Develop a new strategy to manage heritage sites, improving their protection and strengthening their attractiveness through the promotion of sustainable tourism; and Upgrade quality of life for all Luxor inhabitants.

The combination of these three pillars will allow an energy and climate transition towards a greener and more prosperous Luxor.

Hospitality industry relied primarily on the role of the government for leadership on climate change adaptation. However, all hotels should voluntarily change their behavior and put targets for their own consumption patterns (GHG emissions) and a timeframe for achievement including the following procedures:

- Buying new technology and developing technical solutions could reduce and/or prevent the emissions of gases, through renovating old equipment particularly in the kitchens which were classified as highly energy intensive and invest in buying new technology (Radwan, 2012).
- Optimal use of natural resources; getting rid of solid waste in an environmentally responsible manner such as recycling;
- Hotels can also use clean energy (i.e. wind and solar) as an alternative to fossil energy (Radwan, 2012).
- Carbon sinks had also been suggested as an intermediate solution to compensate for energy use in the accommodation sector. Carbon sinks absorbed and stored GHG in a permanent or semi-permanent form (Becken, 2004).
- Lighting is another key area that can be effective in helping hotels to reduce their carbon footprint. By switching to fluorescent lighting which used less energy (Kyriakidis & Felton, 2008).

6 – Methodology

Study Population and Sample Selection

The research population consists of senior managers and heads of departments in hotels in Luxor governorate. Personal interviews were conducted with managers of archaeological and tourist sites. The sample of respondents was selected via convenience sampling.

The study was conducted on a total population of 34 fixed hotels and 259 floating hotels in Luxor, Egypt. (According to tourism in figures, 2019). Where the sample was calculated using sample size calculator and complete guide (available on www.qualtrics.com) with 95% confidence level and 5% error margin.

Table (1): The Hotels' Population and Sample.

No	Type of Hotel	Population	Category	Sample

		Hotel No.		
1.	Fixed hotels	7	5 stars	33
2.		4	4 stars	
3.		9	3 stars	
4.		9	2 stars	
5.		5	1 stars	
6.	Nile Cruise	189	5 stars	133
7.		46	4 stars	
8.		22	3 stars	
9.		2	2 stars	
10.		0	1 stars	

Source: Central Department of Information and Decision Support General Department of Information and Statistics, Ministry of Tourism (2019); www.qualtrics.com.

Data Collection Methods

This study adopted a quantitative approach by using a questionnaire as a tool for data collection. Data was collected through mailed and manually distributed in the investigated hotels and archaeological and tourist sites. A number of (200) questionnaire forms were distributed to managers and heads of departments in fixed and floating hotels in Luxor governorate, (166) valid questionnaire forms were retrieved. Thus, the percentage of valid returned forms constitutes approximately (83%) of the total distributed forms. Personal interviews were held in archaeological and tourist sites for (53) individuals from archaeological site managers, tourist guides, and tourism officials. The questionnaire forms and interviews were distributed from January 2023 to March 2023.

Description of the Questionnaire

The questionnaire was used to measure the impact of the phenomenon of climate change on hotel establishments in Luxor Governorate and the adaptation policies implemented to mitigate the negative effects of this phenomenon through a set of questions that included two parts. The first part was devoted to collecting information about the respondents and included (i.e. gender, age, scientific qualification, current job, total years of experience), and a set of questions about climate change and its impact on facilities. The second part focused on the dimension of evaluating the impact of the climate change phenomenon on hotel establishments in Luxor Governorate, and the adaptation policies they implement to mitigate the negative effects of this phenomenon. The first section of the second part is dedicated to measuring the establishment's awareness of the phenomenon of climate change and its effects, and it consists of (9) statements. The second section of the second part is devoted to measuring the impact of the phenomenon of climate change on the tourism industry in general, and it consists of (7) statements. As the third part of the second section was devoted to measuring the impact of the climate change phenomenon on hotel establishments, and it consisted of (8) phrases. As for the fourth part, it was devoted to measuring adaptation procedures and policies to confront the phenomenon of climate change and its consequences, and it consists of (6) phrases.

Description of Personal Interview Questions

Personal interview questions were used to measure the impact of the phenomenon of climate change on archeological and heritage sites in Luxor Governorate and the adaptation policies implemented to mitigate the negative effects of this phenomenon through a set of questions that included two dimensions. The first part was devoted to collecting information about the respondents and included (i.e. gender, age, scientific qualification, current job, and total years of experience). The second part focused on the dimensions of evaluating the impact of the climate change phenomenon, and the implemented adaptation policies to mitigate the negative effects of this phenomenon. The first section of the second part is dedicated to measuring awareness of the phenomenon of climate change and its effects, and it consists of (9) statements. The second section of the second part is devoted to measuring the impact of the phenomenon of climate change on the tourism industry in general, and it consists of (7) statements. As the third section the second part was devoted to measuring the impact of the climate change phenomenon on archaeological and heritage sites, and it consisted of (8) phrases. The fourth section was devoted to measuring adaptation procedures and policies to confront the phenomenon of climate change and its consequences, and it is consisted of (5) phrases.

All measurement statements were measured based on a five-point Likert scale ranging from 1= strongly disagree to 5 = strongly agree. The researcher depended on previous studies when preparing the questionnaire statement. Then, the questionnaires were validated through a pilot study on investigated hotels. After collecting questionnaires electronically by using Google Forms and also face-to-face. They were examined and incomplete questionnaires were excluded. Finally, the following processes have been done:

1- Configure the extracted spreadsheets for use in the statistical analysis software SPSS and AMOS v25. Statistical analysis of data using the Statistical Package for Social Sciences program version XXV (25). The study used the following methods:

a. Extraction of iterative tables and percentages of variables.

b. The use of linear regression analysis.

c. The use of confirmatory factor analysis (CFA) in verifying the validity of the scale, and factorial referencing seeks to reveal the interrelationships between the measured items, the inclusiveness of their dimensions, and the dimensions` inclusiveness of the scale`s overall degree.

d. The use of Cronbach's alpha coefficient to verify the stability of the scale, used to estimate stability through internal consistency.

Validity (Structural Validity) and Reliability

Structural validity measures the degree to which the scores are an adequate reflection of the dimensionality of the construct to be measured. In this study, the structural validity of the questionnaire was assessed by confirmatory factor analyses (CFA). A quinary factor model of the questionnaire was tested.

Unidimensionality was examined by CFA on the polychoric correlation matrix with Weighted Least Squares with Mean and Variance adjustment (WLSMV) estimation. The Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Root Means Square Error of

Approximation (RMSEA), and Standardized Root Mean Residual (SRMR) evaluate model fit. We report scaled fit indices, which are considered more exact than unscaled indices. Figures (3) and (4) present the model.

1- Questionnaire of Hotels

Table (2): The Validity (Structural Validity).

Indicators	TLI	RMSEA	SRMR
Evaluation value	> 0.9	< 0.06	< 0.08
Model Value	0.999	0.000	0.003

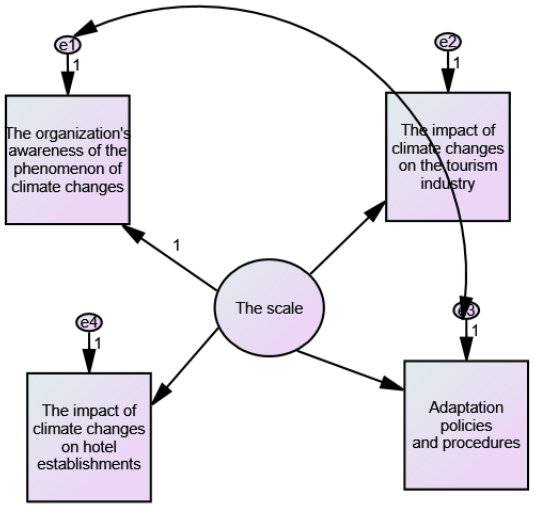

Fig. (4): Structural Validity by Confirmatory Factor Analyses (CFA), Using IBM Amos ver. 25.

Reliability

Reliability by Internal consistency measures the degree of the interrelatedness among the items. Internal consistency was assessed by calculating Cronbach's alpha. A Cronbach's alpha value is 0.853, >0.70 was considered sufficient evidence for reliability.

2- Interview of tourist attractions officials and tour guides

Table (3): The Validity (Structural Validity)

Indicators	TLI	RMSEA	SRMR
Evaluation value	> 0.9	< 0.06	< 0.08
Model Value	0.9	0.05	0.06

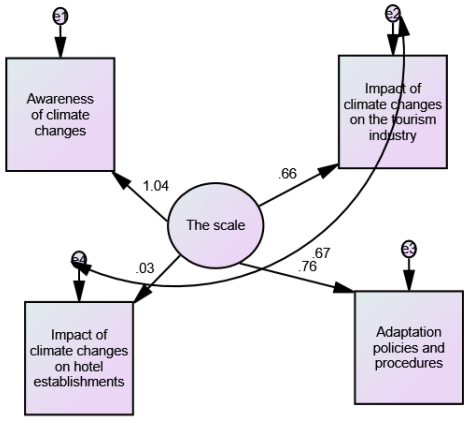

Fig. (5): Structural Validity by Confirmatory Factor Analyses (CFA), Using IBM Amos ver. 25.

Reliability

Reliability by Internal consistency measures the degree of the interrelatedness among the items. Internal consistency was assessed by calculating Cronbach's alpha. A Cronbach's alpha value is 0.886, >0.70 was considered sufficient evidence for reliability.

Results and Discussion

Questionnaire Analysis

Sample Demographic Characteristics

A total of (166) samples were recruited for this research, (19.9%) of the sample (33 people) works at fixed hotels, and (80.1%) of the sample (133 people) works at floating hotels. 50% of the sample (83 people) are general managers, 7.2% of the sample (12 people) are marketing managers, and 22.3% of the sample (37 people) are human resources managers.

Table (4): Sample Demographic Characteristics.

Sample Characteristics (n= 166):		**Count**	**%**
Activity of the Establishment	Fixed hotel	33	19.9%
	Floating hotel	133	80.1%
Establishment Category	1 Stars	0	0.0%
	2 Stars	0	0.0%
	3 Stars	7	4.2%
	4 Stars	27	16.3%
	5 Stars	132	79.5%
Current Job	General Manager	83	50.0%
	Marketing Manager	12	7.2%
	Human Resources Manager	34	20.5%
	Others	37	22.3%
Does the hotel use any of renewable	Yes	15	9.0%

energy sources?	No	151	91.0%
"If the answer is yes", what are the energy sources used?	Wind energy	0	0.0%
	Solar energy	15	9.0%
	Both of them	0	0.0%
	Others	151	91.0%
Does your establishment still rely on conventional energy sources for operations?	Yes	166	100.0%
	No	0	0.0%
Does your establishment have an action plan to reduce the negative impacts of using conventional energy sources?	Yes	109	65.7%
	No	57	34.3%
Has the phenomena of climate change affected occupancy rates and seasons?	Yes	94	56.6%
	No	72	43.4%
If the answer was "yes", was this effect .....?	Positive	31	18.7%
	Negative	135	81.3%

The results showed that (9%) confirmed that hotels use renewable energy sources, (15%) use solar energy, and (91%) use other sources of energy. However, all hotels still depend on traditional energy sources in their operations, 65% of the hotels have an action plan to reduce the negative effects of using traditional energy. The results also showed that (56%) confirmed that climatic phenomena affected the occupancy rates and seasons, and (81.3%) had a negative impact.

Psychometric Properties of the Questionnaire

Descriptive Statistics

Table (5): Hotels' Awareness concerning the Phenomenon of Climate Changes.

No	Item	Descriptive Statistics			
		Mean	Std. Dev.	Sk.	Ku.
A1	There is a clear and noticeable change in various climatic phenomena.	4.33	0.55	-0.05	-0.70
A2	The climate change phenomena greatly affect the degree of attractiveness of the tourist destination.	4.13	1.00	-1.12	0.23
A3	The impact of climate change may be positive and sometimes negative.	3.89	0.86	-0.95	0.54
A4	Climate change has a negative impact on tourism in general in Luxor.	3.04	0.89	0.65	-0.20
A5	Climate change has a negative impact on the establishment.	3.17	0.98	0.21	-1.11
A6	The establishment has effective plans to face the negative effects of climate change.	3.57	1.24	-0.31	-0.80
A7	All employees are fully aware of the impact of climate change on the establishment and operations.	3.42	1.13	0.01	-1.23
A8	Employees cooperate with the management of the establishment in taking all measures to mitigate the	3.84	0.81	-0.26	0.26

	negative effects of climate change on the establishment.				
A9	Governorate agencies are aware of the negative impact of climate change and are working to support action to address it.	3.45	1.13	-0.32	-0.35
Total Mean is (3.65), Std. Dev. is (0.21).					

The results in table (5) indicated that the expressions from (A1) to (A9) measure the extent of the hotels' awareness of the phenomenon of climate change and its effects with an arithmetic mean (3.65) and a standard deviation (0.21) and this result confirms that hotels' awareness of the phenomenon of climate change is relatively moderate.

Table (6): The Impact of Climate Changes on the Tourism Industry in Luxor.

No	Item	Descriptive Statistics			
		Mean	Std. Dev.	Sk.	Ku.
B1	Climate change has negatively affected Luxor's attractiveness as a tourist destination.	2.87	0.73	0.78	0.98
B2	Climate change has changed the quality and nationalities of tourists coming to Luxor.	3.40	0.69	-0.02	-0.23
B3	Climate change has affected the purchasing power of tourists.	3.33	0.86	-0.01	-0.74
B4	Climate change has changed the preferences and interests of tourists coming to Luxor with regard to accommodation and tourist activities.	3.46	0.84	1.12	-0.35
B5	Climate change has contributed to changing the tourist season and its duration in Luxor.	3.71	1.17	-0.18	-1.49
B6	Climate change has contributed to prolonging the duration of the tourist season in Luxor.	3.36	1.02	0.04	-1.16
B7	Climate change has negatively affected the attractiveness and level of tourist attractions in the city.	3.18	0.98	0.49	-0.72
Total Mean is (3.33), Std. Dev. is (0.17).					

The results in table (6) indicated that expressions from (B1) to (B7) measure the impact of climate change on the tourism industry in general in Luxor Governorate with an arithmetic mean (3.33) and a standard deviation (0.17) and this result confirms that climate change has affected the tourism industry in general.

Table (7): The Impact of Climate Changes on Hotels in Luxor

No	Item	Descriptive Statistics			
		Mean	Std. Dev.	Sk.	Ku.
C1	The effects of climate change have significantly increased operating costs.	3.86	0.73	0.23	-1.10
C2	Climate change has contributed to significantly reduced occupancy rates	3.20	0.97	0.48	-0.68
C3	Adaptation measures and coping with the effects of climate change require the organization to bear significant financial burdens.	3.67	1.02	-0.03	-1.18
C4	Climate change negatively affects the competitiveness of the facility, and its inability to make promotions due to	3.82	0.77	-0.50	0.18

	high operating costs.				
C5	Changes in climatic phenomena sometimes cause tourists to cancel their trips to Luxor.	3.02	1.23	0.65	-1.27
C6	Climate change is one of the main reasons for the increase in hotel service prices as a result of increased operating costs, which negatively affects competitiveness.	3.44	1.24	0.17	-1.60
C7	Climate change negatively affects the sustainability of the hotel's infrastructure.	3.23	1.29	0.47	-1.52
C8	The sharp rise in temperatures affects the floating ability of the hotels and other floating vessels to navigate the Nile river, as a result of the low water level.	4.04	1.37	-1.25	0.26
Total Mean is (3.53), Std. Dev. is (0.24).					

The results in table (7) indicated that expressions from (C1) to (C8) measure the effect of climate change on hotel establishments in Luxor governorate with an arithmetic mean (3.53) and a standard deviation (0.24) and this result confirms that climate change has a negative impact on hotels.

Table (8): Impact of Adaptation Policies and Procedures.

No	**Item**	**Descriptive Statistics**			
		Mean	Std. Dev.	Sk.	Ku.
D1	The establishment works to reduce energy consumption in all service areas.	3.83	1.21	-0.33	-1.51
D2	The establishment works to provide its energy needs through renewable energy sources (wind, solar energy.... etc.), and gradually replacing traditional energy sources.	2.80	1.39	0.14	-1.23
D3	Develop programs to prepare the infrastructure of the establishment and increase the awareness of workers of procedures and ways to adapt to climate change and its consequences.	3.39	1.21	-0.59	-0.42
D4	The establishment applies the latest waste management techniques to reduce the negative impact of the waste on the environment and climate.	3.78	1.18	-1.36	1.13
D5	The establishment pursues renewed plans to develop the devices and equipment used in the operations according to the latest technological developments available.	3.64	1.39	-0.61	-0.85
D6	The establishment uses the latest energy-saving smart lighting technology in all service areas and rooms.	4.10	0.73	-0.16	-1.09
Total Mean is (3.59), Std. Dev. is (0.24).					

The results in table (8) indicated that expressions from (D1) to (D6) that measure adaptation policies appliance in hotels to confront the phenomenon of climate change and its effects with arithmetic mean (3.59) and a standard deviation (0.24), meaning that these policies effects are moderate.

Interview Analysis

Sample Demographic Characteristics

A total of (53) samples were recruited for this part of research, (71.7) percent of the sample (38 people) works at the ministry of Tourism and Antiquities, (28.3) percent of the sample (15 people) works a tour guides, and (71.7) percent of the sample (38 people) have More than 5 years of experience. The Demographic and sample characteristics shown in Table (11).

Table (9): Demographic and Sample Characteristics.

ample Characteristics (n= 53):		Count	%
Workplace	Antiquities Restoration Department	1	1.9%
	Qurna Antiquities Restoration Department	4	7.5%
	Temple	3	5.7%
	Antiquities inspection	2	3.8%
	The Ministry of Tourism and Antiquities	38	71.7%
	Museum	2	3.8%
	Antiquities area	3	5.7%
Job	Head of the Department of Antiquities Restoration	2	3.8%
	Restoration technician	6	11.3%
	Restoration specialist	3	5.7%
	Director of the Valley of the Kings	2	3.8%
	General Director of Egyptian Antiquities	7	13.2%
	Director General of the Archaeological Unit	1	1.9%
	A tour guide	15	28.3%
	Translator	1	1.9%
	Archaeological Affairs Undersecretary	2	3.8%
	Director of Antiquities Inspection	8	15.1%
	Antiquities inspector	6	11.3%
Job type	Administrative	13	24.5%
	Artistic	19	35.8%
	Academic	21	39.6%
Years of Experience	Less than 5 years	7	13.2%
	From 5 to 10 years	8	15.1%
	More than 5 years	38	71.7%

Psychometric Properties of the Interview

Descriptive Statistics

Table (10): Descriptive Statistics of Awareness of Climate Changes Items.

No	Item	Descriptive Statistics			
		Mean	Std. Dev.	Sk.	Ku.

A1	There is a clear and noticeable change in various climatic phenomena.	4.8	0.43	-1.22	-0.54
A2	Changes in climatic phenomena greatly affect the degree of attractiveness of the tourist destination.	3.8	1.15	-0.55	-1.14
A3	The impact of climate change may be positive and sometimes negative.	4.1	0.65	-0.07	-0.51
A4	Climate change has negatively affected tourism in general in Luxor.	2.9	0.91	0.23	-1.79
A5	Climate change has negatively affected archaeological sites.	3.5	0.67	-1.19	0.24
A6	We have effective plans to counter the negative impacts of climate change.	3.3	0.94	0.03	-0.92
A7	All employees are fully aware of the impact of climate change.	3.1	0.96	0.39	-0.89
A8	The staff cooperates with the site management in taking all measures to mitigate the negative effects of climate change.	3.6	0.52	-0.18	-1.06
A9	Governorate agencies are aware of the negative impact of climate change and are working to support action to address it.	3.5	0.89	-0.20	-0.66
Total Mean is (3.62), Std. Dev. is (0.23).					

The results in table (10) indicated that the expressions from (A1) to (A9) measure the extent to which tourist and archaeological areas and heritage sites are aware of the phenomenon of climate change and its effects with an arithmetic mean (3.62) and a standard deviation (0.23) and this result confirms the extent of awareness of the phenomenon of climate change in an average way.

Table (11): Descriptive Statistics of Impact of Climate Changes on the Tourism Industry Items.

No	Item	Descriptive Statistics			
		Mean	Std. Dev.	Sk.	Ku.
B1	Climate change has negatively affected Luxor's attractiveness as a tourist destination.	2.6	0.79	0.85	-0.86
B2	Climate change has changed the types and nationalities of tourists coming to Luxor.	3.1	1.04	0.12	-1.59
B3	Climate change has affected the purchasing power of tourists.	3.3	1.17	0.13	-1.52
B4	Climate change has changed the preferences and interests of tourists coming to Luxor with regard to tourist attractions and tourist activities.	3.1	1.00	0.21	-1.37
B5	Climate changes contributed to changing the tourist season and its duration in Luxor.	3.8	0.84	-0.80	0.36
B6	Climate changes contributed to prolonging the duration of the tourist season in Luxor.	3.7	0.85	-0.56	-0.10
B7	Climate change has negatively affected the attractiveness and level of tourist attractions in the	2.9	0.75	0.19	-1.17

	city.				
Total Mean is (3.21), Std. Dev. is (0.15).					

The results in table (11) indicated that the expressions from (B1) to (B7) measure the impact of climate change on the tourism industry in general in Luxor Governorate with an arithmetic mean (3.21) and a standard deviation (0.15) and this result confirms that climate change has affected the tourism industry in general.

Table (12): Descriptive Statistics of Impact of Climate Changes on archaeological, touristic and heritage sites in Luxor Governorate

No	Item	Descriptive Statistics			
		Mean	Std. Dev.	Sk.	Ku.
C1	Sharp changes in humidity and temperature negatively affect stone, wood and metal buildings and objects, especially in open spaces.	4.8	0.43	-1.22	-0.54
C2	Moisture and drought factors lead to the formation of salt crystals on the surface of monuments and walls, as well as the decomposition of salts in the components of stones, statues and columns, which threatens to collapse and obliterate their features.	4.7	0.45	-0.99	-1.06
C3	The wind bulldozes the roofs of buildings and monuments and obliterates inscriptions and colors, threatening to destroy them in the long run.	4.3	0.70	-1.24	2.72
C4	Sharp changes in climatic phenomena have damaged exhibits and wooden components at archaeological sites.	4.2	0.79	-0.76	0.35
C5	The rising water level of the Nile as a result of climate change poses a major threat to archaeological sites and heritage sites on its banks in Luxor.	4.0	0.92	-0.85	0.10
C6	Archaeological sites and heritage sites in Luxor are in danger of extinction within 100 years due to extreme climatic changes in temperature, wind speed, rainfall and others.	3.0	0.83	0.28	-0.97
C7	The sharp rise in temperatures, humidity and wind levels led to cracks and cracks in some buildings, walls and stones in some archaeological sites in Luxor, as well as obliterating the distinctive colors and features of the monument.	3.7	1.11	-0.42	-1.15
C8	The fluctuation in the water table as a result of climate change represents a major threat that negatively affects the discovered as well as the effects that have not yet been discovered.	3.2	1.00	-0.28	-1.58
Total Mean is (3.98), Std. Dev. is (0.24).					

The results in table (12) indicated that the expressions from (C1) to (C8) measure the impact of climate change on archaeological, touristic and heritage sites in Luxor

Governorate with an arithmetic mean (3.98) and a standard deviation (0.24) and this result confirms that climate change affected these areas negatively.

Table (13): Descriptive Statistics of Impact of Adaptation Policies and Procedures Items.

No	Item	Descriptive Statistics			
		Mean	Std. Dev.	Sk.	Ku.
D1	New strategies have been developed to manage heritage sites and archaeological sites that help adapt and cope with the effects of changing weather events.	3.2	1.10	-0.52	0.28
D2	A tight system is applied to manage visitors to archaeological sites to allow controlling the negative effects resulting from the visit.	3.2	1.23	-0.71	-0.97
D3	Some materials are used and some technical measures are applied to protect archaeological sites from the negative effects of climate change.	3.6	0.65	0.09	-0.23
D4	The facility applies the latest waste management techniques to reduce its negative impact on the environment and climate.	3.2	0.90	0.27	-0.70
D5	There are continuous monitoring and follow-up processes by technicians and restorers to assess the negative effects that may occur as a result of the phenomenon of climate change in various sites and they are dealt with instantly.	3.5	1.03	0.19	-1.08
Total Mean is (3.34), Std. Dev. is (0.22).					

The results in table (13) indicated that the expressions from (D1) to (D5) measure adaptation measures and policies to confront the phenomenon of climate change and its effects with arithmetic mean (3.34) and a standard deviation (0.22), meaning that these policies are still not enough to mitigate and reduce negative effects of climate change on tourist attractions in Luxor in general and heritage sites in particular.

Inferential statistic

Test of Hypotheses

Table (14): Pearson correlation analysis between impact of climate changes on the tourism industry and impact of climate changes on hotel establishments (n= 166):

		Impact of climate changes on hotel establishments
Impact of climate changes on the tourism industry	Pearson Correlation	0.508**
	Sig. (2-tailed)	0.00
	N	166

** Significant at $\alpha < 0.01$.

The result revealed a significant correlation between the impact of climate changes on the tourism industry and the impact of climate changes on hotel establishments (R= 0.508, P. < 0.01), this indicates that there is a strong positive correlation, meaning that climate changes negatively affected tourism industry and hotels industry as well.

Table (15): Liner Regression Analysis Showing the effect of hotels' awareness concerning the effects of the phenomenon of climate changes on their adaptation policies and procedures (n= 166):

	B	T	P.value	R	R^2	F	P.value
(Constant)	7.003	2.174*	0.031	0.336	0.113	20.812*	0.001
Hotels' awareness concerning the phenomenon of climate changes	0.443	2.314**	0.001				

** Significant at $\alpha < 0.01$. * Significant at $\alpha < 0.05$.

The result revealed a significant effect between hotels' awareness of the phenomenon of climate changes effects and adaptation policies and procedures ($R^2 = 0.113$, F= 20.812, P. < 0.01). This indicates that an organization's awareness of the phenomenon of climate changes contributed significantly (11%) to adaptation policies and procedures.

Table (16): Liner Regression Analysis showing the effect of tourist attractions officials' awareness concerning the effects of climate changes, on their adaptation policies and procedures. (n= 53)

	B	T	P.value	R	R^2	F	P.value
(Constant)	-8.570	-3.126**	0.003	0.793	0.629	86.600**	0.001
Tourist attractions officials' awareness concerning the phenomenon of climate changes	0.776	9.306**	0.001				

** Significant at $\alpha < 0.01$. * Significant at $\alpha < 0.05$.

The result revealed a significant effect between tourist attractions officials' awareness of climate changes and adaptation policies and procedures ($R^2 = 0.629$, F= 86.6, P. < 0.01). This indicates that awareness of climate change contributed significantly (63%) to adaptation policies and procedures.

Conclusion

The study concluded that:

1- Greenhouse gas emissions cause climate change through carbon dioxide and methane, clearing land and forests, landfills for garbage, energy, industry, transport, buildings, agriculture and land use. As emissions continue to rise, the Earth is now about 1.1°C warmer than it was in the late 1800s, and the last decade (2011-2020) was the warmest on record.

2- The consequences of climate change include intense droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining biodiversity.

3- The tourism and hospitality sectors are vulnerable to climate change. Threats include more extreme weather events, increasing insurance costs and safety concerns, water shortages, and loss and damage to assets and attractions at

destinations. Continued climate-driven degradation and disruption to cultural and natural heritage at World Heritage sites will negatively affect the tourism and hospitality sector, reduce the attractiveness of destinations and lessen economic opportunities for local communities.

4- Tourism and hospitality sector is a contributor to climate change, as international and domestic tourism emissions from three main sub-sectors are estimated to represent between 3.9% and 6.0% of global emissions in 2005, with a best estimate of 4.9%. transportation generated the largest proportion of CO2 emissions (75%) from global tourism, with approximately 40% of the total being caused by air transport alone. Emissions from accommodation and activities were estimated to be substantially lower than transport emissions, but emissions from the accommodation sub-sector are also not negligible.

5- Climate change negatively affected tourism and hotels industry, as hotels' and tourism officials/awareness of the phenomenon of climate change contributed significantly to adaptation policies and procedures.

Recommendations

1- The Egyptian ministry of tourism in cooperation with different official and unofficial tourist organizations in Egypt should create and implement wider awareness campaigns concerning the effects of climate changes on tourism sector in Egypt, and the ideal methods and procedures to mitigate and reduce them.

2- Employees in different Egyptian tourist organizations should stick to implement all needed procedures to reduce the negative effects of climate change on Tourism industry in general, and on their organizations in particular.

3- Adaptation policies and procedures should be continuously developed and updated to be able to face any new negative effects and reduce their severity and effect to the least possible degree,

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الآثار الفعلية والمحتملة لظاهرة التغيرات المناخية على الفنادق ومعالم السياحة الثقافية في الأقصر

الملخص

إن ظاهرة تغير المناخ، ممثلة في التغيرات التدريجية في درجة الحرارة، وهطول الأمطار، والرطوبة الجوية، وكثافة الرياح، وكذلك ارتفاع مستوى سطح البحر والتغيرات في حدوث الأحداث المتطرفة، تؤثر سلبًا على صناعة السياحة والفنادق بشكل عام ، بالإضافة إلى مواقع التراث الثقافي بشكل خاص. تهدف هذه الورقة إلى استطلاع الآثار الفعلية والمحتملة لظاهرة تغير المناخ على الفنادق والمعالم السياحية الثقافية في محافظة الأقصر. استخدمت الدراسة نهجًا كميًا من خلال توزيع استبيان على المديرين في الفنادق الثابتة والعائمة في الأقصر ، بالإضافة إلى مقابلات مع مسؤولي المواقع الثقافية والتراثية والمرشدين السياحيين، فنيو الترميم والخبراء والخبراء الأكاديميون، لقياس وتقييم الوعي بشأن الآثار الفعلية والمحتملة لظاهرة تغير المناخ على الفنادق والمعالم السياحية الثقافية في محافظة الأقصر والتعرف على وجهات نظرهم بشأن جدوى سياسات و إجراءات التخفيف و سياسات وإجراءات التكيف. وخلصت الدراسة إلى أن التغيرات المناخية أثرت سلبًا على صناعة السياحة والفنادق ، حيث ساهم وعي المنشأت الفنادقية و المسؤولين في المواقع السياحية في الحد من الأثار السلبية لظاهرة التغيرات المناخية بشكل كبير مع الإلتزام بسياسات وإجراءات التكيف. كما أوصت الدراسة بأن تلتزم جميع الجمعيات والمنظمات الرسمية وغير الرسمية والعاملين السياحيين بتطوير وتنفيذ سياسات وإجراءات التخفيف والتكيف الأكثر فعالية وحملات التوعية المتعلقة بظاهرة تغير المناخ وآثرها على صناعة السياحة والفنادق لتقليل شدتها إلى أقل درجة ممكنة.

الكلمات المفتاحية: تغير المناخ، الفنادق، مناطق الجذب السياحي، سياسات التكيف.