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CLIMATE CHANGE AND ITS IMPACT ON THE ENVIRONMENT INWADI MUSA USING GEOGRAPHIC INFORMATION SYSTEM

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Shatha Hussein Rawashdeh[1], Hind Khaled Alsarayreh[2], Aymen Abed Al Kareem Taani[3], Ayed Mohammad Taran[4], Safieh Eid Aljawazneh[5], Climate Change And Its Impact On The Environment Inwadi Musa Using Geographic Information System– Palarch's Journal of Archaeology of Egypt/Egyptology 17(9) (2020), ISSN 1567-214X.

Abstract
This research aims at helping policymakers and decision-makers in Wadi Musa to use surface and ground water optimally to maintain the continuity of agricultural lands from drought and to choose modern irrigation methods notto waste significant water and thus maintain the failure of agricultural land soils for future years, especially since the region has distribution in terms of temperature and precipitation.It decreases and gives the importance of the subject of climate changes and its potential effects that will be reflected on various aspects of life, especially in the study area and how to reduce the risks of climate change and the preparations that must be taken. This is to counteract the potential impacts. The problem of climate change and global warming is one of the major problems that our Arab countries will suffer from, so all ways and means must be taken to work to reduce them, and all efforts must be joined between all civil and governmental institutions concerned with the environment and their issues to confront this phenomenon.

Introduction

Climate change means the set of general imbalances in the global climate that cause a fundamental change in weather as a result of several factors. Among the most important of these changes is the occurrence of a sharp rise in temperatures in areas that were previously classified as moderate or the occurrence of floods in areas that were It is classified as dry areas and other such changes, and the fear of the spread of this phenomenon increases and exacerbates it more and more, especially in light of the increase in pollutants and the change of lifestyle, which is a main reason for the occurrence of this phenomenon. The environmental reality in the globe is in grave danger due to the man's unfair behavior towards the natural and environmental resources that God has harnessed for His servants. There are also serious impacts on water resources, the vital environment and economic activities. General air cycle models indicate that the eastern Mediterranean will be adversely affected by the rise of greenhouse gases in the atmosphere, where rain will decrease and air temperature will increase. Jordan is currently suffering from the low amount of renewable water and low agricultural productivity, especially rainfed due to the lack of rain and the high evaporative potential. Therefore, it is useful to study climate changes and assess their future effects on agricultural production and water resources in the different environments in Wadi Musa.

1. Weather changes

Climate change means the set of general imbalances in the global climate that causes a fundamental change in weather as a result of several factors. Among the most important of these changes is the occurrence of a sharp rise in temperatures in areas that were previously classified as moderate or the occurrence of floods in areas that were classified as dry areas and other such changes, and the fear of the spread of this phenomenon increases and exacerbates it more and more, especially in light of the increase in pollutants and the change of lifestyle, which is a main reason for the occurrence of this phenomenon.

Also, the environmental reality in the globe is in grave danger due to the man's unfair behavior towards the natural and environmental resources that God has harnessed for His servants. There are also serious impacts on water resources, the vital environment and economic activities. General air cycle models indicate that the eastern Mediterranean will be adversely affected by the rise of greenhouse gases in the atmosphere, where rain will decrease and air temperature will increase. Jordan is currently suffering from the low amount of renewable water and low agricultural productivity, especially rained due to the lack of rain and the high potential evaporation capacity. Therefore, it is useful to study climate changes and assess their future impacts on agricultural production and water resources in the different environments in Wadi MusaFood production will also face an increasing threat, affecting the main human needs. The increase in the severity and expansion of drought and changes in seasonal extensions may reduce agricultural crops to more than half if no urgent alternatives are sought, which are changes in crop types, fertilizers, and irrigation practices. Also, high temperatures, low precipitation and change in seasons will require the development of new varieties of crops that can adapt to emerging situations. Crops that require less water and can withstand high levels of salinity must be developed and adopted widly.

1.1. Causes of climate change

Jordan, like other countries of the world, was affected by the wave of climate change. Evidence for this is the drought of Azraq Oasis as a result of the lack of water coming to the oasis, the decrease of the Dead Sea water due to the drought of

tributaries that used to supply the Dead Sea with water, the death of many coral reefs and the decrease in their numbers in the Gulf of Aqaba.In addition to the disappearance of Many different types of marine creatures, due to the following reason; The occurrence of global warming as a result of the frequent use of gases from factories, means of transportation and various human activities, the most prominent of which is CFCs,the problem of ozone perforation and its widening, which causes more harmful sunlight to reach the atmosphere, Loss of biodiversity and pressure on environmental resources, causing an imbalance in the environment that indirectly affects climate change.The spread of the phenomenon of urbanization and dependence on energy production, which causes the production of pollutants that lead to global warming.

2.The geographical location of the study area

The Hashemite Kingdom of Jordan includes 12 governorates, where the study area is located within the Ma'an Governorate, which is divided into four brigades (Kasbah Maan, Al-Shoubak, Petra, and Husayniyah), which is about 210 km south of Amman, with a population of 144,082 people and an area of 32,910 km2 and they constitute one third of the area of the Kingdom Almost as for the study area, it covers an area of 456,670 km2, and it is between the longitude of (35 25 00), (35 37 30) east, and the two latitudes (30 05 00), (30 10 00) north. It reaches 39.68 km in length and 25.85 km in width, and its highest height reaches 1735 m above sea level. Wadi Musa is located.

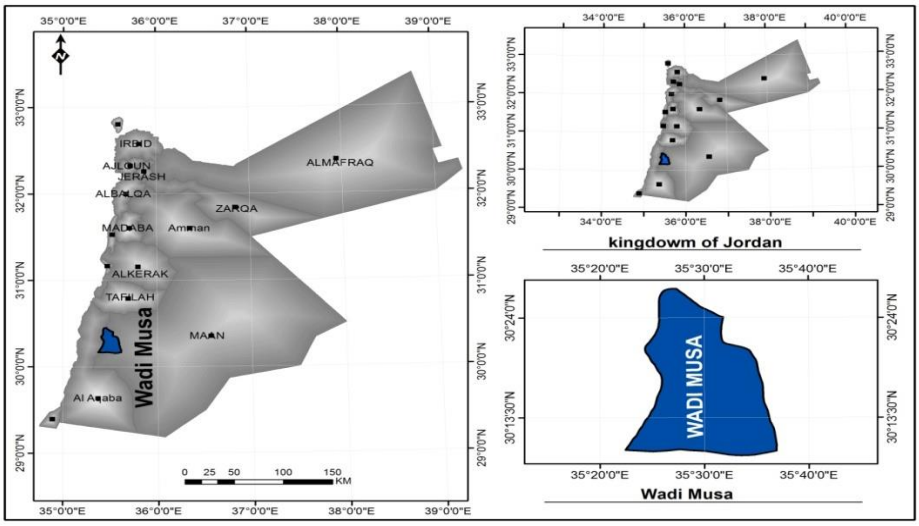


Figure No. (1) represents the geographical location of the study area (Wadi Musa), (Source: researcher's work)

2.2 A satellite image of the study area

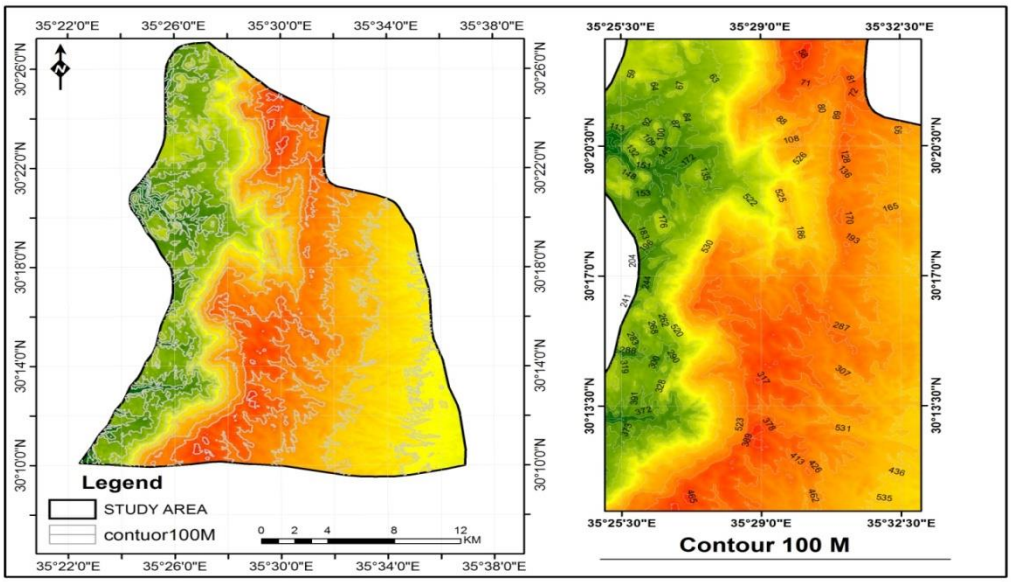


Figure No. (2) Satellite image of the study area (Wadi Musa)

(Source: researcher's work)

Figure No. (3) contour lines for the study area (Wadi Musa) (Source: researcher's

Figure No. (3) contour lines for the study area (Wadi Musa) (Source: researcher's work)

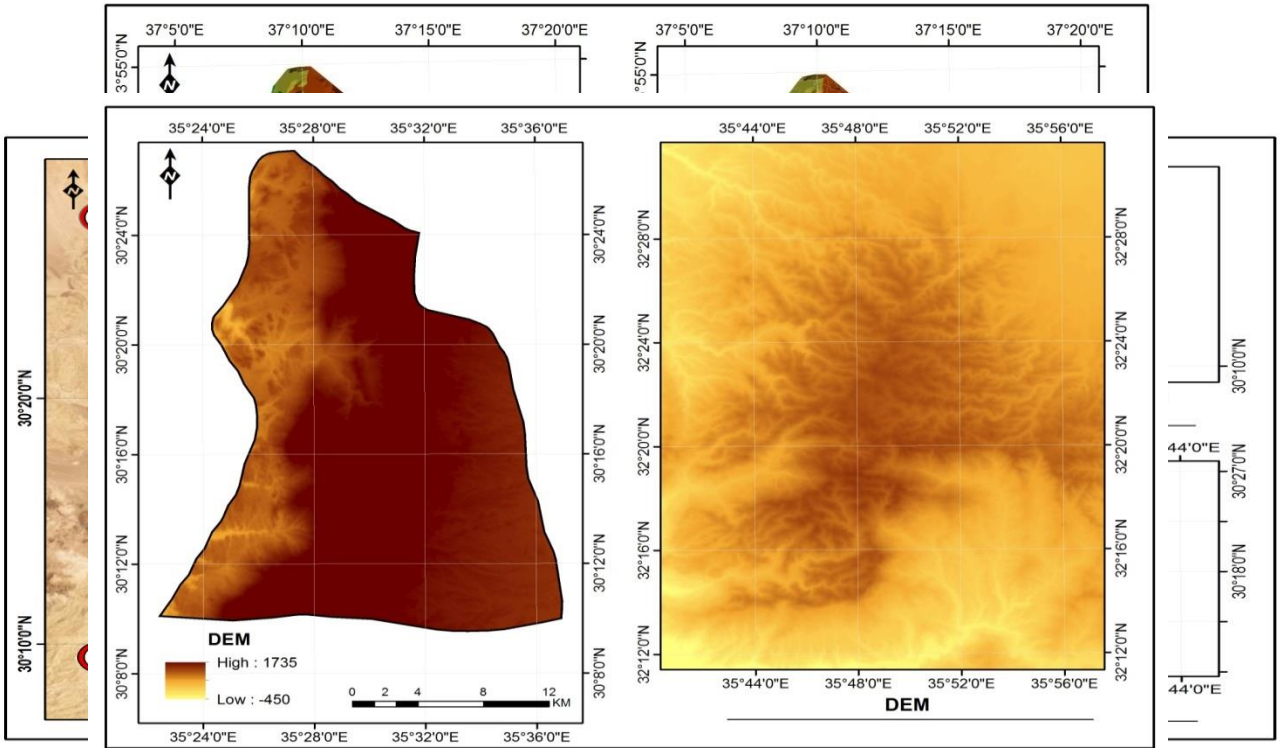


Figure No. (4) irregular triangles grid for the study area (Wadi Musa) (Source: researcher's work)

3. Objectives of the study

This study came to show the reality of the situation in Wadi Musa, and by studying the reality surrounding us, we find that man did not care about the surrounding environment and did not preserve it.because the wheel of development and the industrial boom witnessed by the countries of the world took place without turning attention to the damages that would be resolved to the environment, which led to the emergence of many Among the environmental problems that our modern world suffers, on top of which is the phenomenon of climate change and other environmental problems that are threatening mankind, most of which are caused by environmental stress and pollution. This is why this study came to the following goal. The research aims to lay the foundations and criteria for planning agricultural lands periodically using water regularly. Preserve the places of water from tampering and overgrazing on arable land and intensify efforts to reduce this phenomenon. Study the reality of the situation for the local community and allocate the government-subsidized lands to encourage them to continue to increase land cultivation. Reducing the environmental risks of the study area exposed to be environmental degradation and potential impacts and trying to take the necessary precautions to address this phenomenon. Clarification of some matters for relevant institutions to improve the ability of systems to work in the face of numerous environmental risks, to make the city (integrated, comprehensive, flexible, repetitive, strong, and reflective) and to improve (health, well-being, economy, society, infrastructure, environment, leadership and strategy). Give a comprehensive view of the study area to better understand the potential impacts of climate change, as well as to enhance skills in integrated planning for those with specializations:

4. Research Methodology

For the purpose of demonstrating the validity of the study, the inductive approach that starts with particles and ends with colleges has been followed, and the comparative analytical method for identifying variations and environmental changes in the Wadi Musa region in terms of amounts of rain water, evaporation, drought, agriculture, and land uses. Geographical research methods have also been used in the representation of geographical maps, space images and statistical

messages in particular Geographic Information Systems (GIS) software as an effective tool in mapping operations, performing statistical and spatial analyzes, and creating illustrative maps where ArcGis10.3, (Spatial Analyst) and (Geostatistical Analyst) were used In drawing and analysis processes.

We have also relied on a number of approaches to geographic study during the preparation of the research, as follows:

4.1 The descriptive approach:

As the general characteristics of factors affecting climate change in Wadi Musa were identified and its causes, maps and tables were prepared for that, calculations were made of water quantities, temperatures, areas of use, cultivated areas, and indication of areas prone to drought through spatial and statistical analysis.The negative effects of climate changes were also shown. They affect a person's life dramatically and clearly,

4.2 Analytical approach:

An analytical method was used to analyze the information to identify areas with low rainfall as well as the amounts of evaporation in those areas and areas subject to drought to extract the results to reach an appropriate solution and give correct results,

5. Previousstudies :

The Mediterranean, and the continental wind components, the southwest which accompanies these depressions becomes more powerful, which reduces the relative humidity of this wind, and leads to diminishing rainfall.

3. The report of the United Nations Environment Program (UNEP), (2000), (The report mentioned the increase in the average temperature in the West Asia and the Middle East region about (5.0) مm), for the period (1955-1994), and the increase reached ((25) ºm). During the winter months: December, January, and February, while it reached about one degree Celsius in September, October, and November, climatic models predicted a decrease in soil moisture in most parts of the region, a slight increase in rain, and an increase in evaporation due to An increase in temperature that will increase about (1-2) degrees Celsius for the period (2030-2050).

4. Report of the Intergovernmental Panel on Climate Change ((IPCC 2007), which shows a decrease in precipitation in the coast, the Mediterranean, South Africa, and parts of South Asia during the period (1900-2005) in addition to the increase in drought since the seventies. It is expected that according to the projections conditions will deteriorate in southern Europe due to Climate change (high temperatures and droughts) This is an area currently considered vulnerable to climate variability, and climate change is expected to lead to a decrease in water supply and crop productivity in general.

6.The impact of climate changes on the environment in Wadi Musa. Among these changes are thermal changes and less rainfall in the region in addition to agricultural changes:

6.1 Thermal changes (less rain, evaporation and dehydration)

What is meant here is the difference in temperatures during the five years (2013-2018) in which the drought resulting from the variation in temperature and the decrease in the amounts of rain are studied and thus the surface and groundwater quantities decrease.

6.2 Agricultural changes

These changes are the result of an imbalance in the level of the annual rainfall amounts and consequently lead to changes in the cultivation patterns in general to become land not suitable for cultivation.

6.3Research design and use of geographic information systems

As we mentioned earlier, the study area is located in southern Jordan, in the geographical location on a longitude of 35 degrees and a latitude of 30 degrees, and the total area is 456.7 square kilometers.

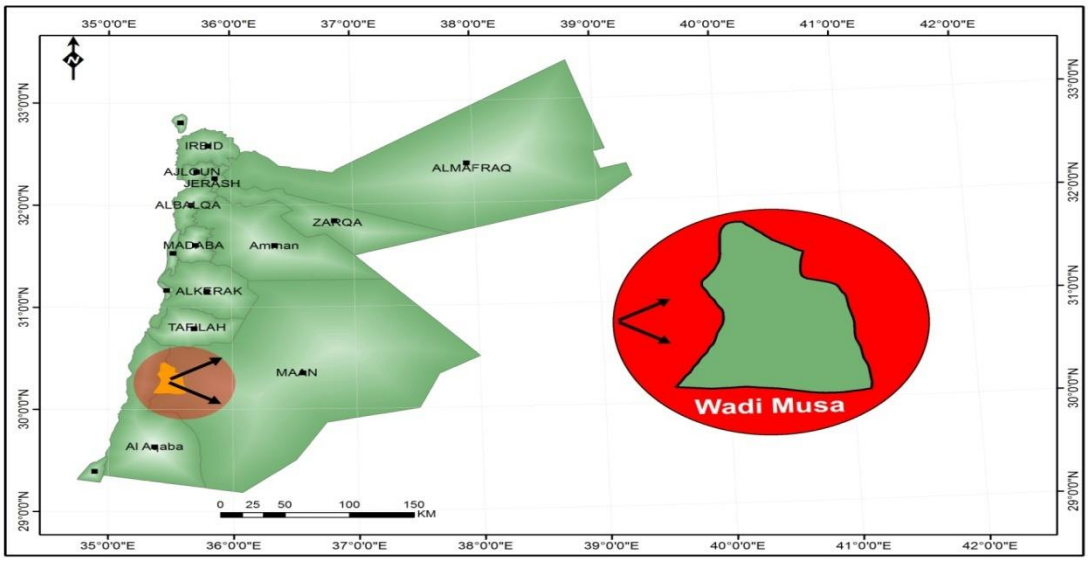


Figure No. (5) Location of the study area for the Kingdom of Jordan (Wadi Musa) (Source: researcher's work)

7.1How to use GIS and remote sensing applications on climate change hubs

7.1.1 Thermal changes (less rain, evaporation and dehydration)

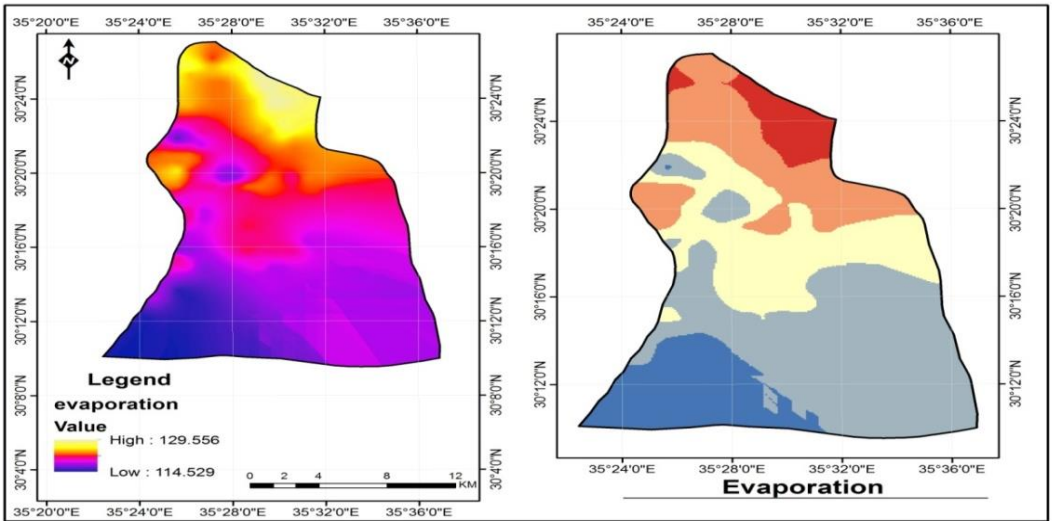


Figure No. (6) Quantities of rain water in the study area (Wadi Musa) (Source: researcher's work)

7.1.2 Rainwater quantities

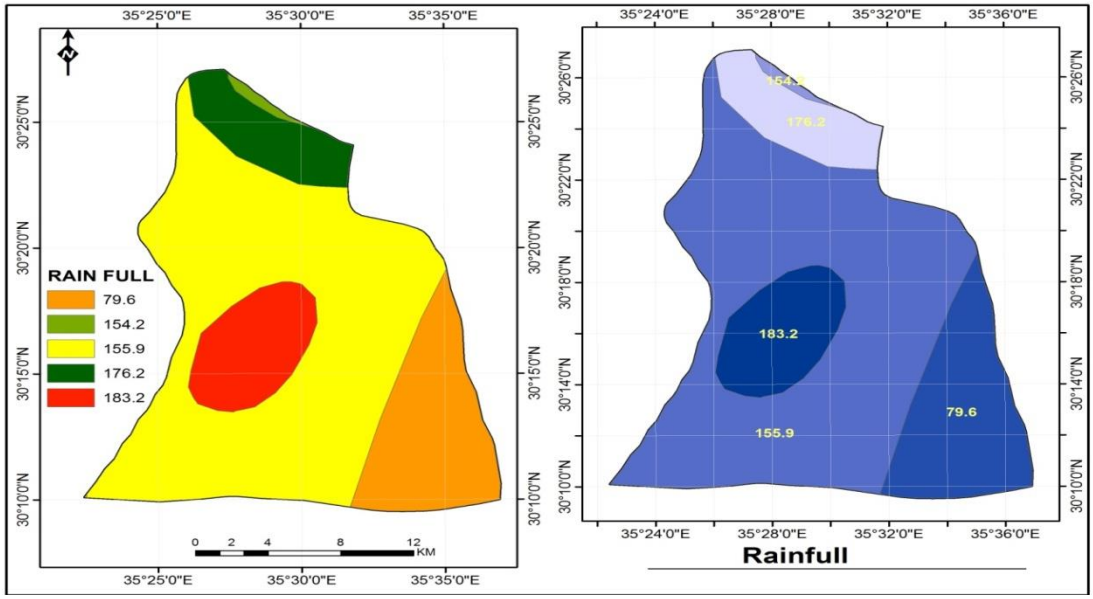
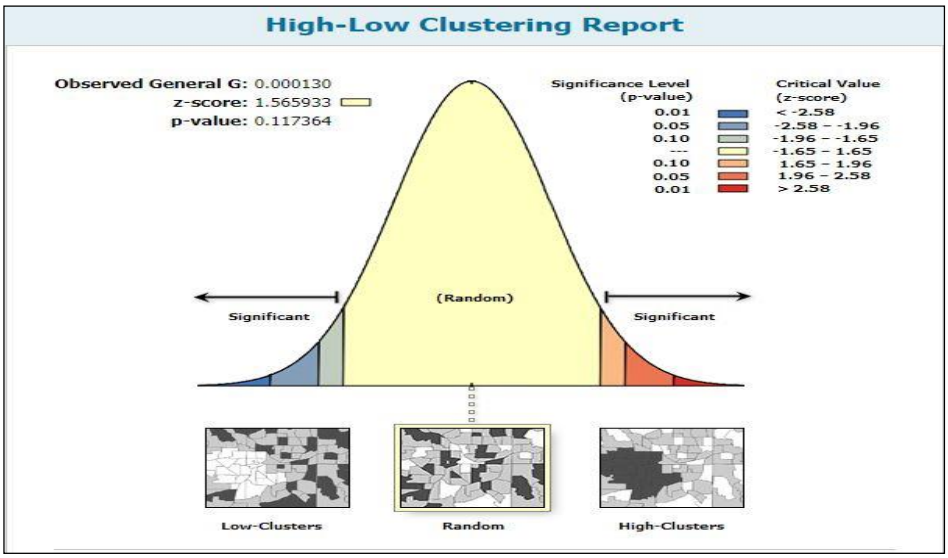


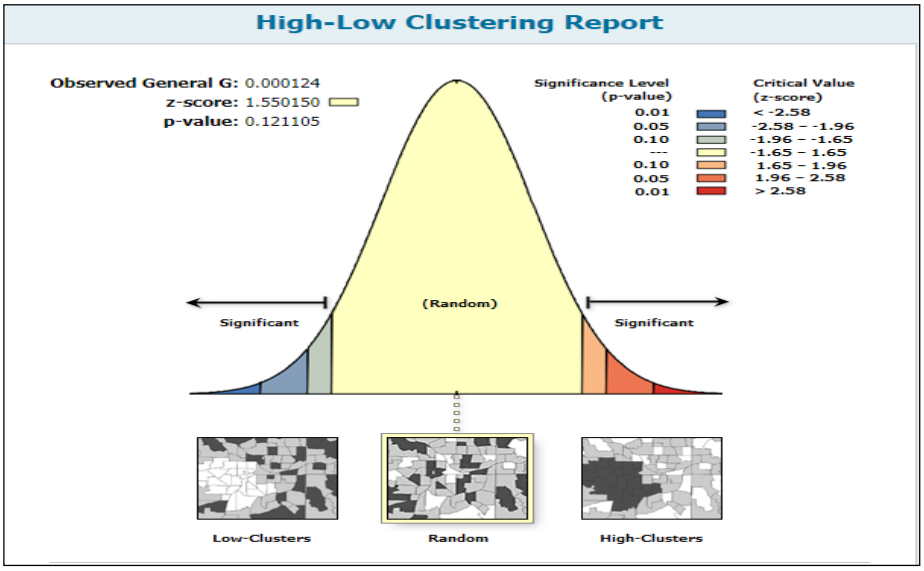
Figure No. (7) Quantities of evaporation from surface water in the study area (Wadi Musa) (Source: researcher's work).

We notice from the figure that the distribution of rain over the study area is a random distribution of water (Random).The amounts of precipitation there are dispersed water and therefore loss and lack of surface water. Therefore, a water harvest must be made in areas with higher and medium precipitation to preserve and use throughout the year to irrigate agricultural crops In the event that the result of the analysis was of a high distribution (High Clusters).This indicates that the study area does not have climate change and also if the distribution is low (Low Clusters) this indicates that a study region does not have climate change.



7.1.3Evaporation quantities of surface water

We notice from the above figure that the evaporation quantities of surface water are a random distribution of water (Random). This indicates that the study area has a random climate change percentage and these results in large evaporation quantities.



7.1.4 Total quantities of drought:

We notice from the above figure that the quantities of dehydration from surface water are high distribution (this indicates high level of climate change in the study area)

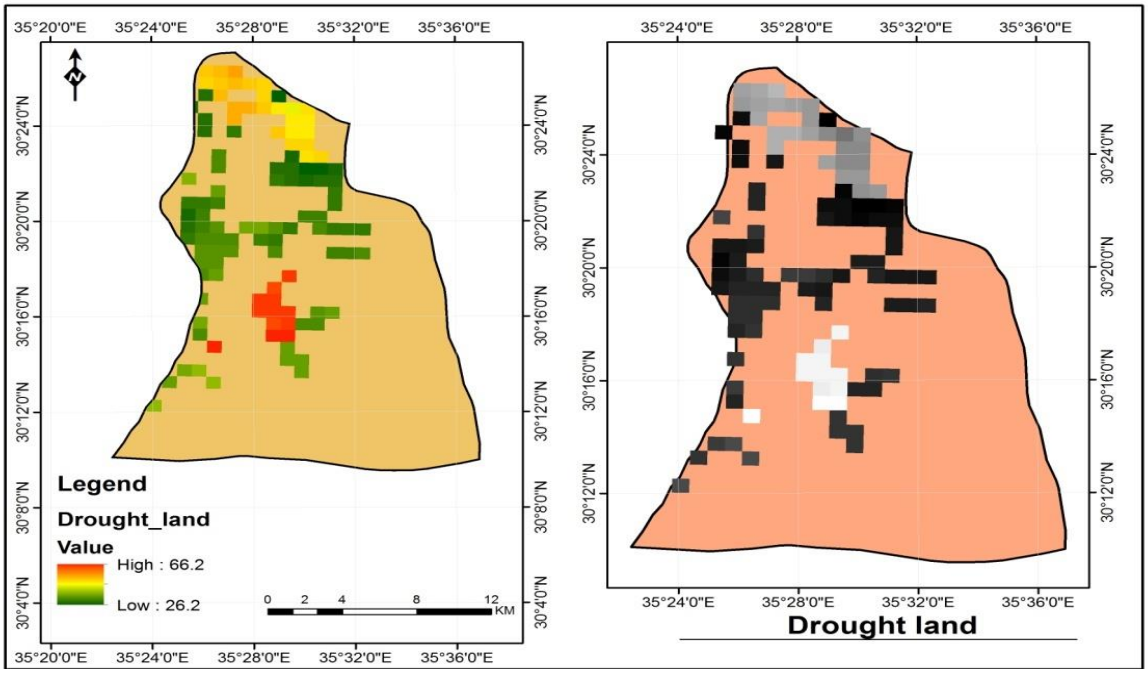


Figure No. (9) Quantities of total drought in the study area (Wadi Musa) (Source: researcher's work).

7.2 Agricultural changes

7.2.1 Agricultural changes are processed with the geographic information system based on the following

1- The ability to quick classify geographical data for different time periods.

2- The geographic information system provides an important spatial and analytical function, as the use of time-consuming geographic data and spatial overlap leads to the development of model input data in various spatial scales.

3- The ability to look at the spatial difference; consequently, the regions can be simulated with a specific decision by the user.

Agricultural classifications are extracted for several periods of time in order to know the types and uses of agricultural lands and to know the sustainability or limited area of these lands.

7.2.2 Land use for the year 1990

Through the figure (10), it appears to us that the highest area of land is the rangelands (Rangelands). This indicates the presence of large amounts of rainwater and highly fertile lands in that time period and the percentage of rangelands is slightly less than the year 1990. It means that the ratio is almost close.

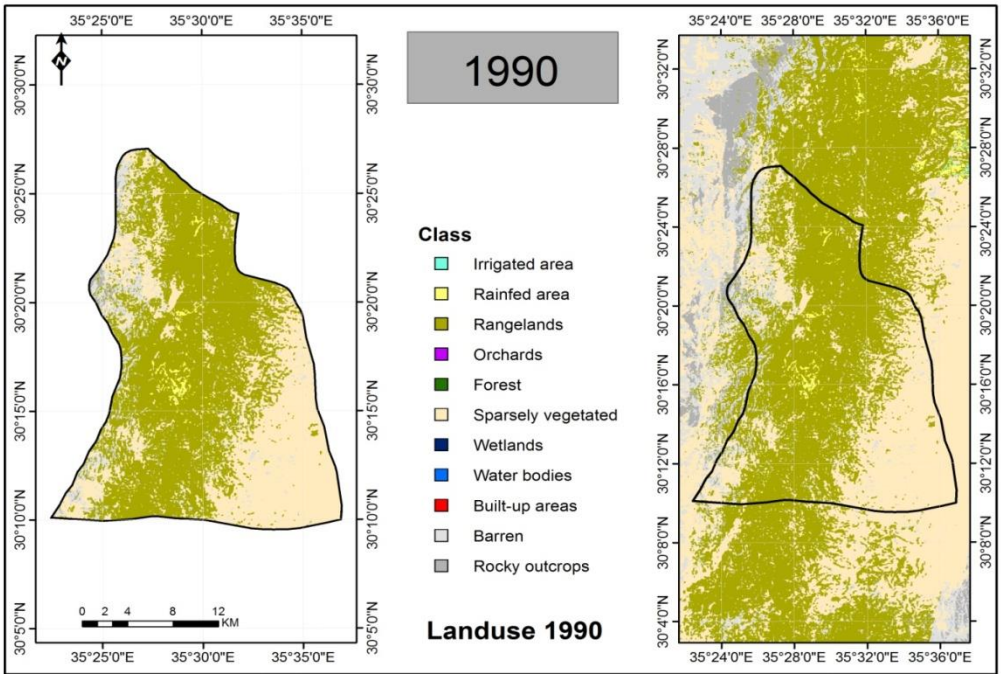


Figure No. (10) RepresentingAlmarai for the year 1990 in the study area (Wadi Musa) (Source: researcher's work).

7.2.3 Land use for the year 2015

Through the figure (11), it appears to us that the rangelands have significantly decreased from the previous two periods due to several factors mentioned above (lack of rain, evaporation, and drought).

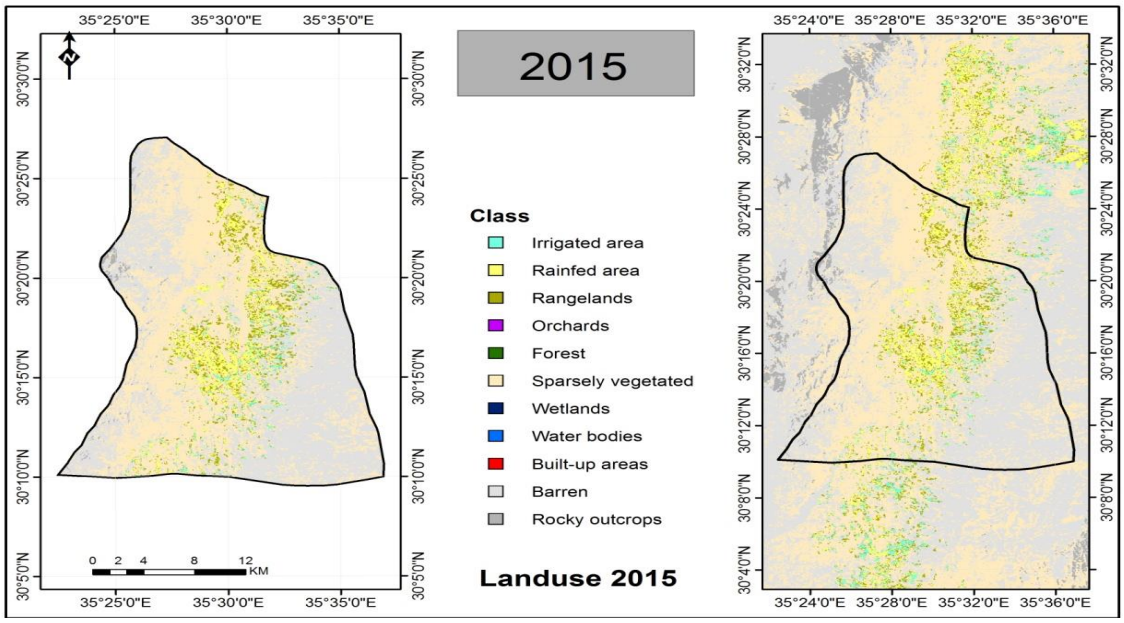


Figure No. (11) RepresentingAlmarai for the year 2015 in the study area (Wadi Musa) (Source: researcher's work)

Through the figure (12), it appears to us that the rangelands have significantly decreased from the previous two periods due to several factors mentioned above (lack of rain, evaporation, and drought).

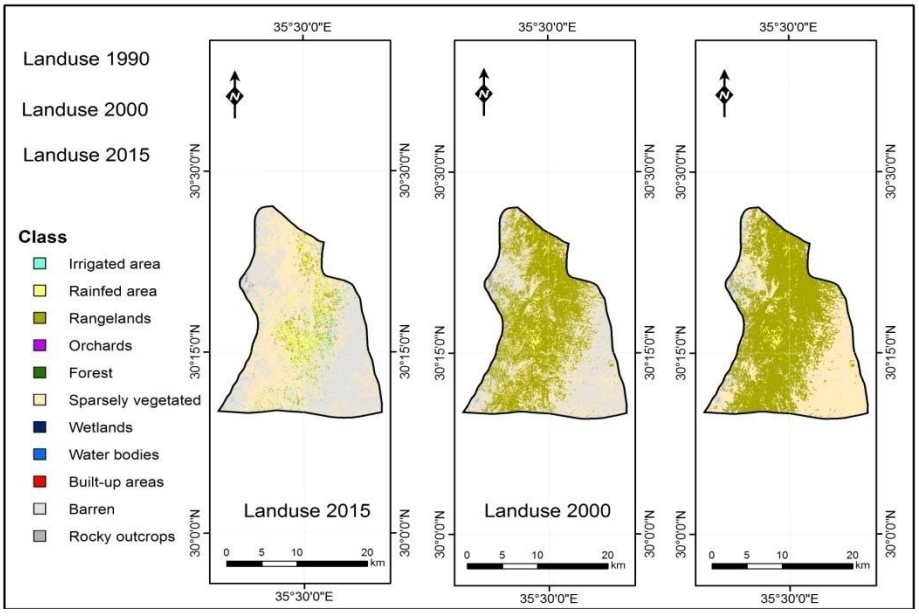


Figure No. (12) Pasture areas during the three years in the study area (Wadi Musa) (Source: researcher's work)

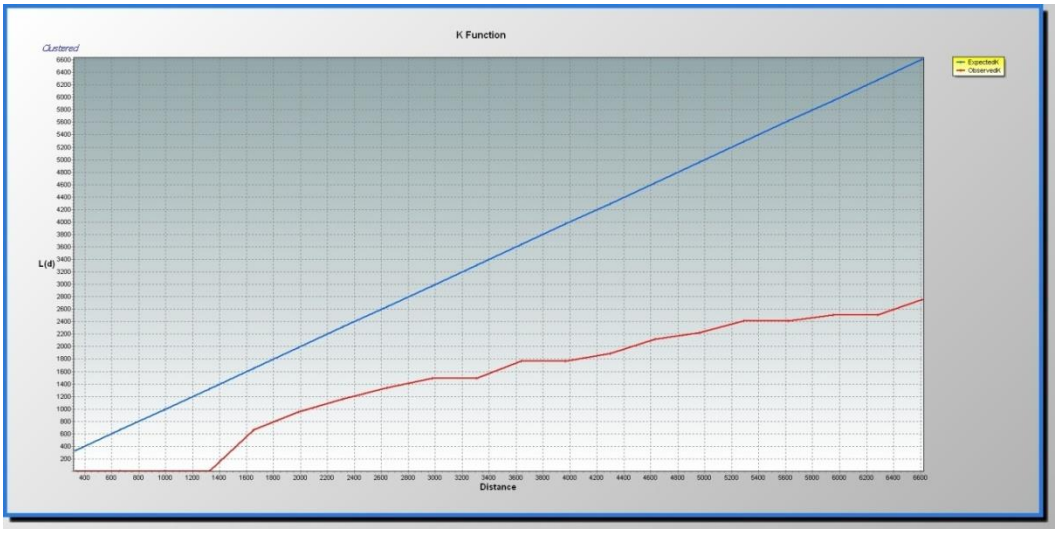


Figure No. (13) Expected drought during the three years in the study area (Wadi Musa) (Source: researcher's work)

We notice from the graph that the expected drought in the study area increased during the next period of time, and that is all Almost 3 years.

Comparing climate changes in the study area

Evaporation rate classification

Drought_land	Drought rate classification	No
114.528976 - 116.714417	A little bit	1
116.714417 - 118.904076	Little	2
118.904076 - 121.060524	Average	3
121.060524 - 123.87191	High	4
123.87191 - 129.556015	Very high	5
0.00	المجموع	

TabelNo. (1) represents the table of evaporation classifications in the study area (Wadi Musa) (Source: researcher's work)

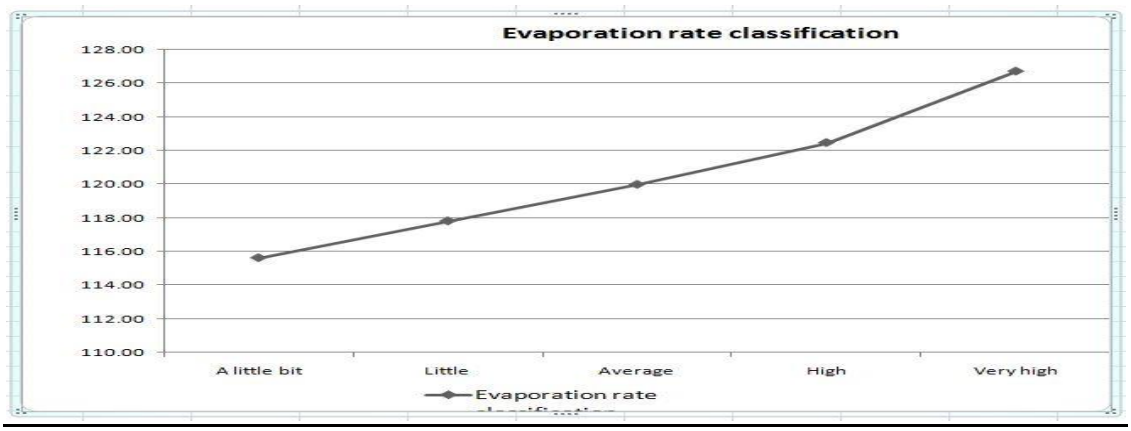


Figure No. (14) represents a graph of evaporation classifications in the study area (Wadi Musa) (Source: researcher's work)

Drought rate classification

Drought_land	Drought rate classification	No
26.2 -33.9	A little bit	1
33.9 -36.9	Little	2
36.9 -40.9	Average	3
40.9 - 55.2	High	4
55.2 - 66.2	Very high	5
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Tabel No. (2) represents drought classifications in the study area (Wadi Musa) (Source: researcher's work

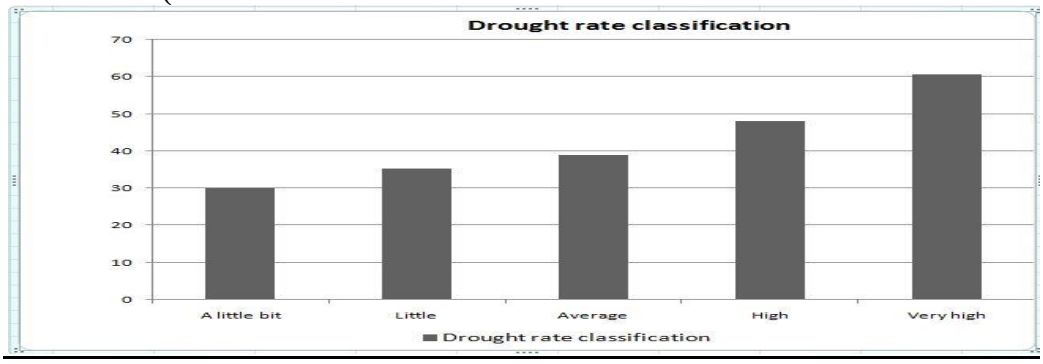

Figure No. (15) represents a graph of drought classifications in the study area (Wadi Musa) (Source: researcher's work).

COMPARE BETWEEN MAX_VALUE AND MIN EVAPORATION & Drought_land MM

MAX_VALUE FOR MIN EVAPORATION & Drought_land	MIN_VALUE FOR EVAPORATION & Drought_land	No
0.04	0.00	1
0.10	0.04	2
0.20	0.10	3
0.36	0.20	4
0.61	0.36	5
0.77	0.61	6
0.87	0.77	7
0.93	0.87	8
0.97	0.93	9
1.00	0.97	10
المجموع		

Table No. (3) compared to the values of drought and evaporation in the study area (Wadi Musa) (Source: researcher's work)

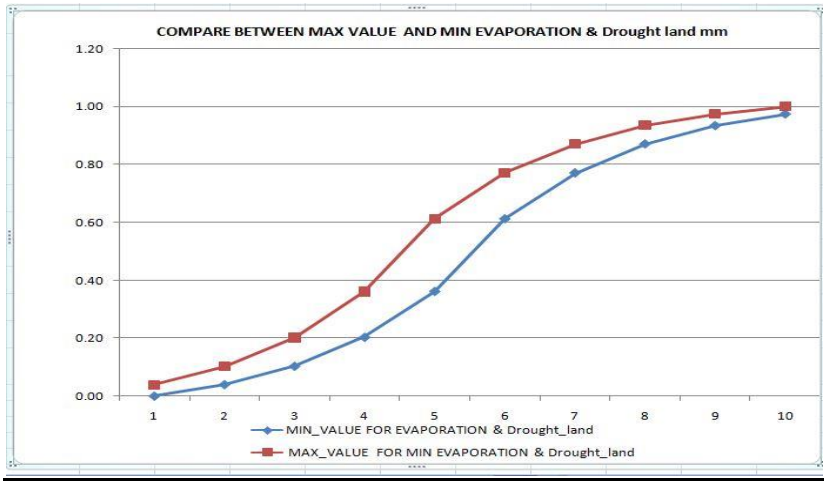

Figure No. (16) compared to the values of drought and evaporation in the study area (Wadi Musa) (Source: researcher's work)

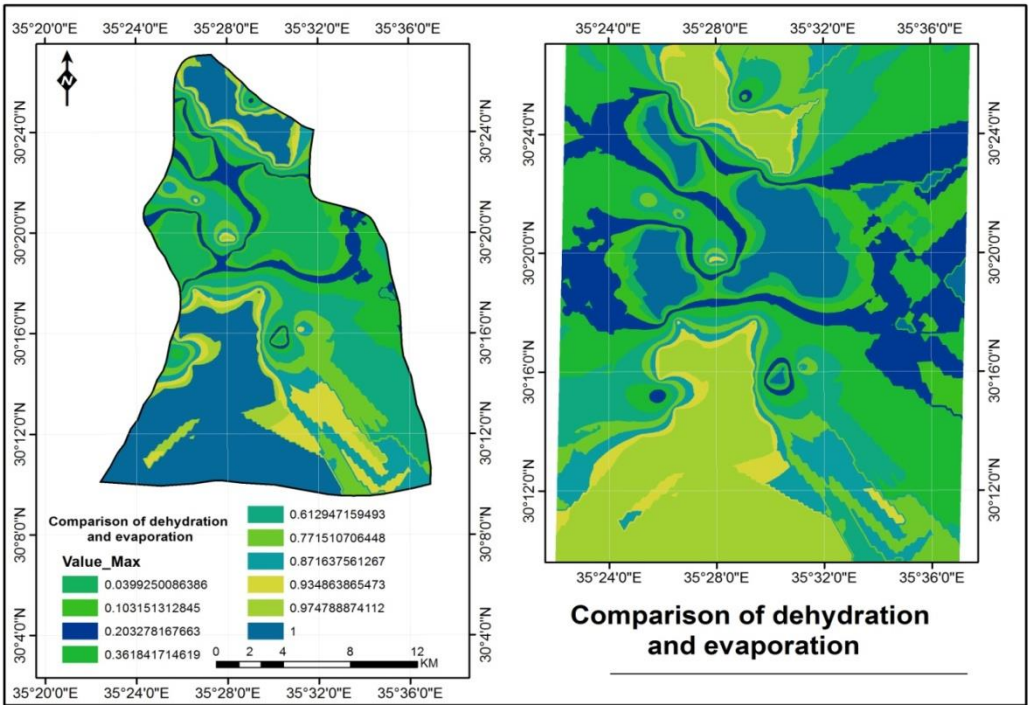

Figure No. (17) Compared to the values of drought and evaporation in the study area (Wadi Musa) (Source: researcher's work)

We notice from the figure above that the highest dryness and evaporation is located in the southern areas of the study area (Al-Tayyibah and Al-Rajaf) area of 151 square kilometers.

8.Findings and recommendations

8.1 Results

The availability of water in the future in order to suit itsrequirements, has a lower rate of rainfall, which is arid or semi-arid regions in the drier southern parts of the study area.

Surface runoff and groundwater are likely to decrease significantly in the study area over the next five years.

The percentage of agricultural lands, which are pastures in general, is reduced by very large areas, and this is due to the increase in drought, as we mentioned previously, which is 65 - 80%.

8.2 Recommendations

Paying attention to groundwater and creating artesian wells to collect water in the form of a water harvest to be used for the purposes of irrigation of agricultural lands.

The use of modern technologies in agriculture and the follow-up of variables or diseases affect agricultural crops due to their influence on climate factors.

Carrying out field studies to educate the local community about the importance of water and not wasting it at rando.

Attracting human experiences in the field of climate and agriculture in order to benefit from them and work alongside decision makers in the government sector to facilitate all obstacles before them.

Work must be taken to protect areas prone to soil erosion, especially agricultural land.

A team of multiple experiences must be formed in order to study the results and indicators issued by the study area with all the vital changes and the environment

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