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## **The Impact of Climate Changes on the Sustainability of Tourism Activity and Archeological Sites Applied to the City of Alexandria**

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### **ARTICLE INFO Abstract**

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Alexandria considered to be one of the most tourist destinations in Egypt. This city was founded by Alexander the Great in 332 B.C to be the capital of Egypt in the Greco Roman Period. Alexandria is also one of the largest cities on the Mediterranean coast. It possesses many different tourist and archaeological attractions. Unfortunately, these tourist and archaeological attractions are threatened by the danger of climate changes. Especially on the sites that are located nearby the coast of the sea, such as Shatbi tombs, Anfushi necropolis, Qaitbey Citadel, Ras el Tin Palace, as well as Bibliotheca Alexandrina Museum. The city is suffering from the negative effect of the climate change since ancient times as some sites are submerging in the area of Abu Qir and the Eastern port area, that are filled now with sunken antiquities. It is a sad fact that Egypt occupies the third place on the list of countries most affected by the climate change, and Alexandria is one of the highest world's coastal megacities that are at risk from Sea Level Rise (SLR) and coastal surges. Hence, the aim of this research came to study the impact of climate changes on the sustainability of tourism activity in Alexandria. This study aims to define the phenomenon of climate changes and its impact on the activity of tourism in the city. It also sheds light on the efforts made by the state and tourism agencies to deal with this phenomenon and reducing its severity. The study uses the questionnaire tool addressed to expert with a view to reaching a number of recommendations to reduce the various effects of the climate changes on the city.

### **1. Introduction**

Climate change poses serious risks to various aspects of life. There are many effects associated with climate changes caused by human pressures, such as pollution by its various sources and forms, in addition to the deterioration of environmental systems of both soil and water resulting from various industrial activities. On the other hand, the effects of Climate changes vary from one region to another <sup>1</sup>. Coastal areas are the most affected by climate change.

<sup>1</sup> طه، هبة الله أحمد مختار (٢٠١٤)، دراسة تأثير التغيرات المناخية على النشاط السياحي في مصر ، رسالة دكتوراه غير منشورة ، كلية السياحة والفنادق جامعه الفيوم ، ص١٠٤ .

The city of Alexandria is considered one of the most sensitive areas to climate change impacts, especially natural-based tourism, as well as its archaeological and tourist sites.

Alexandria has many archaeological, historical, and tourist sites that date to different periods. It attracts the attention of tourists with different destinations. However, it is one of the most exposed areas to the dangers of climate change. Hence, the idea of this research came to study the impact of climate changes on the sustainability of tourism activity and Archeological sites in Alexandria.

## **2. Research Questions**

The problem of the research is represented in its attempt to answer the following questions:

- What is the phenomenon of the climate changes and what are its causes?
- What is the extent to which sustainable tourism practices are adopted in Alexandria?
- What are the effects of climate change on tourist and archaeological sites in Alexandria?
- What are the appropriate solutions and recommendations to mitigate the effects of climate change in Alexandria?

## **3. Research Goals and Objectives**

- Recognizing the phenomenon and causes of climate change
- Shedding light on the touristic and archeological attractions in Alexandria.
- Highlighting tourism types that can be practiced in Alexandria.
- Understanding the effects of climate change on tourist and archeological sites in Alexandria.
- Inspecting the extent of adopting sustainable tourism practices in Alexandria.
- Offering Solutions and recommendations for mitigating climate change.

## **4. The Research Importance**

The importance of the research is to highlight the impact of climate changes on the sustainability of tourism activity and archaeological sites in Alexandria, working to increase awareness of climate changes in the city, as well as coming up with solutions and recommendations based on scientific methods to mitigate the negative impacts of climate changes in order to overcome this crisis.

## **5. Research Methodology**

The collected data depended on the following sources:

### **5.1.Theoretical Framework**

The research relied on a descriptive analytical approach that is concerned with collecting data on the phenomenon and its impacts on the tourist and archeological sites, through the aid of the scientific references, the internet, specialized articles, scientific letters, as well as scientific studies.

## 5.2. Statistical Framework

300 online questionnaires were distributed using the purposive sample to academics in Egyptian faculties and institutes of tourism and hotels, in addition to employees and experts in the Ministry of Environment and the Ministry of Tourism and Antiquities to obtain their opinions on the impact of climate changes on the sustainability of tourism activity and archeological sites in the city of Alexandria. The data were processed statistically through the "SPSS V.22" statistical program.

## 6. Definition of Climate Changes

It can be defined as the orderly change in weather and weather patterns due to human intervention with the Earth system, especially through massive emissions and increased carbon rates (Susanne, 2015). It also can be defined as any significant, long-term change in weather rate occurring for a given region, which can include temperature rate, precipitation rate, wind status, and the long-term magnitude of climate changes, leads to serious impacts on the region's natural ecosystems<sup>2</sup>.

## 7. Causes of Climate Changes

There are many natural and human causes of climate change<sup>3</sup>

- Natural causes are: The greenhouse gases resulting from volcanic eruptions and dust storms in the dry and semi-dry regions, the consequences of the explosion of some stars, such as cosmic radiation, the phenomenon of sunspots resulting from the disturbance of the magnetic field occurring nearly every 11 years.
- Human causes: The polluting gases of the environment caused by various industries, automobile exhaust, the gases emitted from sewage, especially methane gas, which results from agricultural activities such as fertilizers, deforestation, as well as human's misuse of the available resources which led to environmental imbalance.

## 8. Impact of Climate Changes on Tourism

Tourism is one of the most affected sectors by climate changes, especially coastal areas which are considered to be more exposed to the effects of the climate changes. Among these effects are<sup>4</sup>:

- Loss of some portions of the areas that are exposed to the effects of climate changes because of the coastal erosion

<sup>2</sup> سلامة ، زينب حسانين رزق محمد (٢٠١٦): المناخ وآثاره البيئية في جنوبي سيناء، رسالة ماجستير عبر منشورة ، كلية الآداب، جامعه القاهرة، ص٢٧٤.

<sup>٣</sup> زهدي، حسين (١٩٩٧)، الأرصاد الجوية ونظرة للمستقبل، الطبعة الأولى، سلسلة العلم والحياة ،مؤسسة الأهرام للترجمة والنشر، القاهرة ، ص١٠؛ أبو راضي، فتحي عبد العزيز (٢٠٠٦)، الأصول العامة في الجغرافية المناخية ،الجزء الثاني (المناخ التفصيلي والتطبيقي ) ، دار المعرفة الجامعية ،الإسكندرية ،جمهورية مصر العربية ، ص٢١؛ بشير، هشام (٢٠٠٦) ، التغيرات المناخية كمصدر لتهديد التنمية "دراسة حالة مصر"، مجلة الاستقلال ، العدد ٤، المجلد ٣، ص٨١؛ إبراهيم ، أحمد محمد محمد،(٢٠٢٠) تأثير التغيرات المناخية على السياحة الوافدة الى مصر دراسة حالة أقاليم قناة السويس ، مجله كلية الآداب والعلوم الإنسانية ، جامعه قناة السويس ، العدد ٣٥، ص٢٦٨-٢٩٧.

<sup>٤</sup> البطران، منال (٢٠٠٩)، أثر تغير المناخ على مصر وبخاصة على الهجرة الداخلية والخارجية، مؤتمر تغير المناخ وآثاره في مصر، جمهورية مصر العربية، ص٨؛ طه ، مختار، هبة الله أحمد (٢٠٢١)، أثر التغيرات المناخية على النشاط السياحي في مصر ، دراسة لدور المؤسسات الرسمية ، مجلة اتحاد الجامعات العربية للسياحة والضيافة ، المجلد ٢، العدد١، ص١٣١-١١٥.

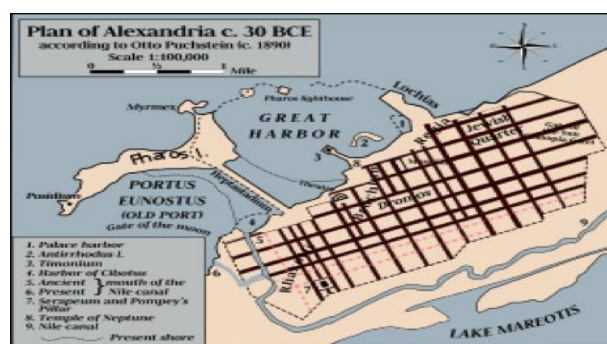
- The rapid deterioration of archeological sites due to the Sea-level rise and the change in rain fall rates and areas.
- The destruction of marine life which is greatly affected by sea-surface warming.
- The tendency to more moderate tourist destinations in the climate because of the consequences of seasonal change
- Social and economic impacts of climate changes such as the migration of people from vulnerable areas.
- Destruction of tourism infrastructure and reduction of the aesthetic values of the region's natural, tourist and archeological landscapes.

## 9. Study Area

Alexandria extends about 32 km along the northern coast of the Mediterranean Sea. The city has a water front that extends 60 km from Abu Qir Bay in the east to Sidi Kreir in the west. The city is surrounded on three sides by the Mediterranean and a lake at its back, making it uniquely exposed to sea level rise caused by global warming.

Alexandria considered to be one of the most tourist destinations in Egypt. This city was founded by Alexander the Great in 332 B.C to be the capital of Egypt in the Greco Roman Period (Grimm, 1996). Its location was already occupied by an ancient Egyptian village named Rhakotis (Bagnall, 2004). An architect from Athens called Dinocrates was responsible for the design (Grimm, 1996; Hölbl, 2001). The city was given a Hellenic design that looked like a chess board (fig. 1) (Sterling, 2021). The architect divided the city into five quarters, they were named after the five letters of the Greek Alphabet: alpha, beta, gamma, delta, epsilon. The streets of ancient Alexandria were paved by small blocks of black basalt.

Brochium, which means the royal quarter, was located at the intersection of the two main streets of Alexandria. It occupied one third of the city. It housed royal palaces, public buildings, government offices, as well as the royal cemetery.



**Fig. (1): Plan of ancient Alexandria**

Sadly, Alexander did not live long enough to see Alexandria when finished. It was the Ptolemaic Dynasty who continued the building of Alexandria (River, 2016). The city of Alexandria greatly flourished during the Ptolemaic Period and it had become the most developed city in the ancient world. While, it began to decline in the Roman period, until it became almost deserted in the 14<sup>th</sup> Century A.D because of a great earthquake. It was during

the reign of "Mohamed Ali" when the city began to flourish again<sup>5</sup>. Nowadays, Alexandria is the second largest city in Egypt. It is Egypt's largest seaport.

The Ptolemaic kings decorated their palaces and temples with pharaonic obelisks, and statues. Therefore, Alexandria embraces Pharaonic, Ptolemaic, Roman, Coptic, Islamic, and modern monuments.

## 10. Trends of Tourism in Alexandria

Alexandria possesses several trends of tourism that can be distinguished as follow<sup>6</sup>

### 10.1. Seasonal Tourism

**In summer:** It depends on the temperate climate of Alexandria in this season and availability of beaches such as: Ajami, Stanley, Sidi Bishr, and Jaleem.

**In winter:** The region of Mariout is characterized by air dryness and relatively low humidity, as it is surrounded by sand and limestone hills. In addition to Lake Mariout which receives a number of migratory birds.

### 10.2. Recreation Tourism

Recreational tourist attractions are represented in the parks of El-Montazah palace, Nozha Park, Al-Shalalat park and the international park.

### 10.3. Cultural Tourism

Alexandria's foundation as the capital of Egypt in the Greek and Roman eras had a clear impact on the number of archeological sites attributed to these two periods, for example: Shatbi tombs, Anfoushi necropolis, Kom el Shoqafa cemetery, Roman theatre and Pompey's pillar. As well as other sites dating to the Islamic era for instance Qaitbey Citadel. In addition to different museums like Bibliotheca Alexandrina Museum, Graeco-Roman Museum, National Museum of Alexandria, Museum of Fine Art, and Royal Jewelry Museum.

### 10.4. Religious Tourism

The city embraces many religious tourist attractions, whether Islamic or Christian such as: El Morsi-Abul Abbas Mosque, Marmina Monastery, and St. Mark's church.

### 10.5. Conference Tourism

This type of tourism is one of the modern trends in Alexandria. It was associated with the establishment of a conference center in Shtabi area, which enjoys a good location on the Mediterranean coast. Conferences are also held in some of Alexandria's major hotels such as: Ramada, Palestine, Sheraton, in addition to Arab Academy for Science, Technology, and Maritime Transport.

## 11. Alexandria and Climate Changes

Alexandria has already suffered from climate changes in the past as it had many sunken antiquities below the buildings of modern Alexandria. For example, Qaitbay fort site, Eastern Harbor, Shatbi and Abu-Qir Bay.

<sup>5</sup> سالم، السيد عبد العزيز (١٩٦١)، تاريخ الإسكندرية وحضارتها في العصر الإسلامي (حتى الفتح العثماني)، الطبعة الأولى، القاهرة، دار المعارف بمصر، ص ١١٤.

<sup>6</sup> الشرايبي، محييات إمام أحمد (١٩٩١)، أقاليم مصر السياحية، دراسة في جغرافية السياحة، الطبعة الأولى، دار الفكر العربي، القاهرة، ص ٧٨؛ جمعه، ماجدة محمد (٢٠٠٠)، جغرافية مصر السياحية، مطبعة التوحيد بشبين الكوم، القاهرة، ص ٢٩١؛ بكير، محمد فتحي (٢٠٠٢)، "جغرافية مصر السياحية"، دار المعرفة الجامعية، الإسكندرية، ص ١٥٨.

The real beginning of the archeological excavations of sunken antiquities dates back to 1933. The site of Abu-Qir is considered to be one of the most important sites of sunken antiquities in Alexandria. It possesses many sunken cities, in addition to sunken fleet of Napoleon (Radwan, 2021). It also includes the remains of the lighthouse, in addition to more than 3000 pieces including statues, sphinxes, columns of different shapes, capitals and bases of columns and parts of obelisks, as well as blocks from different sizes and weights<sup>7</sup> (Mostafa, 2000).

It is a sad fact that Egypt occupies the third place on the list of countries most affected by the climate changes. Alexandria is one of the highest world's coastal megacities that are at risk from Sea-Level Rise (SLR) and coastal surges and erosions (Ismail, H., 2018).

Cultural tourism is one of the most prominent trends of tourism in Alexandria. Unfortunately, the tourist attractions of the city are threatened by the danger of climate changes. Especially on the sites that are located nearby the coast of the sea, For instance, Shatbi tombs, Anfushi necropolis, Kom el-Shoqafa cemetery, Qaitbey Citadel, and Ras el Tin Palace.

## 12. Climate Changes and Archeological Sites

### 12.1. Shatbi Necropolis

The Shatbi necropolis contains the oldest tombs in Alexandria. It was discovered by chance in 1893. It might have been established very soon after the foundation of Alexandria. The development of Alexandrian tombs can be traced here, from modest shaft graves, through gallery tombs, to the monumental hypogea.

The primary burial site evidently belonged to a wealthy but unidentified family. It represents two stone sarcophagi in the shape of a funeral bed with cushion. By the 3<sup>rd</sup> century B.C., the site was used by public and numerous loculi were added.

The tombs are of a simple and Hellenistic design. The doorway of the main tomb leads into a hall, which in turn leads to a second hall, and then to an open courtyard. To the east of the courtyard, is a doorway leading to the burial chamber.

Unfortunately, Shatbi necropolis was flooded in 1999 by a severe storm, which has been described as the worst flooding of Alexandria city over the past decades. Rising subsoil water levels due to sea level rise and heavy rains will lead to a decrease in the carrying capacity of sandy soils as in Shatbi necropolis and catacombs of Kom el-Shoqafa (Hemeda, S., 2021).

### 12.2. Catacombs of Kom el-Shoqafa

It is situated in Karmooze district to the west of Alexandria. This cemetery dates back to the early Roman period and it was discovered in 1900. The cemetery consists of three floors under the ground, the third bottom floor was completely full of water, and therefore it was inaccessible. But in 2018, the Egyptian ministry of Antiquities, in cooperation with American aid, began a project to lower this subsoil water by digging six wells with a depth of 40 meters.

The tomb starts with an entrance that leads to a spiral staircase around the main shaft of the tomb. At the end of the spiral staircase, there is a short corridor ended with a round hall (rotunda), in the middle of which is a shaft used for lowering the mummy into the third floor directly. Around the mouth of the shaft there is a parapet from which projects six columns carrying a dome for decoration. On the left side of the round hall there is a room called

<sup>7</sup> العبادي، مصطفى، و خليل، عماد (٢٠١٦)، الآثار البحرية والتراث الثقافي الغارق.



banquette room, the roof of which is supported with four pillars connected together by three benches taking the shape of U-letter.

The second floor contained a vestibule, at the back of which there is the door of the burial room. This cemetery is famous for its mixed iconography between Egyptian art and the Greco Roman art.

Since 1975, a series of industrial and agricultural changes in Alexandria led to the remarkable increase in the ground water level especially Lake Mariout (400 m from the catacombs), which is the main source of this ground water inside the third floor together with the heavy rain fall as happened in 2015 (Hemeda, S., 2021).

Over time ground water led to increased humidity. This moisture will cause cracking and peeling of rock surface layers and formation of salt erosion that can be dangerous to wall paint layers.

### 12.3. Anfushi Necropolis

Anfushi tombs are one of the most important Greek monuments in the city of Alexandria. The tombs were discovered from 1901 to 1921 and are carved in the rock. They date back to the third century BC, with the late Ptolemaic and early Roman eras. These Tombs are characterized by fresco decorations, imitating alabaster and marble, and they are still in good condition.

Moreover, Anfushi tombs include five funerary buildings similar to the Alexandrian cemeteries in terms of an open courtyard and a front room for prayers leading to the funeral room. Two of them come among the most important tombs in Alexandria, where the two tombs are distinguished by their beautiful inscriptions and unique architectural design.

The tombs bearing numbers (2) and (5) are considered the most beautiful of these tombs due to the splendor of paintings on their walls and ceilings that mixes mural photography with the use of decorative architectural elements taken from ancient Egyptian art. The cemetery suffers from the rise of water levels in some of its parts as in room number 4 of tomb number 5. it is observed that water reached the painted walls (Fahmy, *et al*, 2022).

### 12.4. Mustafa Kamel Necropolis

This necropolis dates back to 250 B.C, it has been discovered by mere chance in 1934, when they were leveling the ground for making a football field. It is known as Mustafa Kamel cemetery because of its location in Mustafa Kamel area in Alexandria. Those tombs are famous for their well-preserved vivid colors.

Mustafa Kamel necropolis now includes 4 tombs carrying numbers from 1 to 4, tombs number one and two has been cut totally under the ground that is why they are in a good condition. However, the other two tombs (3 and 4) have been cut partly under the ground, therefore they are suffering much more damage<sup>8</sup>. The most important tomb is tomb number 1, its importance is due to the presence of a unique water system as well as its magnificent fresco scenes<sup>9</sup>.

<sup>8</sup> قادوس، عزت زكي حامد (٢٠٠٠)، آثار الإسكندرية القديمة.

<sup>9</sup> العبادي، حسام (١٩٩٦)، دليل موجز لآثار مدينة الإسكندرية.

### 12.5. Serapeum

When the Ptolemais ruled Egypt, they encouraged the Greeks to come and settle there, soon after many Greeks came and settled especially in Alexandria. Thus, Egyptians and Greeks lived side by side, each worshiping their own god and speaking their own language. However, the Ptolemaic rulers wanted a common cult connecting both the Egyptians and the Greeks. Thus, the new triad started with Serapis a father god, Isis as the mother goddess, and Harpocrates as a son god. For the ancient Egyptians Serapis was the ancient Egyptian god Osir-Hapi the sacred Apis bull after his death. On the other hand, for the Greeks the new god was identified with their supreme god Zeus.

The temple of Serapis or the Serapeum erected for the new cult at Rhakotis. Very little information is known about the temple but according to the Roman historians we knew that it stood on a high platform and it was approached by a staircase of 100 steps (Mckenzie, 2004).

The temple may have been destroyed by the Jews at the end of the reign of Trajan, and it was reconstructed under the reign of Hadrian but it was much larger. This new temple was destroyed by the Christians in 391 A.D. and on its ruins was built a monastery and a church carrying the name of Saint John the Baptist<sup>10</sup>. Today, the only element that remains standing in the area of the Serapeum is Diocletian's column, erroneously referred to as Pompey's Pillar.

### 12.6. Pompey's Pillar

The so-called Pompey's pillar is a huge pillar of red granite with total height 28 m. This pillar must have been erected after 292 A.D in the honor of the Roman Emperor Diocletian. We know this from the Greek text that is inscribed on the upper part of the base at the western side. A series of revolutions has broken out in Alexandria and Diocletian besieged the city for 8 months before it surrendered. As a result, there was a great famine. The emperor ordered that a portion of the corn tribute that was sent every year to Rome should be diverted to the citizens of Alexandria, so they built this pillar as a thanksgiving for him. The crusaders gave it the name of Pompey's pillar as they believed that the ashes of Pompey the Roman great general were put in a pot on the top of the pillar<sup>11</sup>.

### 12.7. Ras el-Soda Temple

This temple was originally located in Ras el-Soda, which gives it its name. However, it was transferred in 1994 to a new area called "Bab Sharq" in order to rescue the temple from the ground water<sup>12</sup>.

It is the only private temple discovered so far in Alexandria. It dates back to the Roman Period. The temple was constructed by Isadoras the roman charioteer as thanksgiving for goddess Isis on the recovery of his ankle that was broken when he fell down from his chariot<sup>13</sup>.

This temple consists of a platform that is approached by a flight of steps. At the middle of the platform there is a votive marble foot. At the back of the platform there are five marble

<sup>10</sup> مرجع سبق ذكره.

<sup>11</sup> مرجع سبق ذكره.

<sup>12</sup> عاقول، هند جلال يوسف (٢٠١٦)، "معبد الرأس السوداء مثال فريد للعمارة الرومانية في مصر"، أعمال المؤتمر التاسع عشر للاتحاد العام

للأثاريين العرب: دراسات في آثار الوطن العربي ١٨، ص. ٦٨٤-٧٠٧.

<sup>13</sup> رياض، هنري (١٩٦٥)، دليل آثار الأسكندرية.



statues belonging to different deities, the biggest one of them belongs to goddess Isis. All the marble statues, the platform, as well as the votive marble foot are now preserved in the Greco-Roman Museum at Alexandria<sup>14</sup>.

### 13. The statistical analysis tests

The data were processed statistically through the "SPSS V.22" statistical program, using the following statistical tests:

- 1- Cronbach's alpha coefficient was used to determine the reliability of the questionnaire.
- 2- Kolmogorov-Smirnov and Shapiro-Wilk tests were used to find out the distribution normality of data. The results of those two tests determine the type of tests used (parametric or non-parametric tests).
- 3- Frequencies, mean, standard deviation, and percentages were used to describe the characteristics of the sample, and to determine the extent of the sample's response to the research constructs, taking into account that the weighted mean is used to determine the response to the research constructs, as illustrated in Table No. (1).
- 4- Correlation coefficient using Spearman's to show the relationships between research variables and test the hypotheses of the research. It is used in the case of non-parametric tests and ordinal data.
- 5- Simple regression analysis to determine the effect of one variable on another variable.

**Table (1): The weighted mean for the 5-likert scale degrees**

Levels of degree	The weighted mean
Strongly Disagree	1-1.79
Disagree	1.80-2.59
Neutral	2.60-3.39
Agree	3.40-4.19
Strongly Agree	4.20-5

#### 13. 2. The study samples

300 online questionnaires were distributed using the purposive sample to academics in Egyptian faculties and institutes of tourism and hotels, in addition to employees and experts in the Ministry of Environment and the Ministry of Tourism and Antiquities. The number of questionnaires received was 238, all of which were valid for analysis, with a response rate of 79.33%, as shown in Table (2).

**Table (2): The response rate**

No. of distributed questionnaires	No. of received questionnaires	No. of valid questionnaires	The response rate
300	238	238	79.33

#### 13.3. Validity and Reliability

As shown in Table (3), the results indicate that the Cronbach's alpha of the study's constructs is higher than 0.7. This reflects the validity and reliability of the questionnaire used in the study.

<sup>14</sup> مرجع سبق ذكره.

**Table (3): Cronbach's alpha for the study constructs**

Constructs		Number of items	Cronbach's alpha
<b>A</b>	The causes of climate change.	8	0.883
<b>B</b>	Sustainable tourism practices in tourist and archaeological sites.	6	0.772
<b>C</b>	The effects of climate change on tourist and archaeological sites.	11	0.894
<b>D</b>	Solutions and proposals to reduce the negative effects of climate change.	8	0.830

#### 13.4. Characteristics of the sample

According to the results of Table (4), the number of male respondents was 48.3%, while the number of female respondents was 51.7%. Concerning age, the majority of respondents are ranging from 30 to 45 years with 37.4% and 23.9% between 46-60 years. Then, the percentage of respondents less than 30 years old was 22.7% and 16% of the respondents were more than 60 years. Regarding education, most of the respondents with 27.7% have a Ph.D. degree, followed by a bachelor's degree (27.5%). On the other hand, the percentage of respondents with master's degrees was 20.6 .%

Regarding the experience years, the table also indicates that the respondents who have more than 10 years of experience reached 49.5%, followed by those who have between 5-10 years of experience at 30.3%. Then, 20.2% of the respondents' experiences were less than 5 years. For the work, the majority of respondents are working in the academic field (47.9%), and 26.9 % working in the Ministry of Environment. Additionally, there is 25.2 % of the respondents work in the Ministry of Tourism and Antiquities.

**Table (4): Characteristics of the sample**

No.	Items		Freq.	%
1	<b>Gender</b>	Male	115	48.3
		Female	123	51.7
2	<b>Age</b>	Less 30 years	54	22.7
		30 - 45 years	89	37.4
		46- 60 years	57	23.9
		More than 60 years	38	16.0
3	<b>Education</b>	Bachelor	63	26.5
		Master's degree	49	20.6
		PhD degree	66	27.7
		Others	60	25.2
4	<b>Work</b>	Academic	114	47.9
		Ministry of Tourism and Antiquities	60	25.2
		Ministry of Environment	64	26.9
5	<b>Experience</b>	Less 5 years	48	20.2
		5-10 Years	72	30.3
		More than 10 years	118	49.5

#### 13.5. Tests of the normality

The results in table (5) indicated that the significance (Sig.) = 0.00, which is less than 0.05.

Therefore, the sample's responses to the items of the questionnaire variables do not follow the normal distribution. Accordingly, non-parametric tests will be used in the statistical analysis.

**Table (5): Tests of the normality**

No. of items	Shapiro-Wilk			Kolmogorov-Smirnov		
	Statistic	df	Sig.	Statistic	df	Sig.
1	0.784	238	0.000	0.330	238	0.000
2	0.711	238	0.000	0.274	238	0.000
3	0.774	238	0.000	0.260	238	0.000
4	0.662	238	0.000	0.339	238	0.000
5	0.692	238	0.000	0.339	238	0.000
6	0.712	238	0.000	0.328	238	0.000
7	0.711	238	0.000	0.319	238	0.000
8	0.785	238	0.000	0.269	238	0.000
9	0.700	238	0.000	0.294	238	0.000
10	0.751	238	0.000	0.261	238	0.000
11	0.706	238	0.000	0.293	238	0.000
12	0.707	238	0.000	0.309	238	0.000
13	0.706	238	0.000	0.316	238	0.000
14	0.676	238	0.000	0.280	238	0.000
15	0.721	238	0.000	0.316	238	0.000
16	0.778	238	0.000	0.275	238	0.000
17	0.775	238	0.000	0.313	238	0.000
18	0.767	238	0.000	0.339	238	0.000
19	0.731	238	0.000	0.297	238	0.000
20	0.729	238	0.000	0.290	238	0.000
21	0.742	238	0.000	0.269	238	0.000
22	0.754	238	0.000	0.266	238	0.000
23	0.739	238	0.000	0.272	238	0.000
24	0.732	238	0.000	0.269	238	0.000
25	0.731	238	0.000	0.299	238	0.000
26	0.686	238	0.000	0.305	238	0.000
27	0.694	238	0.000	0.311	238	0.000
28	0.685	238	0.000	0.320	238	0.000
29	0.710	238	0.000	0.289	238	0.000
30	0.690	238	0.000	0.301	238	0.000
31	0.719	238	0.000	0.303	238	0.000
32	0.712	238	0.000	0.291	238	0.000
33	0.724	238	0.000	0.290	238	0.000

### 13.6. Descriptive statistics of the study variables

#### A. Climate change's causes in Alexandria

**Table (6): Descriptive statistics for climate change's causes in Alexandria**

Items	Frequencies <sup>1</sup>						Mean	SD <sup>2</sup>	Rank	
	Degree levels	1	2	3	4	5				
1	<b>Overpopulation</b>	Freq.	6	14	23	132	63	3.97	0.90	8
		%	2.5	5.9	9.7	55.5	26.5			
2	<b>Natural changes</b>	Freq.	3	4	10	109	112	4.36	0.75	5
		%	1.3	1.7	4.2	45.8	47.1			
3	<b>Technological development</b>	Freq.	-	6	20	111	101	4.29	0.72	6
		%	-	2.5	8.4	46.6	42.4			
4	<b>Excessive use of fuel</b>	Freq.	3	4	8	84	139	4.48	0.75	2
		%	1.3	1.7	3.4	35.3	58.4			
5	<b>Pollution</b>	Freq.	1	1	8	97	131	4.50	0.62	1
		%	0.4	0.4	3.4	40.8	55			
6	<b>Expansion of industrial activity</b>	Freq.	1	5	13	88	131	4.44	0.73	4
		%	0.4	2.1	5.5	37	55			
7	<b>Using non-environmentally friendly means of transportation</b>	Freq.	-	3	7	107	121	4.45	0.62	3
		%	-	1.3	2.9	45	50.8			
8	<b>Expansion of tourism activities without concerning the environment</b>	Freq.	1	12	27	89	109	4.23	0.87	7
		%	0.4	5	11.3	37.4	45.8			
1 (1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree).							4.34	0.51		
2 SD = Standard deviation.										

Table No. (6) shows the study sample's responses about the causes of climate change in Alexandria Governorate as follows:

- Concerning “**overpopulation**”, the study sample agreed by 55.5% and 26.5% strongly agreed that overpopulation is one of the causes of climate change in Alexandria. On the other hand, 9.7% of the study sample was neutral about that. Also, 5.9% of the study sample did not agree and 2.5% did not agree strongly that overpopulation is one of the causes of climate change in Alexandria. The mean for this statement was 3.97, which is at the agreement level, with a standard deviation of 0.90. Therefore, this phrase was accepted as one of the causes of climate change in Alexandria. Perhaps this is due to the pressure caused by a large number of residents on tourist and archaeological sites and on tourism resources.
- Regarding “**natural changes**”, the study sample strongly agreed by 47.1% and 45.8% agreed that natural changes are one of the causes of climate change in Alexandria. 4.2% of the study sample was neutral about that. On the other side, 1.7% of the study sample did not agree and 1.3% did not agree strongly that natural changes are one of the causes of climate change in Alexandria. The mean for this statement was 4.36, which is at the strongly agreement level, with a standard deviation of 0.75. Consequently, this item was accepted as one of the causes of climate change in Alexandria.
- For “**technological development**”, the study sample agreed by 46.6% and 42.4% strongly agreed that technological development is one of the causes of climate change in

Alexandria. Additionally, 8.4% of the study sample was neutral about that. On the other hand, 2.5% of the study sample did not agree that technological development is one of the causes of climate change in Alexandria. The mean for this statement was 4.29, which is at the strongly agreement level, with a standard deviation of 0.72. Hence, this cause was accepted as one of the causes of climate change in Alexandria.

- Concerning “**excessive use of fuel**”, the study sample strongly agreed by 58.4% and 35.3% agreed that excessive use of fuel is one of the causes of climate change in Alexandria. 3.4% of the study sample was neutral about that. On the other side, 1.7% of the study sample did not agree and 1.3% did not agree strongly that excessive use of fuel is one of the causes of climate change in Alexandria. The mean for this statement was 4.48, which is at the agreement level, with a standard deviation of 0.75. So, excessive use of fuel was accepted as one of the causes of climate change in Alexandria.
- Regarding “**pollution**”, the study sample strongly agreed by 55 % and 40.8% agreed that pollution is one of the causes of climate change in Alexandria. 3.4% of the study sample was neutral about that.

On the other side, 0.4% of the study sample did not agree and 0.4% also did not agree strongly that pollution is one of the causes of climate change in Alexandria. The mean for this statement was 4.50, which is at the strongly agreement level, with a standard deviation of 0.62. Consequently, pollution was accepted as one of the causes of climate change in Alexandria.

- Concerning “**expansion of industrial activity**”, the study sample strongly agreed by 55% and 37% agreed that expansion of industrial activity is one of the causes of climate change in Alexandria. 5.5% of the study sample was neutral about that. On the other side, 2.1% of the study sample did not agree and 0.4% did not agree strongly that expansion of industrial activity is one of the causes of climate change in Alexandria. The mean for this statement was 4.44, which is at the agreement level, with a standard deviation of 0.73. So, this item was accepted as one of the causes of climate change.
- For “**using non-environmentally friendly means of transportation**”, the study sample strongly agreed by 50.8% and 45% agreed that using non-environmentally friendly means of transportation is one of the causes of climate change in Alexandria. Additionally, 2.9% of the study sample was neutral about that. On the other hand, 1.3% of the study sample did not agree that using non-environmentally friendly means of transportation is one of the causes of climate change in Alexandria. The mean for this statement was 4.45, which is at the strongly agreement level, with a standard deviation of 0.62. Hence, using non-environmentally friendly means of transportation was accepted as one of the causes of climate change in Alexandria.
- Regarding “**expansion of tourism activities without concerning the environment**”, the study sample strongly agreed by 45.8 % and 37.4% agreed that expansion of tourism activities without concerning the environment is one of the causes of climate change in Alexandria. 11.3% of the study sample was neutral about that. On the other side, 5% of the study sample did not agree and 0.4% also did not agree strongly that expansion of tourism activities without concerning the environment is one of the causes of climate change in Alexandria. The mean for this statement was 4.23, which is at the strongly agreement level, with a standard deviation of 0.87. Consequently, expansion of tourism activities without concerning the environment was accepted as one of the causes of climate change in Alexandria.

**In conclusion**, the study sample strongly agreed on the causes of climate change mentioned above, where the general mean for the climate change causes in Alexandria was 4.34 at the strong agreement level, with a standard deviation of 0.51.

### B. Sustainability of tourist and archaeological sites

**Table (7): Descriptive statistics for sustainability of tourist and archaeological sites in Alexandria**

Items	Frequencies						Mean	SD	Rank
	Degree levels	1	2	3	4	5			
1 Adopting environmentally friendly activities in tourist and archaeological sites.	Freq.	2	8	4	132	92	4.28	0.73	6
	%	0.8	3.4	1.7	55.5	38.7			
2 Providing environmentally friendly garbage facilities on beaches and at archaeological sites.	Freq.	-	6	13	118	101	4.32	0.69	4
	%	-	2.5	5.5	49.6	42.4			
3 Removal of waste from tourist and archaeological sites in Alexandria.	Freq.	2	3	9	107	117	4.40	0.70	2
	%	0.8	1.3	3.8	45	49.2			
4 Community awareness to preserve the environment.	Freq.	-	6	5	138	89	4.30	0.63	5
	%	-	2.5	2.1	58	37.4			
5 Take the necessary procedures to reduce the negative impacts on the environment in Alexandria.	Freq.	-	6	7	101	124	4.44	0.67	1
	%	-	2.5	2.9	42.4	52.1			
6 Involving the local community in protecting the environment.	Freq.	5	3	7	105	118	4.38	0.79	3
	%	2.1	1.3	2.9	44.1	49.6			
							4.35	0.48	

Table (7) shows the study sample's responses about sustainability of tourist and archaeological sites in Alexandria as follows:

- Concerning the statement **“Adopting environmentally friendly activities in tourist and archaeological sites”**, the study sample agreed by 55.5% and 38.7% strongly agrees on the statement. 1.7% of the study sample was neutral about that. Also, 3.4% of the study sample did not agree and 0.8% did not agree strongly. The mean for this statement was 4.28, which is at the strong agreement level, with a standard deviation of 0.73. Therefore, this statement was accepted as one of the sustainability practices at tourist and archaeological sites in Alexandria.
- Regarding the phrase **“Providing environmentally friendly garbage facilities on beaches and at archaeological sites”**, the study sample agreed by 49.6% and 42.4% strongly agrees on the phrase. 5.5% of the study sample was neutral about that. On the other side, 2.5% of the study sample did not agree. The mean for this statement was 4.32, which is at the strongly agreement level, with a standard deviation of 0.69. Consequently, this phrase was accepted as one of the sustainability practices at tourist and archaeological sites in Alexandria.
- For the statement **“Removal of waste from tourist and archaeological sites in Alexandria”**, the study sample strongly agreed by 49.2% and 45% agree on the statement. 3.8% of the study sample was neutral about that. In contrast, 1.3% of the study sample did not agree and 0.8 did not strongly agree. The mean for this statement



was 4.40, which is at the strongly agreement level, with a standard deviation of 0.70. Hence, this statement was accepted as one of the sustainability practices at tourist and archaeological sites in Alexandria.

- Concerning the statement “**Community awareness to preserve the environment**”, the study sample agreed by 58% and 37.4% strongly agrees on the statement. 2.1% of the study sample was neutral about that. On the other hand, 2.5% of the study sample did not agree on the statement. The mean for this statement was 4.30, which is at the strong agreement level, with a standard deviation of 0.63. Therefore, this statement was accepted as one of the sustainability practices at tourist and archaeological sites in Alexandria.
- Regarding the phrase “**Take the necessary procedures to reduce the negative impacts on the environment in Alexandria**”, the study sample strongly agreed by 52.1% and 42.4% agrees on the phrase. 2.9% of the study sample was neutral about that. On the other side, 2.5% of the study sample did not agree. The mean for this statement was 4.44, which is at the strongly agreement level, with a standard deviation of 0.67. Hence, this phrase was accepted as one of the sustainability practices at tourist and archaeological sites in Alexandria.
- For the statement “**Involving the local community in protecting the environment**”, the study sample strongly agreed by 49.6% and 44.1% agree on the statement. 2.9% of the study sample was neutral about that. In contrast, 1.3% of the study sample did not agree and 2.1 did not strongly agree. The mean for this statement was 4.38, which is at the strongly agreement level, with a standard deviation of 0.79. So, this statement was accepted as one of the sustainability practices at tourist and archaeological sites in Alexandria.

**Based on the above**, the study sample strongly agreed on sustainability practices at tourist and archaeological sites in Alexandria mentioned above, where the general mean was 4.35 at the strong agreement level, with a standard deviation of 0.48.

### C. Consequences of climate changes on the tourist and archaeological sites in Alexandria

**Table (8): Descriptive statistics for consequences of climate changes on the tourist and archaeological sites in Alexandria**

	Items	Frequencies					Mean	SD	Rank	
		Degree levels	1	2	3	4				5
1	Lack of beaches suitable for tourism activity	Freq.	5	10	8	127	88	4.19	0.85	8
		%	2.1	4.2	3.4	53.4	37			
2	Poor tourist services	Freq.	-	14	18	116	90	4.18	0.81	9
		%	-	5.9	7.6	48.7	37.8			
3	Low rates of tourism	Freq.	1	22	13	123	79	4.08	0.88	10
		%	0.4	9.2	5.5	51.7	33.2			
4	Increased unemployment rates	Freq.	-	22	15	139	62	4.01	0.83	11
		%	-	9.2	6.3	58.4	26.1			
5	Impact on seasonality and tourist comfort	Freq.	1	10	13	93	121	4.36	0.80	2
		%	0.4	4.2	5.5	39.1	50.8			
6	Direction to other tourist destinations	Freq.	1	15	11	91	120	4.32	0.86	4
		%	0.4	6.3	4.6	38.3	50.4			
7	The negative impact	Freq.	1	9	12	107	109	4.32	0.77	5

	<b>on some tourism projects in Alexandria</b>	%	0.4	3.8	5	45	45.8			
8	<b>Decline and destruction of the city's archaeological and tourist aesthetic</b>	Freq.	1	8	15	107	107	4.31	0.77	6
		%	0.4	3.4	6.2	45	45			
9	<b>The disappearance of tourist patterns and the change in tourism programs</b>	Freq.	1	15	11	98	113	4.29	0.85	7
		%	0.4	6.3	4.6	41.2	47.5			
10	<b>Negative impact on archaeological and tourist areas</b>	Freq.	1	6	10	114	107	4.34	0.71	3
		%	0.4	2.5	4.2	47.9	45			
11	<b>Flooding some archaeological sites with water</b>	Freq.	-	6	11	104	117	4.39	0.69	1
		%	-	2.5	4.6	43.7	49.2			
								4.25	0.56	

Table (8) shows the study sample's responses about the climate changes consequences on the tourist and archaeological sites in Alexandria as follows:

- Concerning the statement **“Lack of beaches suitable for tourism activity”**, the study sample agreed by 53.4% and 37% strongly agrees on the statement. 3.4% of the study sample was neutral about that. In contrast, 4.2% of the study sample did not agree and 2.1% did not agree strongly. The mean for this statement was 4.19, which is at the agreement level, with a standard deviation of 0.85. Therefore, this statement was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- Regarding the phrase **“Poor tourist services”**, the study sample agreed by 48.7% and 37.8.4% strongly agree on the phrase. 7.6% of the study sample was neutral about that. On the other side, 5.9% of the study sample did not agree. The mean for this statement was 4.18, which is at the agreement level, with a standard deviation of 0.81. Consequently, this phrase was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- For the statement **“Low rates of tourism”**, the study sample strongly agreed by 33.2% and 51.7% agree on the statement. 5.5% of the study sample was neutral about that. In contrast, 9.2% of the study sample did not agree and 0.4 did not strongly agree. The mean for this statement was 4.08, which is at the agree level, with a standard deviation of 0.88. Hence, this statement was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- Concerning the statement **“Increased unemployment rates”**, the study sample agreed by 58.4% and 26.1% strongly agrees on the statement. 6.3% of the study sample was neutral about that. On the other hand, 9.2% of the study sample did not agree on the statement. The mean for this statement was 4.01, which is at the agree level, with a standard deviation of 0.83. Therefore, this statement was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- Regarding the phrase **“Impact on seasonality and tourist comfort”**, the study sample strongly agreed by 50.8% and 39.1% agrees on the phrase. 5.5% of the study sample was neutral about that. On the other side, 4.2% of the study sample did not agree and 0.4% did not agree strongly. The mean for this statement was 4.36, which is at the strongly

agree level, with a standard deviation of 0.80. Hence, this phrase was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.

- For the statement “**Direction to other tourist destinations**”, the study sample strongly agreed by 50.4% and 38.3% agree on the statement. 4.6% of the study sample was neutral about that. In contrast, 6.3% of the study sample did not agree and 0.4 did not strongly agree. The mean for this statement was 4.32, which is at the strongly agreement level, with a standard deviation of 0.86. So, this statement was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- Concerning the statement “**The negative impact on some tourism projects in Alexandria**”, the study sample agreed by 45% and 45.8% strongly agrees on the statement. 5% of the study sample was neutral about that. In contrast, 3.8% of the study sample did not agree and 0.4% did not agree strongly. The mean for this statement was 4.32, which is at the strongly agree level, with a standard deviation of 0.77. Therefore, this statement was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- Regarding the phrase “**Decline and destruction of the city's archaeological and tourist aesthetic**”, the study sample agreed by 45% and 45% strongly agree on the phrase. 6.2% of the study sample was neutral about that. On the other side, 3.4% of the study sample did not agree and 0.4% strongly agrees. The mean for this statement was 4.31, which is at the agreement level, with a standard deviation of 0.77. Consequently, this phrase was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- For the statement “**The disappearance of tourist patterns and the change in tourism programs**”, the study sample strongly agreed by 47.5% and 41.2% agree on the statement. 4.6% of the study sample was neutral about that. In contrast, 6.3% of the study sample did not agree and 0.4 did not strongly agree. The mean for this statement was 4.29, which is at the strongly agree level, with a standard deviation of 0.85. Hence, this statement was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- Concerning the statement “**Negative impact on archaeological and tourist areas**”, the study sample agreed by 47.9% and 45% strongly agrees on the statement. 4.2% of the study sample was neutral about that. On the other hand, 2.5% of the study sample did not agree on the statement and 0.4 did not strongly agree. The mean for this statement was 4.34, which is at the strongly agree level, with a standard deviation of 0.71. Therefore, this statement was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.
- Regarding the phrase “**Flooding some archaeological sites with water**”, the study sample strongly agreed by 49.2% and 43.7% agrees on the phrase. 4.6% of the study sample was neutral about that. On the other side, 2.5% of the study sample did not. The mean for this statement was 4.39, which is at the strongly agree level, with a standard deviation of 0.69. Hence, this phrase was accepted as one of the climate changes consequences on the tourist and archaeological sites in Alexandria.

**Based on the above**, the study sample strongly agreed on the climate changes consequences on the tourist and archaeological sites in Alexandria mentioned above, where the general mean was 4.25 at the strong agreement level, with a standard deviation of 0.56.

### D. Solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria

**Table (9): Descriptive statistics for solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria**

Items	Frequencies						Mean	SD	Rank
	Degree levels	1	2	3	4	5			
1 Increase the awareness of the community surrounding museums about ways to deal with the environment.	Freq.	3	5	5	140	85	4.26	0.71	8
	%	1.3	2.1	2.1	58.8	35.7			
2 Conducting training courses and workshops for tour guides about the climate change and its impact on tourist sites.	Freq.	-	4	3	130	101	4.38	0.60	6
	%	-	1.7	1.3	54.6	42.4			
3 Developing the necessary programs to adapt to climate change.	Freq.	2	7	7	91	131	4.44	0.76	1
	%	0.8	2.9	2.9	38.2	55			
4 Reducing the causes of climate change in Alexandria.	Freq.	-	5	5	126	102	4.37	0.63	7
	%	-	2.1	2.1	52.9	42.9			
5 Rehabilitation and training of human resources working in the tourism and archaeological sites in Alexandria.	Freq.	1	6	4	107	120	4.42	0.69	2
	%	0.4	2.5	1.7	45	50.4			
6 Expansion in the development of new areas.	Freq.	-	5	8	108	117	4.42	0.66	3
	%	-	2.1	3.4	45.4	49.2			
7 Providing information related to the phenomenon of climate change.	Freq.	-	7	6	111	114	4.39	0.68	4
	%	-	2.9	2.5	46.6	47.9			
8 Spread environmental awareness among the society.	Freq.	-	4	8	116	110	4.39	0.63	5
	%	-	1.7	3.4	48.7	46.2			
							4.38	0.45	

Table (9) shows the study sample's responses about the proposals to reduce the negative effects of climate change on tourism in Alexandria as follows:

- Concerning the statement **“Increase the awareness of the community surrounding museums about ways to deal with the environment”**, the study sample agreed by 58.8% and 35.7% strongly agrees on the statement. 2.1% of the study sample was neutral about that. In contrast, 2.1% of the study sample did not agree and 1.3% did not agree strongly. The mean for this statement was 4.26, which is at the strongly agree level, with a standard deviation of 0.71. Therefore, this statement was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.
- Regarding the phrase **“Conducting training courses and workshops for tour guides about the climate change and its impact on tourist sites”**, the study sample agreed by 54.6% and 42.4% strongly agree on the phrase. 2.1% of the study sample was neutral about that. On the other side, 1.7% of the study sample did not agree. The mean for this statement was 4.38, which is at the strongly agree level, with a standard deviation of 0.60. Consequently, this phrase was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.
- For the statement **“Developing the necessary programs to adapt to climate change”**, the study sample strongly agreed by 55% and 38.2% agree on the statement. 2.9% of the study sample was neutral about that. In contrast, 2.9% of the study sample did not agree and 0.8 did not strongly agree. The mean for this statement was 4.44, which is at the

strongly agree level, with a standard deviation of 0.76. Hence, this statement was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.

- Concerning the statement “**Reducing the causes of climate change in Alexandria**”, the study sample agreed by 52.9% and 42.9% strongly agrees on the statement. 2.1% of the study sample was neutral about that. On the other hand, 2.1% of the study sample did not agree on the statement. The mean for this statement was 4.37, which is at the strongly agree level, with a standard deviation of 0.83. Therefore, this statement was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.
- Regarding the phrase “**Rehabilitation and training of human resources working in the tourism and archaeological sites in Alexandria**”, the study sample strongly agreed by 50.4% and 45% agrees on the phrase. 1.7% of the study sample was neutral about that. On the other side, 2.5% of the study sample did not agree and 0.4% did not agree strongly. The mean for this statement was 4.42, which is at the strongly agree level, with a standard deviation of 0.69. Hence, this phrase was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.
- For the statement “**Expansion in the development of new areas**”, the study sample strongly agreed by 49.2% and 45.4% agree on the statement. 3.4% of the study sample was neutral about that. In contrast, 4.1% of the study sample did not agree. The mean for this statement was 4.42, which is at the strongly agree level, with a standard deviation of 0.66. So, this statement was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.
- Concerning the statement “**Providing information related to the phenomenon of climate change**”, the study sample agreed by 46.6% and 47.9% strongly agrees on the statement. 2.5% of the study sample was neutral about that. In contrast, 2.9% of the study sample did not agree. The mean for this statement was 4.39, which is at the strongly agree level, with a standard deviation of 0.68. Therefore, this statement was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.
- Regarding the phrase “**Spread environmental awareness among the society**”, the study sample agreed by 48.7% and 46.2% strongly agrees on the phrase. 3.4% of the study sample was neutral about that. On the other side, 1.7% of the study sample did not agree. The mean for this statement was 4.39, which is at the agreement level, with a standard deviation of 0.63. Consequently, this phrase was accepted as one of the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria.  
**Based on the above**, the study sample strongly agreed on the solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria mentioned above, where the general mean was 4.38 at the strong agreement level, with a standard deviation of 0.45.

### 13.7. Correlation analysis among studied variables

#### A. The relationship between climate change and sustainable tourism practices in tourist and archaeological sites

**Table (10): The relationship between the causes of climate change and sustainable tourism practices in tourist and archaeological sites**

		The causes of climate change	Sustainable tourism practices in tourist and archaeological sites
Spearman's rho	The causes of climate change	Correlation Coefficient	1.000
		Sig. (2-tailed)	.
		N	238
	Sustainable tourism practices in tourist and archaeological sites	Correlation Coefficient	0.383**
		Sig. (2-tailed)	0.000
		N	238

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The results shown in table (10) assured that there is a direct positive relationship between the causes of climate change and sustainable tourism practices in tourist and archaeological sites (Sig. = 0.000 < 0.05). This means that the greater the causes of climate change, the greater the need to rely on sustainable tourism practices in tourist and archaeological sites.

Accordingly, the first hypothesis is accepted. To determine the effect, simple regression was used as the following:

**Table (11): Effect of the causes of climate change on sustainable tourism practices in tourist and archaeological sites**

Model	Un standardized Coefficients		Standardized Coefficients	Adjusted R square	t	Sig.
	B	Std. Error	Beta			
1	(Constant)	1.923	0.215	0.354	8.931	0.000
	The causes of climate change	0.560	0.049		0.595	11.366

a. Dependent Variable: Sustainable tourism practices in tourist and archaeological sites

The findings in table (11) showed that the independent variable (The causes of climate change) affects the dependent variable (Sustainable tourism practices in tourist and archaeological sites). So, the causes of climate change explain 35.4% of the variation in sustainable tourism practices in tourist and archaeological sites.



## B. The relationship between climate change and sustainable tourism practices in tourist and archaeological sites

**Table (12): The relationship between the causes of climate change and sustainable tourism practices in tourist and archaeological sites**

			The causes of climate change	The climate change consequences on tourist and archaeological sites
Spearman's rho	The causes of climate change	Correlation Coefficient	1.000	0.221**
		Sig. (2-tailed)	.	0.001
		N	238	238
	The climate change consequences on tourist and archaeological sites	Correlation Coefficient	0.221**	1.000
		Sig. (2-tailed)	0.001	.
		N	238	238

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The results shown in table (12) confirmed that there is a direct positive relationship between the causes of climate change and the climate change consequences on tourist and archaeological sites (Sig. = 0.001 < 0.05). This means that the greater the causes of climate change, the greater climate change consequences on tourist and archaeological sites.

Accordingly, the second hypothesis is accepted. To determine the effect, simple regression was used as the following:

**Table (13): Effect of the causes of climate change on climate change consequences on tourist and archaeological sites**

Model	Un standardized Coefficients		Standardized Coefficients	Adjusted R square	t	Sig.	
	B	Std. Error	Beta				
1	(Constant)	1.992	0.274	0.476	0.223	7.271	0.000
	The causes of climate change	0.521	0.063			8.312	0.000

a. Dependent Variable: Climate change consequences on tourist and archaeological sites

The findings in table (13) showed that the independent variable (The causes of climate change) affects the dependent variable (Climate change consequences on tourist and archaeological sites). So, the causes of climate change explain 35.4% of the variation in climate change consequences on tourist and archaeological sites.

## C. The relationship between climate change consequences on tourist and archaeological sites and sustainable tourism practices in tourist and archaeological sites

The results shown in table (14) indicated that there is no a relationship between the climate change consequences on tourist and archaeological sites and sustainable tourism practices in tourist and archaeological sites (Sig. = 0.073 > 0.05). This is due to the fact that the results of the study, as shown in Table (7), showed a high level of sustainable tourism practices that are applied in the tourist and archaeological sites in Alexandria Governorate. As a result, there is

no clear effect of the effects of climate change on the sustainability of tourist and archaeological sites in Alexandria. Hence, the third hypothesis has not been proven.

**Table (14): The relationship between climate change consequences on tourist and archaeological sites and sustainable tourism practices in tourist and archaeological sites**

			Climate change consequences on tourist and archaeological sites	Sustainable practices in tourist and archaeological sites
Spearman's rho	Climate change consequences on tourist and archaeological sites	Correlation Coefficient	1.000	0.117
		Sig. (2-tailed)	.	0.073
		N	238	238
	Sustainable tourism practices in tourist and archaeological sites	Correlation Coefficient	0.117	1.000
		Sig. (2-tailed)	0.073	.
		N	238	238

**D. The relationship between solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria and sustainable tourism practices in tourist and archaeological sites**

**Table (15): The relationship between proposals to reduce the negative effects of climate change on tourism in Alexandria and sustainable tourism practices in tourist and archaeological sites**

			Proposals to reduce the negative effects of climate change on tourism in Alexandria	Sustainable tourism practices in tourist and archaeological sites
Spearman's rho	Proposals to reduce the negative effects of climate change on tourism in Alexandria	Correlation Coefficient	1.000	0.447**
		Sig. (2-tailed)	.	0.000
		N	238	238
	Sustainable tourism practices in tourist and archaeological sites	Correlation Coefficient	0.447**	1.000
		Sig. (2-tailed)	0.000	.
		N	238	238

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The results shown in table (15) confirmed that there is a direct positive relationship between the proposals to reduce the negative effects of climate change on tourism in Alexandria and sustainable tourism practices in tourist and archaeological sites (Sig. = 0.000 < 0.05).

This means that the greater proposals to reduce the negative effects of climate change on tourism in Alexandria, the greater sustainable tourism practices in tourist and archaeological sites.

Accordingly, the forth hypothesis is accepted. To determine the effect, simple regression was used as the following:

**Table (16): Effect of proposals to reduce the negative effects of climate change on tourism on sustainable tourism practices in tourist and archaeological sites**

Model	Un standardized Coefficients		Standardized Coefficients	Adjusted R square	t	Sig.
	B	Std. Error	Beta			
1	(Constant)	1.049	0.213	0.506	4.929	0.000
	Proposals to reduce the negative effects of climate change on tourism	0.754	0.048		0.713	15.622

a. Dependent Variable: Sustainable tourism practices in tourist and archaeological sites.

The findings in table (16) showed that the independent variable (Proposals to reduce the negative effects of climate change on tourism) affects the dependent variable (Sustainable tourism practices in tourist and archaeological sites). So, the proposals to reduce the negative effects of climate change on tourism explain 50.6% of the variation in Sustainable tourism practices in tourist and archaeological sites in Alexandria.

**Based on the previous results, the hypotheses can be summarized through the following table:**

**Table No. (17): Summary of the results of the research hypotheses**

No.	Hypotheses	The result
1	There is a relationship between climate change and sustainable tourism practices in tourist and archaeological sites	Supported
2	There is a relationship between the causes of climate change and sustainable tourism practices in tourist and archaeological sites	Supported
3	There is a relationship between climate change consequences on tourist and archaeological sites and sustainable tourism practices in tourist and archaeological sites	Not supported
4	The relationship between solutions and proposals to reduce the negative effects of climate change on tourism in Alexandria and sustainable tourism practices in tourist and archaeological sites	Supported

#### 14. General Results of the Study:

- The respondents strongly agreed on the causes of climate change mentioned in the study, where the overall average of the causes of climate change in Alexandria was 4.34 at a strong consensus level, with a standard deviation of 0.51.
- It was also clear how strongly the respondents agreed on sustainability practices at tourist and archaeological sites in Alexandria, where the overall average was 4.35 at the level of strong consensus with a standard deviation of 0.48.
- The respondents also strongly agreed on the effects of climate changes on the tourist and archaeological sites in Alexandria, where the overall average was 4.25 at the level of strong agreement, with a standard deviation of 0.56
- The respondents strongly agreed on the solutions and recommendations mentioned to minimize the negative effects of climate change on tourism in Alexandria, where the

overall average was 4.38 at the level of strong agreement, with a standard deviation of 0.45

### 15. Recommendations:

- Taking precautionary measures and strengthening early warning systems and wave height measurement devices regarding the climate change, especially Sea Level Rise, coastal surges and erosions in order to reduce their dangers.
- To work on coordination between the Beaches Protection Authority, the Ministry of Tourism and Antiquities and the Ministry of Environment to protect tourist and archaeological areas and minimize the negative effects of climate changes on them.
- To work on the implementation of environmentally friendly projects to mitigate the risks of climate change in the region.
- To work on preparing programs to inform and educate citizens to coexist and adapt to the effects of successive climate changes.
- To take advantage of research projects to mitigate the negative effects of climate change in the city.
- To coordinate with the competent authorities to increase awareness of the risks that affect the environment due to climate change.
- To provide the necessary funding to implement the necessary measures to mitigate the negative effects of climate change on the city of Alexandria.
- Working on the protection and development of tourist and archaeological sites in Alexandria.
- Increasing archaeological excavations in the city of Alexandria to record and document all the antiquities of Alexandria.
- Seeking to register the archeological sites of Alexandria on the World Heritage Sites List to receive the supports of the UNESCO and its experience in preserving heritage.

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## تأثير التغيرات المناخية على استدامة النشاط السياحي والمواقع الأثرية بالتطبيق على مدينة الاسكندرية

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المعلومات المقالة	المخلص
<p><b>الكلمات المفتاحية</b></p> <p>الأسكندرية؛ التغيرات المناخية؛ الوعي المجتمعي؛ الشواطئ؛ الآثار الغارقة.</p> <p><b>(JAAUTH)</b> المجلد ٢٤، العدد ٢، (٢٠٢٣)، ص ٢٧٦-٣٠١</p>	<p>تعتبر الاسكندرية من أشهر الوجهات السياحية في مصر فقد أسسها الإسكندر الأكبر عام ٣٣٢ ق.م لتكون عاصمة مصر في العصر اليوناني الروماني وهي أيضا من أكبر المدن الممتدة على ساحل البحر المتوسط حيث أنها تمتلك العديد من المزارات السياحية والأثرية المتنوعة إلا أن هذه المعالم السياحية والأثرية مهددة بخطر التغيرات المناخية، خاصة في المناطق القريبة من شاطيء البحر مثل مقابر الشاطبي، جبانة الأنفوشي، قلعة قايتباي، قصر رأس التين ومتحف مكتبة الأسكندرية. وتعاني المدينة من سلبيات التغيرات المناخية منذ القدم حيث تعرضت بعض المواقع للغرق مثل منطقة أبي قير ومنطقة الميناء الشرقي المليئة بالآثار الغارقة. من المؤسف ولكنها الحقيقة أن مصر تحتل المركز الثالث على قائمة الدول الأكثر تأثراً بالتغير المناخي، بينما تعتبر الأسكندرية واحدة من أعلى المدن الساحلية في العالم تأثراً المعرضة لخطر ارتفاع مستوى سطح البحر والعواصف الساحلية.</p> <p>ومن هنا جاء هدف البحث لدراسة تأثير التغيرات المناخية على استدامة نشاط السياحة والمواقع الأثرية بالإسكندرية. ولقد هدفت الدراسة إلى التعريف بظاهرة التغيرات المناخية وتأثيرها على النشاط السياحي بالمدينة والجهود المبذولة من قبل الدولة والأجهزة السياحية في التعامل معها والتخفيف من حدتها مستخدما في ذلك أداة الاستبانة الموجهة إلى الخبراء وذلك بغرض التوصل إلى اقتراح عدد من التوصيات للحد من تأثيراتها المختلفة على المدينة.</p>