



## Evaluation of the Impact of Climate Change on the Egyptian Tourist Destination - An Applied Study on Luxor and Aswan Governorates

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### Abstract

The study aimed to identify the main causes of climate change, the impact of climate change on inbound tourism to Egypt, and to evaluate the effects of climate change on tourist destinations in general and archaeological sites in Luxor and Aswan in particular. The study relied on a questionnaire to collect data to verify these objectives. 286 questionnaires were distributed randomly among faculty members, experts from the ministries of tourism, antiquities, environment, and the tourism development authority in many governorates within Egypt. The study analyzed 226 questionnaires using SPSS v.28 software. The results highlighted inadequate environmental human practices as the main cause of climate change. The study also showed that climate change has a strong impact on inbound tourism to Egypt through changes in tourists' perspective when making the decision to travel to Egypt. Furthermore, the study indicated that the most significant impact of climate change on tourist destinations was severe drought, while the most significant impact on archaeological sites was the negative impact on the colors of tombs and temples. The study recommended maintaining the climate of archaeological sites and reducing the impact of climate change on them by regulating the temperature and humidity in the buildings and structures surrounding them.

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## Introduction

Climate change refers to long-term alterations in weather patterns, including temperature increases, shifts in rainfall and wind, storms, floods, and other weather conditions. This phenomenon poses significant challenges to the global economy, environment, food security, transportation, health, and other areas (Prakash, 2021). Human activity, particularly the emission of greenhouse gases from activities such as industry, transportation, agriculture, heating, and fossil fuel use, is widely considered to be the main cause of climate change. Greenhouse gases trap heat in the atmosphere, which leads to rising temperatures and changes in the Earth's system (Lamb et al., 2021).

Climate change also has significant effects on oceans and seas, such as rising sea levels and changes in marine life, which negatively impact ecological systems, wildlife, and human communities (Cai et al., 2021). Scientists, researchers, governments and civil societies are collaborating to study the impacts of climate change, assess their effects, and develop measures to adapt to and mitigate them (Thomas et al., 2019). International agreements, government initiatives and international organizations are all essential tools to address climate change (Hickmann et al., 2021). These tools include reducing carbon emissions, promoting sustainability, developing clean energy technology, enhancing agriculture, controlling pollution, implementing climate change adaptation measures, and other actions. Addressing climate change requires global cooperation and joint efforts among all stakeholders to achieve necessary reforms to tackle this global challenge (Sachs et al., 2019).

The tourism industry is a crucial economic sector, accounting for around 25% of the gross domestic product of many countries (Al-Romeedy, 2024a). Tourist destinations are also affected by climate change in multiple ways, including changes in temperature, rainfall, wind, storms, and rising sea levels. Research indicates that climate change is increasingly affecting tourism, and its impact is growing overtime (Barnett, 2020). The tourism industry is actively working to assess the impact of climate change on tourist destinations and devise plans to adapt to and mitigate its effects. These plans include promoting sustainability in tourism by developing environmentally, socially, and economically sustainable tourism practices, adopting clean energy technologies and renewable resources in the tourism industry, and collaborating with local communities to improve the environmental, cultural, and social management of tourist destinations (Edgell, 2019; Reckien et al., 2017).

Additionally, climate change provides an opportunity to create new and diverse tourist destinations. These destinations can be developed in areas affected by climate change, such as polar regions, remote islands, mountainous, and desert regions, offering unique and diverse tourist experiences (Loehr & Becken, 2021; Steiger et al., 2019). In light of this, the study aims to achieve the following objectives:

- A. Identifying the main causes of climate change.
- B. Assessing the effects of climate change on inbound tourism to Egypt.
- C. Recognizing how can tourist destination face challenge of climate changes?
- D. Evaluating the different impacts of climate change on tourist destinations through application on Luxor and Aswan.

## Literature review

### Climate Change

Climate change is the term used to describe alterations in the Earth's atmospheric and climatic systems over a prolonged period. These changes include variations in temperature, precipitation, wind, storms, sea-levels, and ecological systems. Climate change is influenced by natural and human factors, with human activities, particularly the emission of greenhouse gases from industry, transport, agriculture, heating, and other fossil fuel usage, being the main driver of current climate change (Dow & Downing, 2016). Climate change has far-reaching effects on various areas, such as the environment, ecological systems, economy, health, food security, and transportation. For example, it impacts agriculture, animal farming, and fishing, leading to decreased production, ecological degradation, and an upsurge in insect-borne diseases, pollution, and other climate-related issues (Onyeaka et al., 2021).

Moreover, climate change brings changes in weather and climatic patterns, such as an increase in extreme weather conditions like thunderstorms, hurricanes, floods, and droughts, shift in precipitation and snowfall patterns, and rising temperatures, resulting in sea-level rise, changes in marine life, and negative environmental impacts on ecological systems, wildlife, and human settlements (D'Amato et al., 2020). Addressing climate change is a pressing challenge for communities, governments, companies, and individuals. Mitigation and adaptation measures include reducing carbon emissions, promoting sustainability, developing clean energy technology, investing in green infrastructure, providing protection from severe weather, and managing natural resources in a more efficient and sustainable manner (Allen & Craig, 2016).

### The causes of climate change

The main greenhouse gases responsible for climate change are carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydro fluorocarbons (HFCs), and sulfur hexafluoride (SF<sub>6</sub>) (Driga & Drigas, 2019). These greenhouse gases trap heat in the atmosphere, leading to a rise in temperatures and changes in atmospheric and climate systems on Earth. These changes result in an increase in severe weather events such as thunderstorms, hurricanes, floods, and droughts, changes in rainfall and snow patterns, and rising temperatures. These changes also negatively impact ecological systems, wildlife, and human societies (Naz et al., 2022; Wilcox et al., 2019).

As such, the primary causes of climate change are human activities that generate greenhouse gas emissions. These activities as mentioned by Fakana (2020) and Nwankwoala (2015) include:

- A. Burning fossil fuels: The process of extracting and burning coal, oil, and natural gas releases significant amounts of greenhouse gases, making it a major contributor to carbon emissions.
- B. Agriculture and livestock: The fermentation and bacterial digestion of plants and animals in agricultural and livestock activities lead to methane production.
- C. Land use and deforestation: Trees absorb carbon dioxide from the atmosphere and store it in plant tissues and soil. Deforestation and land use change lead to significant carbon emissions.
- D. Transportation: Air, land, and sea transportation activities contribute significantly to carbon emissions.

E. Industry: The production processes of certain industries, such as iron and steel, cement, paper, and chemical industries, result in the emission of many greenhouse gases.

Though natural factors such as changes in solar activity, volcanic activity, sea activity, and natural changes in the atmosphere also impact climate change, they are not the primary cause of current climate change.

Climate change has adverse impacts on ecological systems, economies, and societies, which can be further exacerbated by factors such as changes in water and soil use, biodiversity, pollution, infrastructure degradation, poverty, education, and health. It is crucial to take vigorous measures to address the root causes of climate change and mitigate its effects (Cramer et al., 2018). Human activities are among the major contributors to climate change, and they pose significant challenges to the world today. As the global population grows and there is an increased demand for energy, food, and natural resources, carbon emissions are on the rise (Tong & Ebi, 2019). It is crucial to consider other human causes of climate change, such as changes in consumption patterns, production and industry patterns, technology, development patterns, and non-compliance with climate change agreements. Failure to address these factors may lead to a further increase in greenhouse gas emissions, exacerbating the negative effects of climate change (Sovacool et al., 2021).

There are several human causes of climate change that require attention, including changes in consumption patterns, production and industry patterns, technology, development patterns, and non-compliance with climate change agreements (Ngoma et al., 2023; Freitag et al., 2021).

- 1) Changes in consumption patterns: With an increasing demand for products and services, there is a higher likelihood of consuming more natural resources and emitting more carbon.
- 2) Changes in production and industry patterns: Industries rely on natural resources and energy, leading to greenhouse gas emissions and changes in the atmospheric and climate systems.
- 3) Changes in technology: Technological advancements can lead to changes in energy usage, consumption, production, and lifestyle patterns that may increase carbon emissions.
- 4) Development patterns: Development patterns that contribute to higher consumption of natural resources and carbon emissions can adversely affect the atmospheric, climate, and environmental systems.
- 5) Failure to comply with climate change agreements: Neglecting the commitments to reduce carbon emissions and comply with climate change agreements can result in a rise in greenhouse gases in the atmosphere and worsen the negative effects of climate change.

### **The consequences of climate change**

Climate change has adverse effects on humans, wildlife, and the environment, which can be summarized as follows:

- A. Temperature increase: The rise in temperature leads to changes in the climate system, increases the frequency of extreme weather events such as floods, droughts, and hurricanes, and causes the melting of ice in polar regions, resulting in a rise in the sea level (Price et al., 2013).

- B. Ecological system changes: Climate change causes changes in the distribution of animals and plants, affecting biodiversity and increasing the risk of extinction of many species, leading to the distortion of ecological systems (Dash et al., 2021).
- C. Depletion of natural resources: Climate change depletes natural resources such as water, food, and energy, which affects human survival (Maja & Ayano, 2021).
- D. Sea level rise: The temperature increase leads to the melting of polar ice and increases sea level, causing floods and impacting coastal areas and cities (Garner et al., 2017).
- E. Air pollution increase: Climate change increases greenhouse gas emissions and air pollution, causing higher levels of pollution in cities and negative impacts on public health (D'amato et al., 2016).
- F. Health impacts: Climate change has negative impacts on public health, such as the increase in vector-borne diseases, allergies, respiratory diseases, and heat-related illnesses (Anderko et al., 2020).
- G. Economic impacts: Climate change has negative impacts on agriculture, fishing, tourism, transportation, energy, health, insurance, and technology, leading to poverty, displacement, and conflicts, especially in poor and vulnerable communities (Ebele & Emodi, 2016).

Climate change has a widespread impact on all aspects of life, and it is crucial to take immediate action to reduce carbon emissions and promote sustainability in consumption, production, and lifestyle (Nielsen et al., 2021). Developing effective solutions for adaptation and mitigation of climate change impacts, providing support to poor and vulnerable communities to adapt to climate change and achieve sustainable development is also critical. Achieving these goals requires international cooperation and solidarity, taking tangible actions in areas such as government policies, environmental legislation, investments in renewable and sustainable energy, improving environmental management, promoting public awareness and education, and focusing on achieving sustainable development and social and economic justice (Rieckmann, 2018).

### **The role of the tourism industry in causing climate change**

The tourism industry significantly contributes to climate change (Al-Romeedy, 2024b; Lenzen et al., 2018).

- Air transport: Air travel releases vast amounts of greenhouse gases, making it one of the largest sources of carbon emissions globally. Since tourism relies heavily on air transport to move tourists between countries and cities, it contributes significantly to increasing carbon emissions and accelerating climate change (Shen et al., 2020).
- Land transport: Tourist transportation also relies heavily on fossil fuels, which increase greenhouse gas emissions. Land transport includes buses, cars, trains, and tourist buses (Rahman et al., 2017).
- Hotels and tourist facilities: Hotels and tourist facilities consume considerable amounts of energy and water and produce large amounts of solid and liquid waste, making them major sources of carbon emissions. Thus, an increase in the number of tourists, hotels, and tourist facilities will lead to a rise in energy and water consumption and carbon emissions, further accelerating climate change (Puig et al., 2017).
- Tourist activities: Many tourist activities, such as surfing, ice skating, diving, camping, and hiking, cause environmental pollution and destruction of the ecosystem.

These activities lead to water and soil pollution, destruction of wildlife and marine life, and contribute to worsening climate change (Cui et al., 2016).

### **Strategies for reducing the impact of the tourism industry on climate change**

The tourism industry has a negative impact on the environment, causing land degradation, waste disposal, water and air pollution (Qi et al., 2020). To mitigate the impact of the tourism industry on climate change, several measures can be implemented, including:

- A. Promoting sustainable tourism: Sustainable tourism practices can be promoted to reduce the environmental impact, preserve natural resources, and protect biodiversity, including promoting rural and sustainable tourism practices in marine tourism (Choi et al., 2021).
- B. Adopting eco-friendly transportation: Alternative transportation methods that rely on renewable energy and minimize carbon emissions can be used, such as electric buses, hybrid cars, bicycles, and electric trains (Agaton et al., 2020).
- C. Enhancing energy efficiency in tourist facilities: Modern technologies, heat-insulating materials, effective lighting, and more efficient heating and cooling can be used to improve energy efficiency in tourist facilities. Sustainable practices should also be encouraged in construction, operation, and maintenance (Perný et al., 2021).
- D. Encouraging social and environmental responsibility: The tourism industry must encourage social and environmental responsibility, encouraging tourists to participate in environmental and local social activities, raising awareness of environmental challenges, and promoting contributions to reduce the negative impacts of the tourism industry (Panwanitdumrong & Chen, 2021).
- E. Raising environmental awareness: Tourists and local communities can be trained, educated, and guided on how to reduce the environmental impact of tourism, promoting the use of sustainable products and responsible use of natural resources (Friess, 2017).
- F. Encouraging the adoption of clean technology and promoting innovation in the tourism industry can be achieved by investing in research and development and providing support for the development and implementation of sustainable technology that reduces carbon emissions and improves the environmental efficiency of the industry (Fernando et al., 2019).

In order for the tourism industry to effectively contribute to climate change mitigation, it should adopt environmentally sustainable practices, use clean technology, increase environmental awareness among tourists and local communities, and promote social responsibility within the industry (Pan et al., 2018).

### **The impact of climate change on the tourist destination sustainability**

Tourist destinations are significantly impacted by climate change, which causes changes in temperature, natural landscapes, rainfall, biodiversity, and natural resources. These changes can affect the appeal of tourist destinations and their ability to attract visitors. Furthermore, climate change can have a significant impact on the tourism industry, as it affects various factors that are crucial to tourism, including natural landscapes, natural resources, biodiversity, temperature, and rainfall (Weiskopf et al., 2020).

For instance, rising temperatures and changing climate patterns can have a negative effect on winter tourism, particularly in mountainous regions where snow and ice are essential for attracting tourists. As a result, tourism in these areas may be significantly impacted.

Similarly, climate change can disrupt rainfall patterns during peak tourism seasons in certain regions, affecting agriculture, water resources, forests, and ultimately, the tourism industry (Steiger et al., 2022; Kilungu et al., 2019).

It should be noted that certain tourist regions may be susceptible to natural disasters resulting from climate change, such as floods, hurricanes, droughts, and forest fires, which can cause substantial material losses and disrupt tourism in these areas. The tourism industry is one of the most vulnerable industries to the effects of climate change, as it heavily depends on natural resources, natural landscapes, and climate to attract visitors and promote environmental, economic, and social sustainability (Dogru et al., 2019).

For instance, water scarcity in arid areas can jeopardize the sustainability of tourist destinations, as the industry relies on water for various activities such as swimming, diving, water sports, and sea excursions. Water scarcity can diminish the appeal of tourist areas, limit available activities, and potentially decrease economic growth, causing negative consequences for local communities that depend on tourism as a source of income (Hoogendoorn & Fitchett, 2018).

Likewise, rising temperatures can undermine the sustainability of tourist destinations, leading to unfavorable effects on tourist activities and attractions, as well as affecting the quality of life for both residents and tourists. Higher temperatures can diminish the appeal of tourist destinations that rely on cold weather activities such as winter sports, skiing, and climbing, and it can also exacerbate health and social issues due to extreme heat, negatively impacting the well-being of both local residents and visitors (GhulamRabbany et al., 2013).

Climate change has the potential to impact the sustainability of natural resources and biodiversity in tourist destinations, resulting in decreased economic growth for the industry and negative consequences for local communities that rely on tourism for their livelihoods. Climate change can result in the destruction of pastures, forests, beaches, wilderness areas, and water resources, which can have an adverse impact on the sustainable development and economic growth of tourist destinations (Boley & Green, 2016). Climate change can also affect archaeological sites in various ways, potentially compromising their preservation and reducing their historical and cultural value. In arid and desert regions, rising temperatures and reduced rainfall can cause erosion of stone and sculptural buildings, archaeological foundations, and the deterioration of plaster and mud used in construction. Additionally, sandstorms and strong winds can damage sensitive archaeological features, leading to erosion (Altieri & Nicholls, 2017).

In coastal areas, an increase in sea level due to climate change can cause the submergence and destruction of ancient archaeological sites. Severe storms and floods can also wash away the floors and foundations of archaeological structures, resulting in significant damage. Climate change can also alter rainfall and humidity patterns, causing erosion of archaeological inscriptions and shapes, as well as changing the chemical properties of stone and other materials used in construction (Ezcurra & Rivera-Collazo, 2018).

Moreover, climate change can cause alterations in the plants, animals, and insects in the vicinity of archaeological sites, affecting the natural environment and biodiversity of the area and, consequently, the cultural and historical aspects of the archaeological site. Additionally, climate change can increase chemical erosion of archaeological materials, resulting in the deterioration of paintings, inscriptions, and texts engraved on stones, metals, and glass used in furniture and decorations. Ultimately, this can lead to a reduction in the value, aesthetics,

and historical and cultural significance of the archaeological site (Nielsen et al., 2021). Therefore, it is essential for local and international communities, governments, and institutions to implement measures and strategies to safeguard archaeological sites against the impacts of climate change, develop techniques and methods for preserving these historical sites, and enhance continuous monitoring of the environmental effects on archaeological sites (Kırmızı & Karaman, 2021).

Measures can also be taken to mitigate the effects of climate change on archaeological sites, such as creating modern irrigation systems and sustainable agricultural practices, developing green infrastructure to reduce negative environmental impacts on archaeological sites, and promoting awareness and education about the importance of preserving archaeological sites for future generations. These measures also include preparing emergency plans to deal with extreme weather conditions, minimizing the negative effects of severe weather events on archaeological sites, implementing regular maintenance programs, and increasing cooperation between countries to protect archaeological sites and achieve sustainable development in the region (Nikolaou et al., 2020).

### **Evaluating the impact of climate change on Luxor and Aswan**

The impact of climate change on tourist destinations, particularly in Egypt's Luxor and Aswan Governorates, cannot be underestimated. These regions are known for their cultural heritage and historical sites, drawing millions of tourists annually. However, climate change poses a significant global challenge that affects multiple sectors, including tourism (Jaber et al., 2021; Grimm et al., 2018). The rise in temperatures stands out as a prominent consequence of climate change in Luxor and Aswan. This increase in temperature has negative implications for both tourist activities and infrastructure. During the summer months, the intense heat can make outdoor exploration arduous and uncomfortable for tourists, requiring significant physical exertion. Moreover, the elevated temperatures increase health risks, raising the chances of visitors experiencing heat-related illnesses (Kozmal et al., 2021; Hussein et al., 2020).

Climate change also brings about changes in the water levels of the Nile River, which is of vital importance to Egypt. Adequate water availability is essential for agriculture and the preservation of historical sites in Luxor and Aswan. However, climate change has resulted in unpredictable rainfall patterns and decreased water flow in the Nile. Consequently, this can give rise to water scarcity, negatively impacting irrigation systems, agricultural activities, and ultimately affecting the overall attractiveness and appeal of the tourist destinations (Jaber et al., 2021; Shedded, 2022; Mohamed et al., 2022). In addition, climate change has the capacity to disturb the fragile ecological equilibrium in the area. The escalating sea levels and heightened erosion pose a threat to the coastal regions of Luxor and Aswan. These natural wonders hold significance not only for tourism but also for sustaining local ecosystems (Upadhyay, 2020; Held et al., 2018). Furthermore, climate change is leading to an increase in the frequency of extreme weather events such as sandstorms and flash floods. These events have the potential to disrupt transportation, inflict damage on infrastructure, and pose risks to the safety of tourists. The historical sites and monuments, including the temples of Luxor and the Abu Simbel temples, are particularly susceptible to these weather events, putting them at risk of structural damage and jeopardizing their long-term preservation (Fazel-Rastgar, 2020; Russell, 2013).



## Methodology

### Study instrument

The study relied on a questionnaire that was divided into four sections that covered the demographic characteristics of the study sample, the causes of climate change, the impact of climate change on inbound tourism to Egypt, and finally the impact of climate change on the Egyptian tourist destination in general and archaeological sites in particular. For the first section, which dealt with demographic characteristics, it included gender, age, educational level, and place of work. As for the second section, which dealt with the causes of climate change, it included 10 phrases to identify the most important causes of climate change, which were prepared by Fakana (2020). For the third section, which dealt with the impact of climate change on inbound tourism to Egypt, it included 14 phrases that were modified to fit the nature of inbound tourism to Egypt, based on Tang and Lau (2021), Priego et al. (2015), and Pintassilgo et al. (2016). The fourth section, which dealt with the impact of climate change on the Egyptian tourist destination, was divided into two parts. The first part dealt with assessing the various effects of climate change on the Egyptian tourist destination in general through 15 phrases that were prepared and modified based on Atzori et al. (2018) and Seetanah & Fauzel (2018). The second part addressed the impact of climate change on archaeological sites in Egypt through 8 phrases that were prepared and modified based on Hollesen et al. (2017), Carmichael et al. (2018), and Hollesen et al. (2018). The survey form was designed using a five-point Likert scale in the second, third, and fourth sections, which relied on the presence of five degrees between agreement and disagreement (5= completely agree, 4= agree, 3= somewhat agree, 2= disagree, 1= completely disagree).

### Population and Study Sample

The study population represented staff of the faculty of tourism and hotels in Egyptian government universities, members of the faculty of archaeology at Cairo University, experts from the Ministry of Tourism and Antiquities, and Environment, and experts from the Tourism Development Authority. The survey form was distributed and sent to a random sample of faculty staff and experts both in paper and electronic form, amounting to 286 individuals during the period from December 2023 to the end of March 2024. A total of 248 responses were obtained. The questionnaires were examined and reviewed, and it was found that 22 questionnaires were incomplete and were therefore excluded from the analysis. In the end, the study relied on the analysis of only 226 questionnaires out of the total distributed, with a response rate of 79%.

### Statistical tests

To analyze the study data and test the hypotheses, the study used SPSS V. 28 software. The following statistical methods were used:

- 1) Cronbach's alpha test to evaluate the degree of reliability of the study tool.
- 2) Frequencies and percentages were used to describe the demographic characteristics of the study sample.
- 3) Means were used to determine the responses of the sample members towards all study sections.
- 4) The t-test was used to identify differences in the responses of the study sample to the variables, and it is used when determining differences between two independent samples.

- 5) The ONE-WAY ANOVA test was used to identify differences in the responses of the study sample to the study variables, and it is used when determining differences between more than two independent samples.

## Results

### Cronbach's alpha test

Cronbach's alpha test was used to evaluate the reliability of the study tool. The acceptable value for Cronbach's alpha is 0.70 (Al-Romeedy, 2023a,b). This value indicates that the study tool has a high degree of reliability and is valid for use in measuring what it was designed to measure. Table (1) shows the results of the Cronbach's alpha test.

Table (1) results of reliability

Variables	Cronbach alpha	Number of items
Causes of climate changes	0.863	10
The impact of climate change on inbound tourism to Egypt	0.901	14
The impact of climate change on tourist destinations	0.888	23
Total	0.879	47

The results in Table (1) show an increase in all Cronbach's alpha values above the acceptable and estimated value of (0.70) (Al-Azab & Al-Romeedy, 2024), where the value of Cronbach's alpha for causes of climate changes was (0.863), (0.901) for the impact of climate change on inbound tourism to Egypt, and (0.888) for the impact of climate change on tourist destinations. Additionally, the value of Cronbach's alpha for the entire study tool was (0.879). These values indicate that the study tool has a high degree of reliability, confidence in its statements and results, and is valid for use.

### The Demographic Characteristics of the Study Sample

Table (2) shows the demographic characteristics of the study sample in terms of gender, age, educational level, and place of work.

Table (2) The demographic characteristics of the study sample

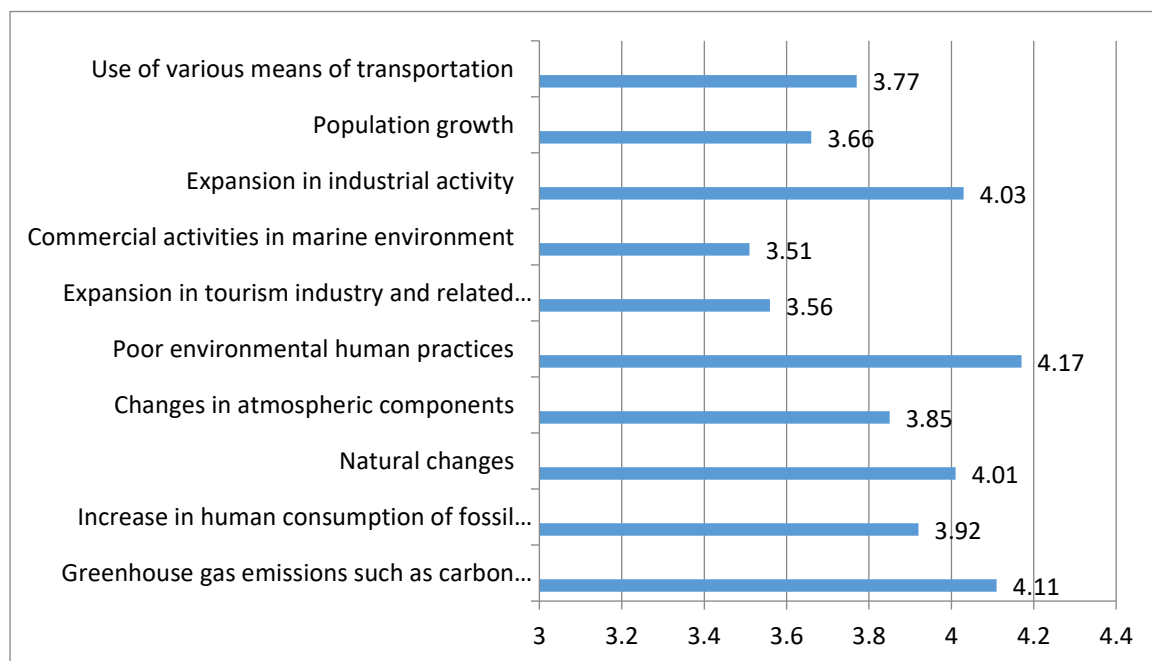
Characteristics		Freq.	%
Gender	Male	164	72.6
	Female	62	27.4
Age	Less than 30 years	11	4.9
	From 30 to 39 years	66	29.2
	From 40 to 49 years	98	43.3
	50 years and above	51	22.6
Educational level	Less than bachelor	7	3.1
	Bachelor	44	19.5
	Postgraduate	175	77.4
Place of work	Faculties of tourism and hotels	149	65.9
	Faculty of archeology – Cairo Univ.	14	6.2
	Ministry of tourism and antiquities	32	14.2
	Tourism development authority	17	7.5
	Ministry of environment	14	6.2

This table shows that the majority of the study sample were male, accounting for 72.6% (164 respondents), while females accounted for 27.4% of the total study sample (62 respondents). Regarding age, 43.3% of the study sample were between 40-49 years old (98 respondents), followed by those between 30-39 years old at 29.2% (66 respondents), then those aged 50 years and above at 22.6% (51 respondents), and those under 30 years old at 4.9% (11 respondents). As for educational level, the majority of the study sample held postgraduate degrees at 77.4% (175 respondents), and 19.5% held a bachelor's degree (44 respondents). Concerning place of work, almost two-thirds of the study sample worked as faculty members in colleges of tourism and hotels at 65.9% (149 respondents), followed by those working in the Ministry of Tourism and Antiquities at 14.2% (32 respondents), then those working in the Tourism Development Authority at 7.5% (17 respondents), followed by those working as faculty members at the Faculty of Archaeology, Cairo University at 6.2% (14 respondents), and the same percentage (6.2%) worked in the Ministry of Environment (14 respondents).

## Descriptive Analysis of Study Variables

### *Causes of climate changes*

Figure (1) indicates the results of the descriptive analysis of the causes of climate changes.

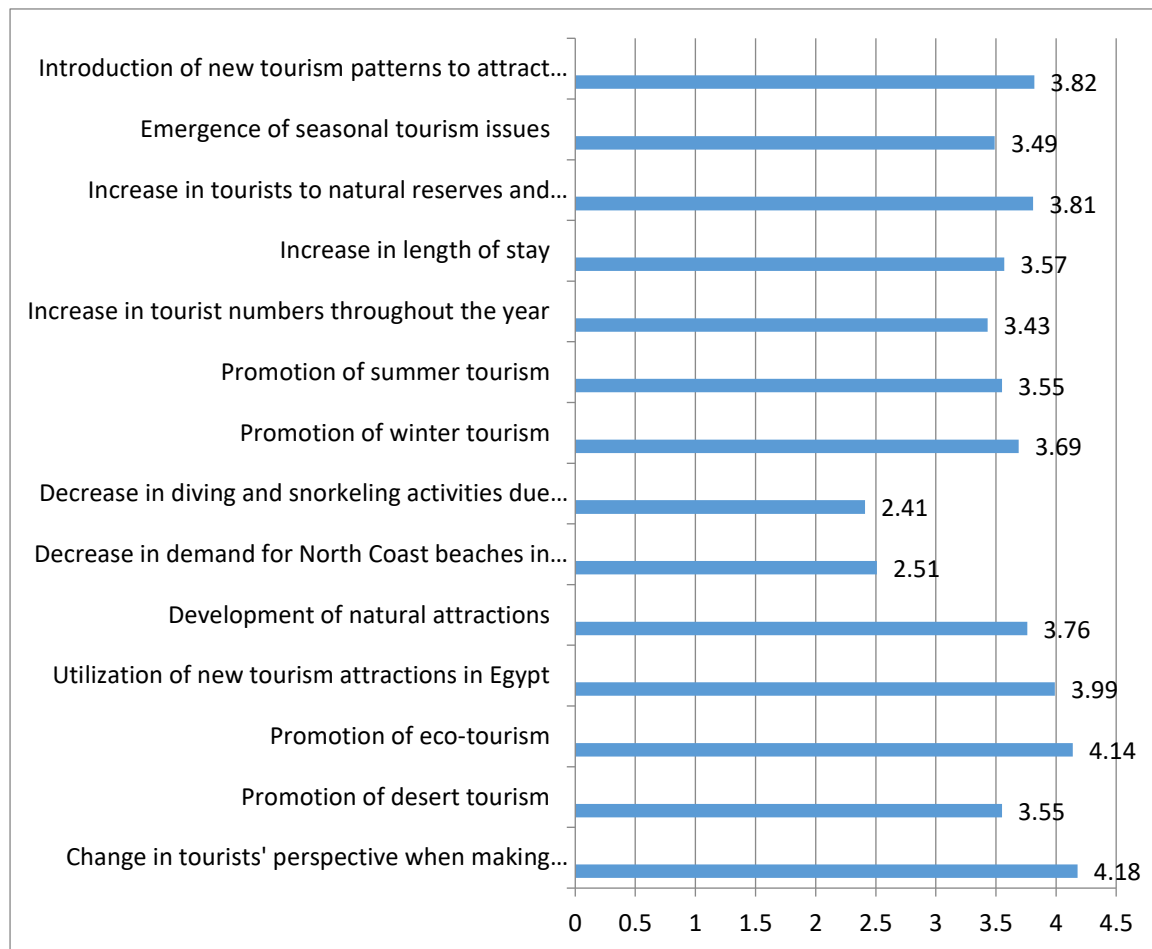


**Figure (1) Causes of climate changes**

The results in figure (1) show that the most significant cause of climate change is poor environmental human practices, with mean of (4.17), followed by greenhouse gas emissions such as carbon dioxide as the second strongest cause of climate change with mean of (4.11), then expansion in industrial activity as the third most significant cause with mean of (4.03), followed by natural changes as the fourth most significant cause with mean of (4.01), then increase in human consumption of fossil energy sources (coal, petroleum, gas) with mean of (3.92), followed by changes in atmospheric components with mean of (3.85), then use of various means of transportation with mean of (3.77), followed by population growth with mean of (3.66), then expansion in tourism industry and related activities with mean of (3.56), and finally commercial activities in the marine environment with mean of (3.51).

### The impact of climate change on inbound tourism to Egypt

Figure (2) reveals the results of the descriptive analysis of the impact of climate change on inbound tourism to Egypt.



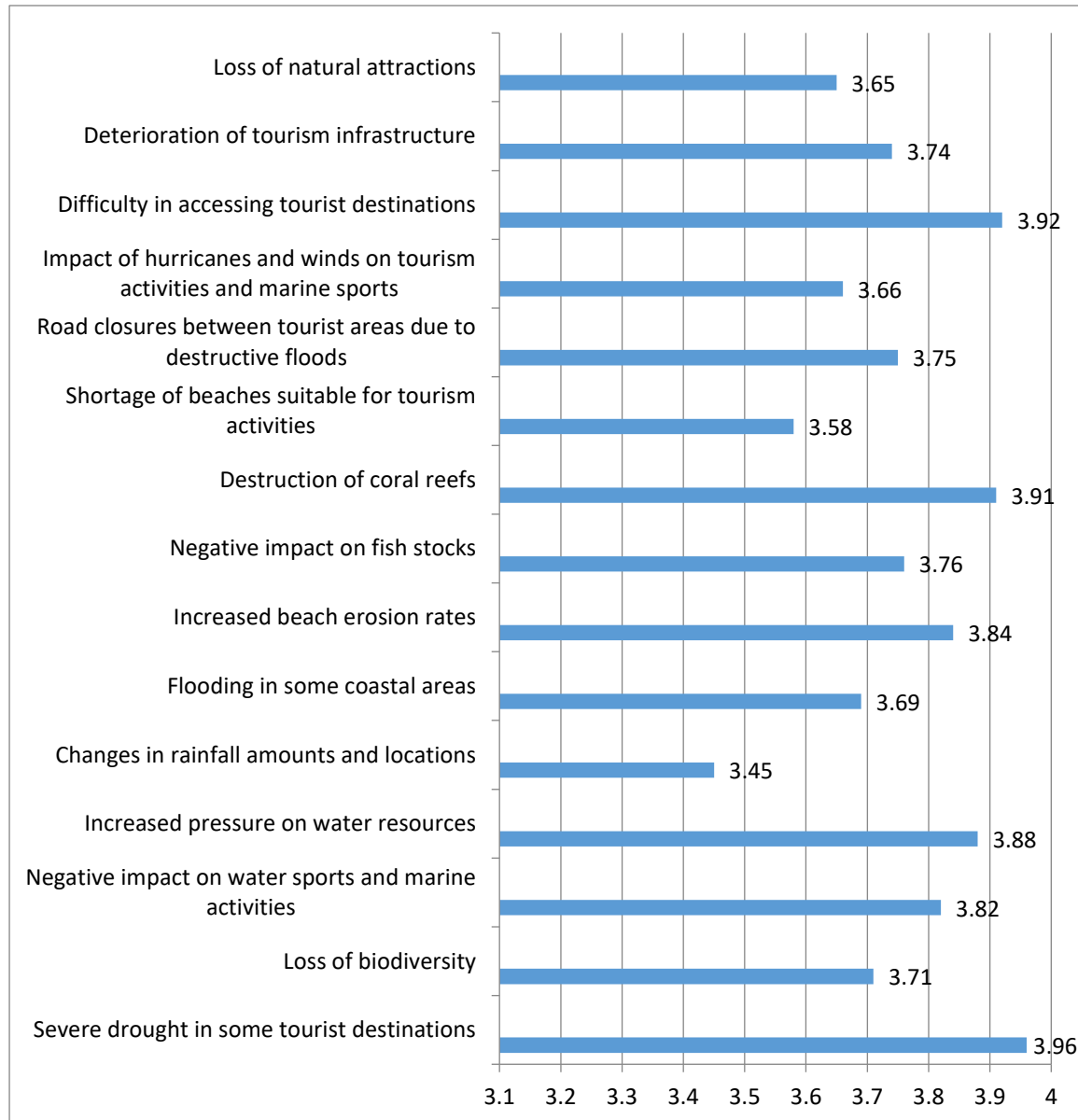
**Figure (2) The impact of climate change on inbound tourism to Egypt**

The results in figure (2) indicate that there are several impacts of climate change on inbound tourism to Egypt. the strongest impact of climate change on inbound tourism to Egypt is change in tourists' perspective when making the decision to travel to Egypt with mean of (4.18), followed by promotion of eco-tourism with mean of (4.14), then utilization of new tourism attractions in Egypt with mean of (3.99), followed by introduction of new tourism patterns to attract tourists with mean of (3.82), then increase in tourists to natural reserves and protected areas with mean of (3.81), followed by development of natural attractions with mean of (3.76), then promotion of winter tourism with mean of (3.69), followed by increase in length of stay with mean of (3.57), then promotion of summer tourism with mean of (3.55), then promotion of desert tourism with mean of (3.55), followed by emergence of seasonal tourism issues with mean of (3.49), then increase in tourist numbers throughout the year with mean of (3.43), followed by decrease in demand for north coast beaches in Egypt with mean of (2.51), and finally decrease in diving and snorkeling activities due to coral reef degradation with mean of (2.41).

## The impact of climate change on tourist destinations

### A- *The general impacts of climate change on tourist destinations*

Figure (3) depicts the general impacts of climate change on tourist destinations.



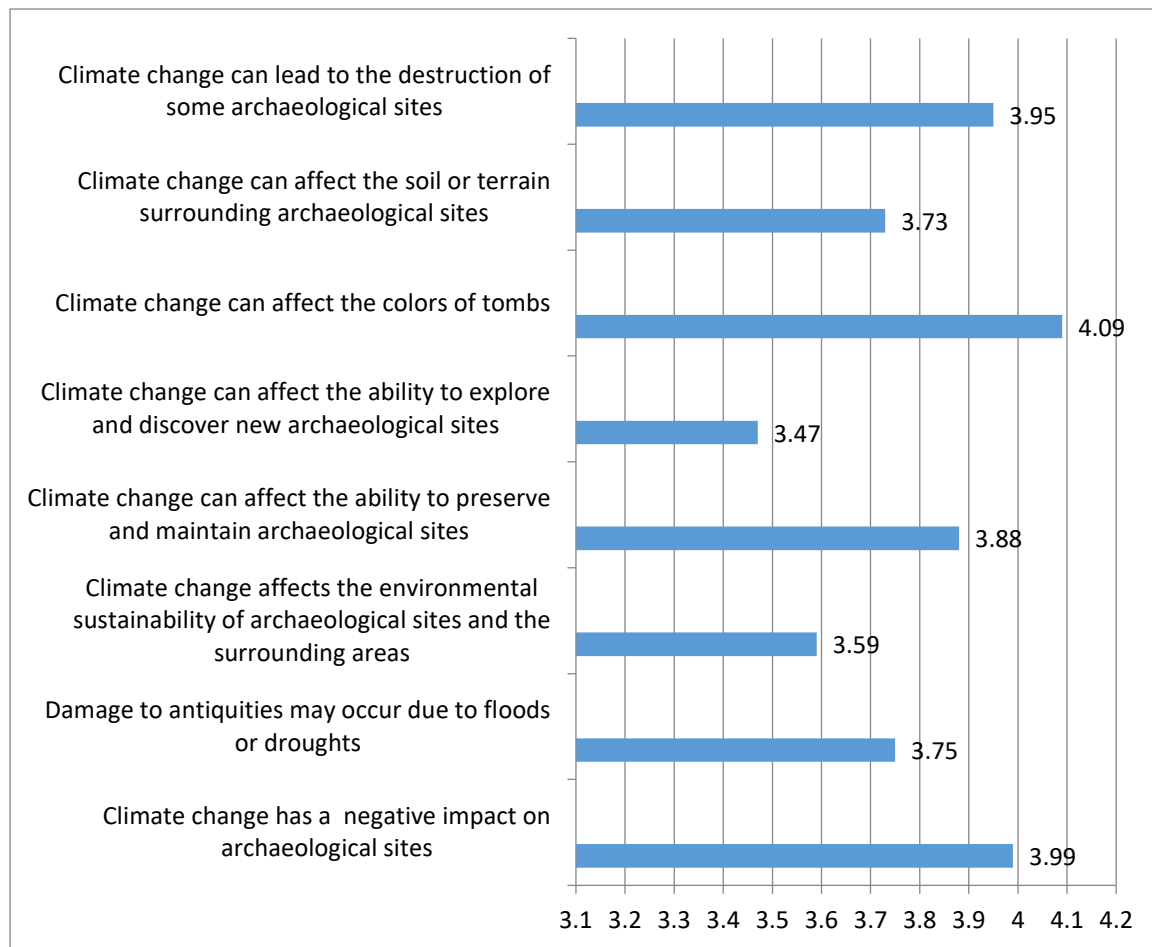
**Figure (3) The general impacts of climate change on tourist destinations**

The results in figure (3) highlight that there are multiple general impacts of climate change on tourist destinations. The most significant impacts are severe drought in some tourist destinations with a mean of (3.96), followed by difficulty in accessing tourist destinations with a mean of (3.92), then destruction of coral reefs with a mean of (3.91), followed by increased pressure on water resources with a mean of (3.88), then increased beach erosion rates with a mean of (3.84), followed by negative impact on water sports and marine activities with a mean of (3.82), then negative impact on fish stocks with a mean of (3.76), followed by road closures between tourist areas due to destructive floods with a mean of (3.75), then deterioration of tourism infrastructure with a mean of (3.74), then loss of biodiversity with a mean of (3.71),

followed by flooding in some coastal areas with mean of (3.69), then impact of hurricanes and winds on tourism activities and marine sports with mean of (3.66), then loss of natural attractions with mean of (3.65), followed by shortage of beaches suitable for tourism activities with mean of (3.58), and finally changes in rainfall amounts and locations with mean of (3.45).

**B- The impact of climate change on archaeological sites in Luxor and Aswan**

Figure (4) highlights the impact of climate change on the archaeological sites in Luxor and Aswan.



**Figure (4) The impact of climate change on archaeological sites in Luxor and Aswan**

Figure (4) illustrates that climate change can impact the historical sites in Luxor and Aswan in various ways. the highest impact is climate change can affect the colors of tombs with mean of (4.09), followed by climate change has a negative impact on archaeological sites with mean of (3.99), then climate change can lead to the destruction of some archaeological sites with mean of (3.95), followed by climate change can affect the ability to preserve and maintain archaeological sites with mean of (3.88), then damage to antiquities may occur due to floods or droughts with mean of (3.75), followed by climate change can affect the soil or terrain surrounding archaeological sites with mean of (3.73), then climate change affects the environmental sustainability of archaeological sites and the surrounding areas with mean of (3.59), and finally climate change can affect the ability to explore and discover new archaeological sites with mean of (3.47).

### Results of t-test

The t-test was conducted to identify the statistical differences in the study sample's responses to its variables (causes of climate change, the impact of climate change on inbound tourism to Egypt, the impact of climate change on tourist destinations, the impact of climate change on the archeological sites in Luxor and Aswan) according to gender. Table (3) shows the statistical differences found between genders in these variables.

**Table (3) results of t test according to gender**

Variables	t	Mean rank		Sig
		Male	Female	
Causes of climate changes	1.036	3.712	3.669	0.093
The impact of climate change on inbound tourism to Egypt	0.925	3.895	3.816	0.142
The general impacts of climate change on tourist destinations	0.846	3.795	3.777	0.199
The impact of climate change on archaeological sites in Luxor and Aswan	0.982	3.692	3.717	0.121

**Table (3) indicates the following results:**

- For causes of climate changes, the significance level value was 0.093, which is greater than 0.05. this means that there were no statistically significant differences in causes of climate changes according to the gender variable.
- For the impact of climate change on inbound tourism to Egypt, the significance level value was 0.142, which is greater than 0.05. this means that there were no statistically significant differences in the impact of climate change on inbound tourism to Egypt according to the gender variable.
- For the general impacts of climate change on tourist destinations, the significance level value was 0.199, which is greater than 0.05. this means that there were no statistically significant differences in the general impacts of climate change on tourist destinations according to the gender variable.
- For the impact of climate change on archaeological sites in Luxor and Aswan, the significance level value was 0.121, which is greater than 0.05. this means that there were no statistically significant differences in the impact of climate change on archaeological sites in Luxor and Aswan according to the gender variable.

## Results of ONE-WAY ANOVA test

### Testing differences according to age

A ONE-WAY ANOVA test was conducted to identify the statistical differences in the study sample's responses to its variables according to age. Table (4) shows the results of the ANOVA analysis for differences according to age.

**Table (4) results of ONE WAY ANOVA according to age**

Variables		Sum of Squares	f	Fig.
Causes of climate changes	Between groups	1.983	0.842	0.472
	Within Groups	174.336		
	Total	176.319		
The impact of climate change on inbound tourism to Egypt	Between groups	18.152	0.689	0.224
	Within Groups	258.857		
	Total	277.009		
The general impacts of climate change on tourist destinations	Between groups	5.751	2.285	0.080
	Within Groups	186.254		
	Total	182.004		
The impact of climate change on archaeological sites in Luxor and Aswan	Between groups	2.587	0.960	0.412
	Within Groups	199.347		
	Total	201.934		

**Table (4) shows the following results:**

- For causes of climate changes, the significance level value was 0.472, which is greater than 0.05. this means that there were no statistically significant differences in causes of climate changes according to the age variable.
- For the impact of climate change on inbound tourism to Egypt, the significance level value was 0.224, which is greater than 0.05. this means that there were no statistically significant differences in the impact of climate change on inbound tourism to Egypt according to the age variable.
- For the general impacts of climate change on tourist destinations, the significance level value was 0.080, which is greater than 0.05. this means that there were no statistically significant differences in the general impacts of climate change on tourist destinations according to the age variable.
- For the impact of climate change on archaeological sites in Luxor and Aswan, the significance level value was 0.412, which is greater than 0.05. this means that there were no statistically significant differences in the impact of climate change on archaeological sites in Luxor and Aswan according to the age variable.



### Testing differences according to educational level

A ONE-WAY ANOVA test was conducted to identify the statistical differences in the study sample's responses to its variables according to educational level. Table (5) shows the results of the ANOVA analysis for differences according to educational level.

**Table (5) results of ONE WAY ANOVA according to educational level**

Variables		Sum of Squares	f	Fig.
Causes of climate changes	Between groups	2.314	0.984	0.401
	Within Groups	174.005		
	Total	176.319		
The impact of climate change on inbound tourism to Egypt	Between groups	14.359	0.645	0.071
	Within Groups	262.650		
	Total	277.009		
The general impacts of climate change on tourist destinations	Between groups	3.169	1.242	0.295
	Within Groups	188.836		
	Total	192.004		
The impact of climate change on archaeological sites in Luxor and Aswan	Between groups	2.359	0.875	0.455
	Within Groups	199.574		
	Total	201.934		

### Table (5) clarifies the following results:

- For causes of climate changes, the significance level value was 0.401, which is greater than 0.05. this means that there were no statistically significant differences in causes of climate changes according to the educational level variable.
- For the impact of climate change on inbound tourism to Egypt, the significance level value was 0.071, which is greater than 0.05. this means that there were no statistically significant differences in the impact of climate change on inbound tourism to Egypt according to the educational level variable.
- For the general impacts of climate change on tourist destinations, the significance level value was 0.295, which is greater than 0.05. this means that there were no statistically significant differences in the general impacts of climate change on tourist destinations according to the educational level variable.
- For the impact of climate change on archaeological sites in Luxor and Aswan, the significance level value was 0.455, which is greater than 0.05. this means that there were no statistically significant differences in the impact of climate change on archaeological sites in Luxor and Aswan according to the educational level variable.

### Testing differences according to place of work

A ONE-WAY ANOVA test was conducted to identify the statistical differences in the study sample's responses to its variables according to place of work. Table (6) shows the results of the ANOVA analysis for differences according to place of work.

**Table (6) results of ONE WAY ANOVA according to place of work**

Variables		Sum of Squares	f	Fig.
Causes of climate changes	Between groups	1.998	5.048	0.009
	Within Groups	174.320		
	Total	176.319		
The impact of climate change on inbound tourism to Egypt	Between groups	33.623	10.223	0.000
	Within Groups	243.386		
	Total	277.009		
The general impacts of climate change on tourist destinations	Between groups	8.839	3.571	0.015
	Within Groups	183.165		
	Total	192.004		
The impact of climate change on archaeological sites in Luxor and Aswan	Between groups	2.880	6.071	0.002
	Within Groups	199.053		
	Total	201.934		

**Table (6) reveals the following results:**

- For causes of climate changes, the significance level value was 0.009, which is less than 0.05. this means that there were statistically significant differences in causes of climate changes according to the workplace variable.
- For the impact of climate change on inbound tourism to Egypt, the significance level value was 0.000, which is less than 0.05. this means that there were statistically significant differences in the impact of climate change on inbound tourism to Egypt according to the workplace variable.
- For the general impacts of climate change on tourist destinations, the significance level value was 0.015, which is less than 0.05. this means that there were statistically significant differences in the general impacts of climate change on tourist destinations according to the workplace variable.
- For the impact of climate change on archaeological sites in Luxor and Aswan, the significance level value was 0.002, which is less than 0.05. this means that there were statistically significant differences in the impact of climate change on archaeological sites in Luxor and Aswan according to the workplace variable.

### **Results and recommendations:**

#### **Results:**

- There are many reasons that lead to climate change, some of which are related to the tourism industry, such as the expansion of tourism industry and its related activities, negative activities in the marine environment, and the use of different transportation means, especially airplanes, which emit greenhouse gases like carbon dioxide. There are also other reasons for climate change that are not related to tourism, such as an increase in energy consumption, natural changes, changes in the atmospheric components, industrial activities, and population growth.
- Climate change affects inbound tourism to Egypt in several ways, such as its impact on tourists' decision to travel to Egypt, the popularity of some types of tourism like eco-tourism and desert tourism, and its impact on winter and summer tourism, tourist attractions, tourist accommodation rates, and the number of tourists.

- Climate change has many impacts on tourist destinations, such as contributing to severe drought in some destinations, loss of biodiversity, water problems, floods and heavy rain, extreme temperatures, destruction of coral reefs, loss of fish wealth, erosion of beaches, sinking of some coastal areas, and loss of natural attractions.
- Climate change may negatively impact archaeological sites in Luxor and Aswan, where it may lead to changes in the colors of tombs and temples, damage to archaeological sites due to drought, heavy rain, or high temperatures, and negative impact on environmental sustainability in archaeological sites. Climate change also limits the ability to explore new archaeological sites or preserve and maintain existing ones. Climate change could ultimately lead to the complete destruction of archaeological sites.
- There were no statistically significant differences in the study sample's responses to Causes of climate changes, The impact of climate change on inbound tourism to Egypt, The general impacts of climate change on tourist destinations, and The impact of climate change on archaeological sites in Luxor attributed to gender, age, and educational level.
- There were statistically significant differences in the study sample's responses to Causes of climate changes, The impact of climate change on inbound tourism to Egypt, The general impacts of climate change on tourist destinations, and The impact of climate change on archaeological sites in Luxor attributed to workplace.

### **Recommendations**

To alleviate the impact of climate change on tourist destinations in Luxor and Aswan Governorates, the following recommendations can be proposed for various stakeholders:

#### **Government and Policy Makers:**

- 1) Enacting and enforcing comprehensive policies addressing climate change adaptation and mitigation, tailored specifically to the tourism sector in Luxor and Aswan.
- 2) Allocating resources towards research and monitoring programs to enhance understanding of local climate change impacts and develop evidence-based strategies.
- 3) Emphasizing sustainable development by promoting initiatives such as renewable energy projects, green infrastructure, and eco-friendly transportation systems.
- 4) Offering financial incentives and assistance to encourage adoption of sustainable practices and reduction of carbon emissions among tourism businesses.
- 5) Fostering partnerships with international organizations and other stakeholders to access funding and expertise for climate change adaptation and mitigation initiatives.

#### **Local Tourism Industry:**

- 1) Incorporating climate change factors into business practices and conduct climate risk evaluations for hotels, resorts, and tourist amenities.
- 2) Embracing sustainable tourism approaches encompassing energy and water conservation techniques, waste management plans, and environmentally friendly transportation alternatives.
- 3) Raising awareness among tourists regarding responsible and sustainable tourism practices, advocating for waste reduction, resource conservation, and preservation of local ecosystems and cultures.
- 4) Engaging in partnerships with local communities, non-governmental organizations (NGOs), and governmental bodies to formulate and execute climate change adaptation and resilience plans.

**Local Communities and Residents:**

- 1) Facilitating climate change education and awareness initiatives to foster comprehension and endorsement of sustainable methods within the local community.
- 2) Advocating for community-driven endeavors advancing alternative livelihoods and revenue streams, lessening reliance on practices exacerbating climate change.
- 3) Safeguarding and conserving natural assets such as forests, water sources, and cultural landmarks, integral to both tourism and indigenous ecosystems.
- 4) Engaging in local governance discussions regarding tourism expansion, ensuring climate change factors are duly acknowledged and integrated into decision-making processes.

**International Organizations and Donors:**

- 1) Extending financial and technical aid to bolster climate change adaptation and mitigation endeavors in Luxor and Aswan, particularly within the tourism industry.
- 2) Organizing capacity-building workshops and knowledge exchange forums aimed at augmenting the comprehension of local stakeholders regarding climate change repercussions and viable countermeasures.
- 3) Cultivating alliances and cooperative ventures among global entities, regional administrations, and enterprises to pool resources and knowledge for advancing climate change initiatives.

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## المخلص العربي:

تقييم أثر التغيرات المناخية علي المقصد السياحي المصري -  
دراسة تطبيقية علي محافظتي الأقصر وأسوان

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## المخلص

أصبحت التغيرات المناخية خطراً يهدد استدامة المقاصد السياحية حول العالم، وتعمق تطوير الحركة السياحية. كما أن تلك التغيرات المناخية قد تؤثر سلباً علي المواقع الأثرية، وتؤدي إلي تدميرها أو تدهورها بشكل سريع. هدفت هذه الدراسة إلي تحديد أهم مسببات التغيرات المناخية، أثر التغيرات المناخية علي حركة السياحة الوافدة إلي مصر. كما هدفت الدراسة إلي تقييم آثار التغيرات المناخية علي المقصد السياحي بشكل عام، وعلي المواقع الأثرية في الأقصر وأسوان بشكل خاص. اعتمدت الدراسة علي استمارة الاستبيان لتجميع البيانات للتحقق من تلك الأهداف. تم توزيع ٢٨٦ استمارة علي عينة عشوائية من أعضاء هيئة التدريس، وخبراء من وزارات السياحة والآثار، والبيئة، وهيئة التنمية السياحية. اعتمدت الدراسة علي تحليل ٢٢٦ استمارة باستخدام برنامج SPSS v.28. أبرزت نتائج الدراسة أن أهم مسببات التغيرات المناخية كان الممارسات البشرية السلبية علي البيئة. كما أوضحت النتائج أن التغيرات المناخية أثرت بشكل قوي علي حركة السياحة الوافدة إلي مصر من خلال التأثير علي اتخاذ السائح لقرار السفر إلي مصر. كذلك أوضحت النتائج أن أكثر التأثيرات التي أحدثتها التغيرات المناخية علي المقاصد السياحية كان الجفاف الشديد، بينما كان أكثر التأثيرات في المواقع الأثرية هو التأثير السلبي علي ألوان المقابر والمعابد. أوصت الدراسة بالحفاظ علي مناخ الموقع الأثري وتقليل تأثير التغير المناخي عليه، من خلال تنظيم درجة الحرارة والرطوبة في المباني والهياكل المحيطة به.

**الكلمات الدالة:** التغير المناخي، المقصد السياحي، المواقع الأثرية، الأقصر، أسوان.