

The impacts of Climate Changes in The Region Surrounding Al-Mustaqbal University

Preliminary Report

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Part 1: Overview of Climate Change in Iraq

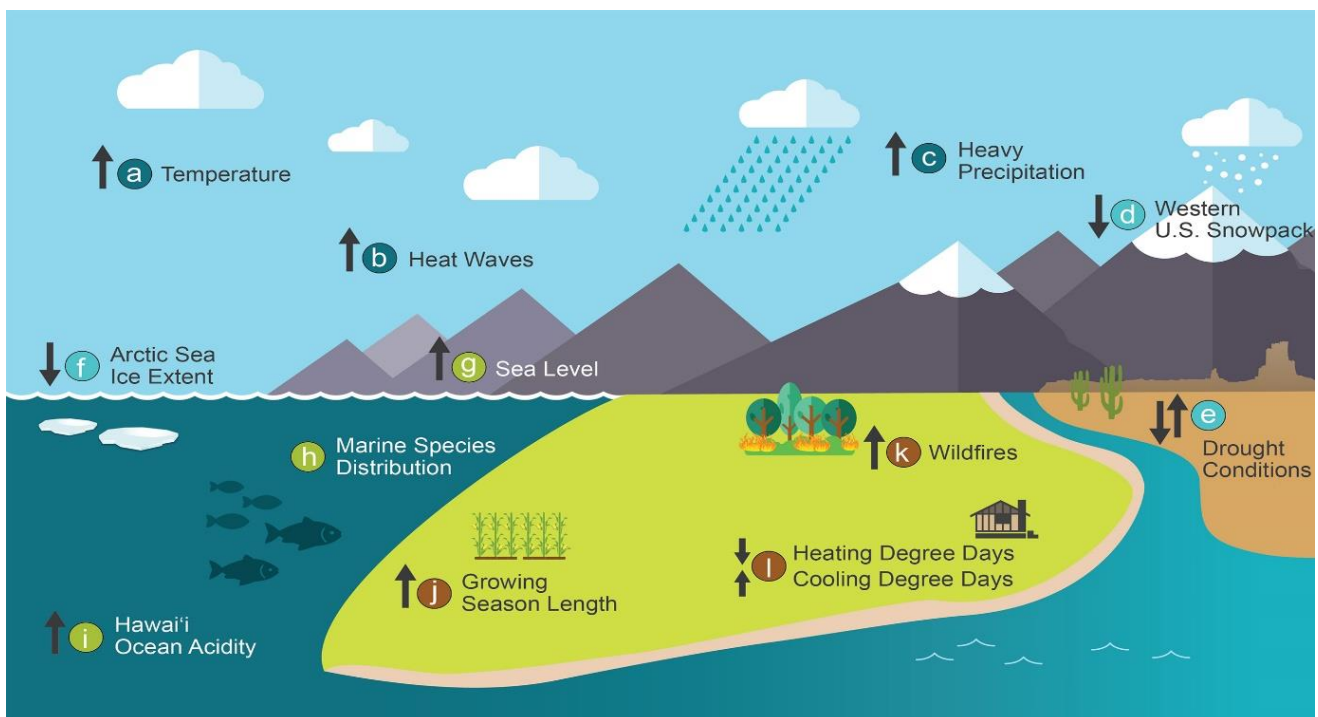


Introduction

What Is Climate Change?

Climate change encompasses a natural process marked by fluctuations in temperature, rainfall, wind, and other environmental factors occurring over decades or longer periods. Throughout millions of years, the Earth has witnessed both warmer and colder phases. However, the current epoch is characterized by an unprecedented acceleration in global warming, primarily attributed to human activities, notably the combustion of fossil fuels leading to the emission of greenhouse gases. These emissions, such as carbon dioxide and methane, act as a metaphorical blanket enveloping the planet, trapping the sun's heat and elevating temperatures. Sources of these emissions include the burning of fossil fuels for transportation and heating, land clearance, and landfill waste. Notably, sectors like energy, industry, agriculture, and waste disposal contribute significantly to the escalating levels of greenhouse gases.

Contrary to a common misconception that associates climate change solely with rising temperatures, its ramifications extend far beyond. The Earth operates as an interconnected system, where alterations in one facet trigger cascading effects across others. Present-day consequences of climate change encompass intense droughts, water scarcity, devastating fires, surging sea levels, widespread flooding, polar ice melting, catastrophic storms, and a decline in biodiversity. The impact of climate change is experienced diversely by individuals, influencing aspects such as health, food security, housing, safety, and livelihoods. Certain populations, like those residing in small island developing States, are particularly susceptible to the adverse effects of climate change, evident in phenomena like sea-level rise compelling entire communities to relocate. The forecasted increase in "climate refugees" further underscores the urgent need for global efforts to mitigate and adapt to the challenges posed by climate change.





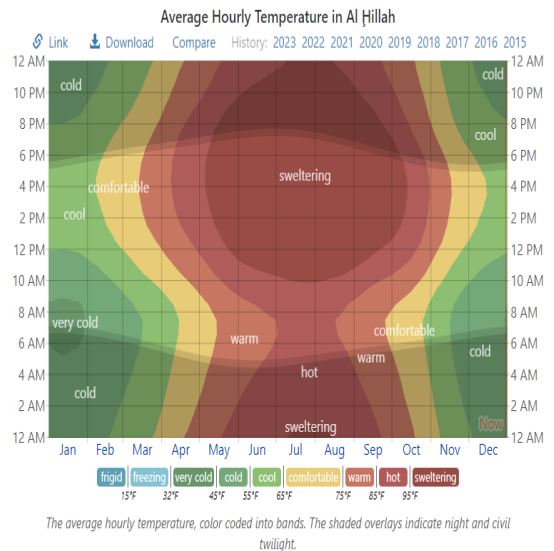
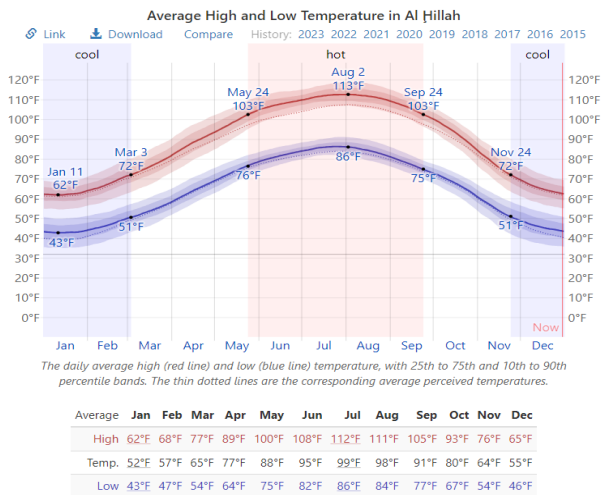
A Brief History of Iraq

Over the course of history, Mesopotamia, renowned for its predominantly hot climate, comprised diverse environments such as deserts, foothills, steppes, and marshes. The common thread among these regions was the scarcity of summer precipitation. The Lower Mesopotamian weather featured hot, dry summers and mild, dry winters in deserts and steppes, while foothills experienced mild winters and dry, warm summers. In Northern Mesopotamia, a millennium ago, communities thrived on natural rainfall for agriculture, but a significant climate shift around 6400 B.C. witnessed a mass migration from the moderate north to the arid south, likely driven by severe climate effects like drought and cooling.

The annual flood cycle of the Tigris and Euphrates rivers played a pivotal role in Mesopotamian agriculture. Through adept control of floods using irrigation canals and drainage systems, the Mesopotamians doubled their agricultural output, leading to the emergence of the first class-based society and cities. Climate continued to influence human civilizations, with recorded dust activity and a major drought around 2200 B.C. contributing to the collapse of Akkadia. The Neo-Assyrian empire also faced a mega-drought, leading to conflicts and the fall of Nineveh.

As research progressed, a surprising revelation during the Islamic Golden Age (816-1009 AD) indicated extreme cold climates in Iraq, including snowfalls and hailstorms. Notably, events like frozen Tigris canals and widespread snowfall challenged the perception of Iraq's typically hot nature. Moving to the modern era, since 1950, Iraq has experienced rising temperatures, environmental degradation from wars, and declining biodiversity. The Iraq-Iran war and marshland destruction caused a 90% loss in marshes by 2001, with only 58% recovered by 2006. Additionally, a decrease in precipitation and an increase in dust storms are evident, pointing to the profound impact of both natural and anthropogenic factors on Iraq's climate over the years.





The figure below shows you a compact characterization of the entire year of hourly average temperatures. The horizontal axis is the day of the year, the vertical axis is the hour of the day, and the color is the average temperature for that hour and day.

Climate and Average Weather Year-Round in Al Hillah Iraq

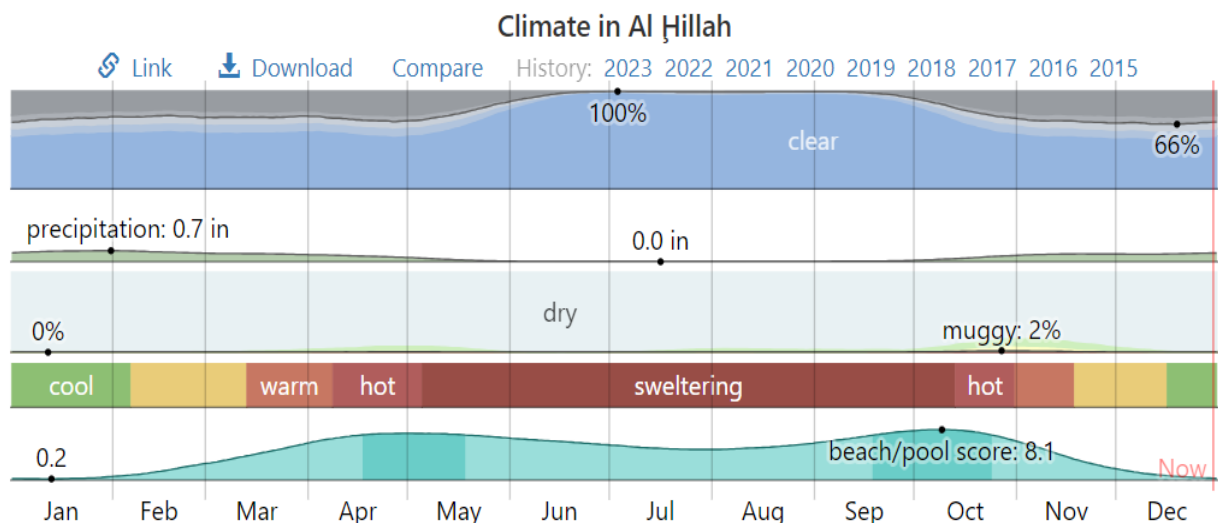
In Al Hillah, the summers are long, sweltering, arid, and clear and the winters are cool, dry, and mostly clear. Over the course of the year, the temperature typically varies from 43°F to 113°F and is rarely below 35°F or above 119°F.

Based on the beach/pool score, the best times of year to visit Al Hillah for hot-weather activities are from mid-April to mid-May and from mid-September to late October.

Average Temperature in Al Hillah

The *hot season* lasts for 4.0 months, from May 24 to September 24, with an average daily high temperature above 103°F. The hottest month of the year in Al Hillah is July, with an average high of 112°F and low of 86°F.

The *cool season* lasts for 3.4 months, from November 24 to March 3, with an average daily high temperature below 72°F. The coldest month of the year in Al Hillah



Al Hillah weather by month. Click on each chart for more information.

Rainfall

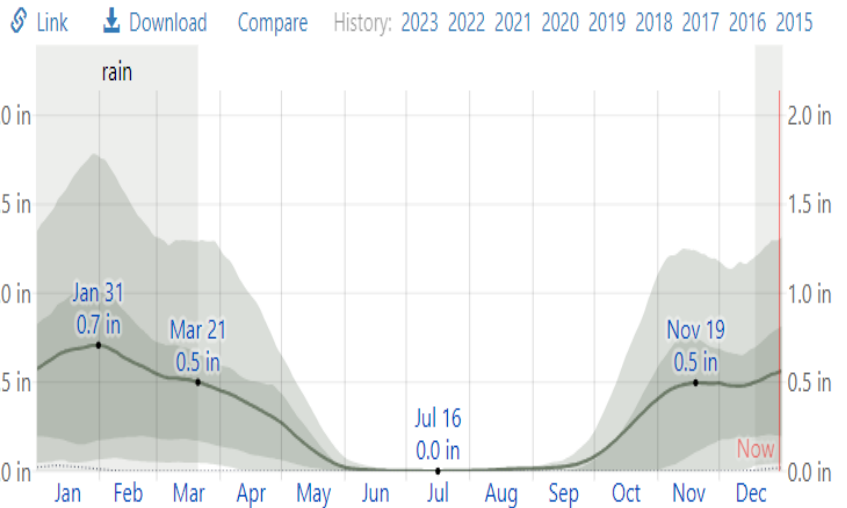
To show variation within the months and not just the monthly totals, we show the rainfall accumulated over a sliding 31-day period centered around each day of the year. Al Hıllah

experiences some seasonal variation in monthly rainfall.

The rainy period of the year lasts for 3.1 months, from December 18 to March 21, with a sliding 31-day rainfall of at least 0.5 inches. The month with the most rain in Al Hıllah is January, with an average rainfall of 0.7 inches.

The rainless period of the year lasts for 8.9 months, from March 21 to December 18. The month with the least rain in Al Hıllah is July, with an average rainfall of 0.0 inches.

Average Monthly Rainfall in Al Hıllah



The average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands. The thin dotted line is the corresponding average snowfall.

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

Rainfall	0.7"	0.6"	0.5"	0.4"	0.1"	0.0"	0.0"	0.0"	0.0"	0.2"	0.5"	0.5"
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Clouds

In Al-Hıllah, the average percentage of the sky covered by clouds

experiences *significant* seasonal variation over the course of the year.

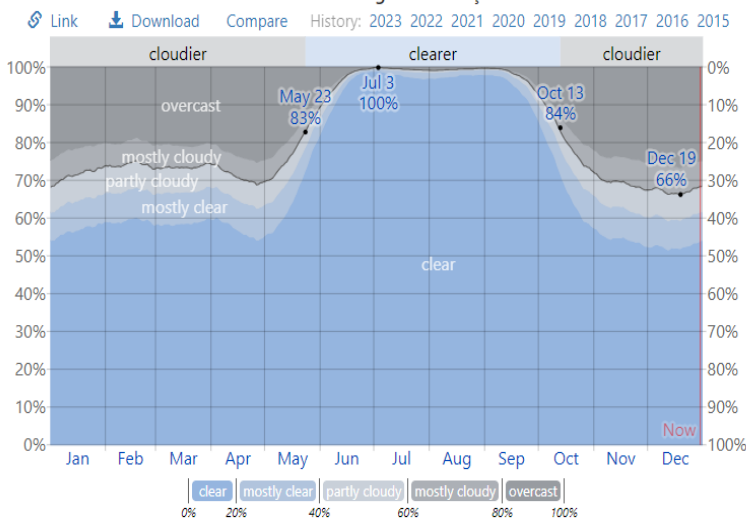
The *clearer* part of the year in Al Hıllah begins around *May 23* and lasts for 4.7 months, ending around *October 13*.

The *clearest* month of the year in Al Hıllah is *July*, during which on average the sky is *clear, mostly clear, or partly cloudy* 99% of the time.

The *cloudier* part of the year begins around *October 13* and lasts for 7.3 months, ending around *May 23*.

The *cloudiest* month of the year in Al Hıllah is *December*, during which on average the sky is *overcast or mostly cloudy* 33% of the time.

Cloud Cover Categories in Al Hıllah



The percentage of time spent in each cloud cover band, categorized by the percentage of the sky covered by clouds.

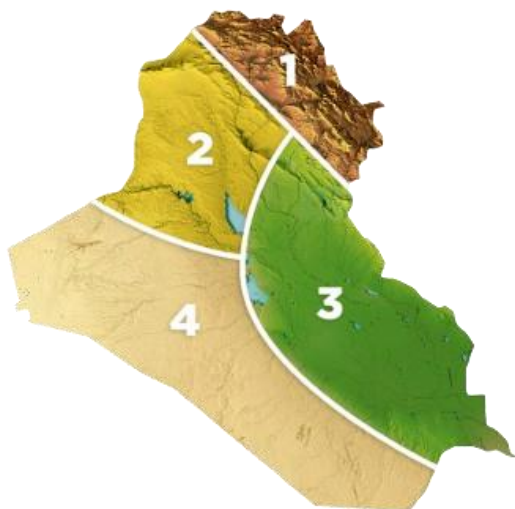
Fraction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cloudier	29%	26%	26%	29%	21%	3%	1%	1%	2%	19%	31%	33%
Clearer	71%	74%	74%	71%	79%	97%	99%	99%	98%	81%	69%	67%

Geography and Climate

Situated in southwest Asia, the Republic of Iraq shares borders with Turkey to the north, Iran to the east, Jordan and Syria to the west, and Saudi Arabia and Kuwait to the south. The country exhibits diverse topography, divided into four distinct regions: mountains to the north and northeast (1); a northern upland region between the Tigris and Euphrates rivers (2); central and southeastern Iraq's Tigris-Euphrates alluvial lowlands (3); and the desert to the west and south (4).

Iraq experiences a predominantly continental and subtropical semi-arid climate, except for the northern and northeastern mountainous regions, which have a Mediterranean climate. The country observes two major seasons with distinct weather patterns. Summer, lasting from late April to October, is characterized by clear skies, exceptionally high temperatures ranging from 35 to 51 degrees Celsius, low relative humidity, and minimal precipitation. Winters, spanning from November to March, are mild to cold, with temperatures ranging between 2 and 15 degrees Celsius.

Rainfall in Iraq is seasonal, predominantly occurring between December and February for most of the country. However, in the north and northeast regions, the rainy season extends from November to early April. This geographical and climatic diversity contributes to the unique environmental conditions experienced across Iraq, influencing the livelihoods and activities of its



Climate Change: Now and the Future

In recent times, global climate change has unequivocally established itself as an undeniable reality. Iraq, grappling with its own set of challenges exacerbated by a fragile state and deteriorating infrastructure, stands at the forefront of experiencing the multifaceted impacts of climate change. Once considered the Middle East's breadbasket and a part of the Fertile Crescent, Iraq has deviated significantly from that historical norm. The nation is now grappling with rising temperatures, diminishing rainfall, escalating desertification, severe sandstorms, diminishing water resources, agricultural setbacks, and economic disruptions on a national scale.

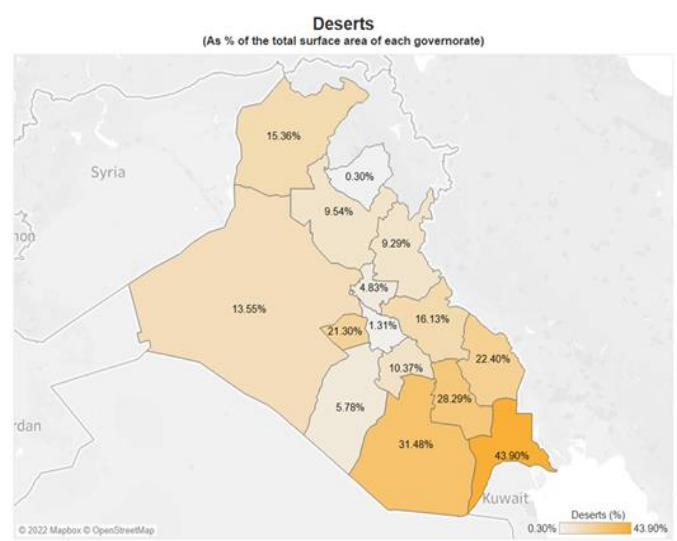
The consequences of climate change are acutely felt across Iraq's 42 million inhabitants, who are concentrated in specific regions due to the harsh climate. This concentration has direct implications for the people, affecting their lives, economic prospects, and posing challenges to water and food security. According to projections from the Climate Change Knowledge Portal and USAID, Iraq faces a grim future if immediate measures to mitigate the crisis are not implemented. By the year 2050, it is anticipated that the mean annual temperature will rise by 2°C. Simultaneously, the mean annual average rainfall is expected to decrease by 9%, with the most substantial reduction of 17% anticipated during December, January, and February. The projections also indicate an increased frequency of heatwaves, a reduction in the number of frost days, a decrease in the maximum amount of rain falling in any 5-day period, but an overall increase in rainfall intensity. Additionally, an average 22% decrease in runoff across the nation is anticipated, signaling a critical need for proactive measures to address the impending challenges posed by climate change in Iraq.

Climate Change Impacts in Iraq

Desertification

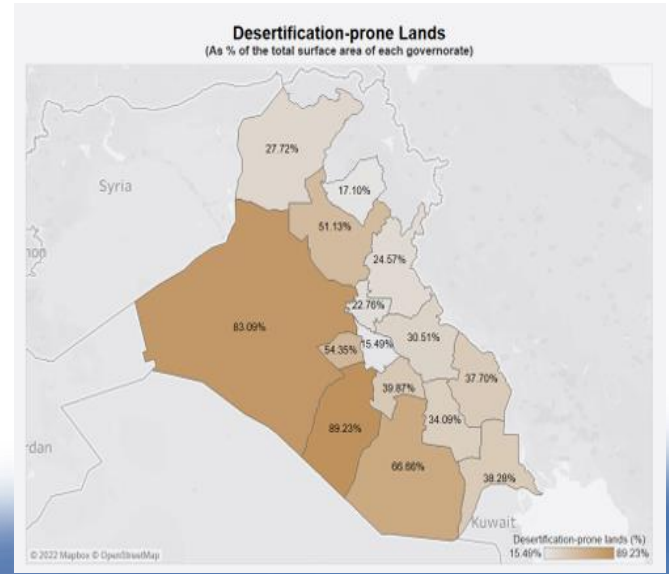
The United Nations Convention to Combat Desertification, held in 1994, defines desertification as "land degradation in arid, semi-arid, and dry sub-humid areas resulting from various factors, including climatic variations and human activities."

cultivated lands decreased from 12.2% to 8.3% of the total area. The rapid growth in population, from 7 million in 1960 to 40 million in 2020, has intensified the pressure on agricultural lands, leading to increased demand for crops and food that the struggling agricultural sector finds challenging to meet.



The economic repercussions of desertification are substantial. A decline in agricultural output forces small-scale farmers to migrate from dried-up farms to urban centers, triggering competition for limited resources and employment opportunities. Moreover, desertification negatively impacts irrigation, biodiversity, natural ecosystems, and livestock populations. Between 1990 and 2010, an estimated 6,000 plant species were lost due to desertification. Addressing the challenges posed by desertification in Iraq requires a comprehensive and sustainable approach that considers both climatic and human-induced factors.

In Iraq, desertification is a complex issue driven by a combination of climate-related factors and human-induced actions. Climate elements such as high temperatures, water scarcity, and soil erosion contribute significantly to the problem. However, human activities, including population growth, unregulated tree felling leading to deforestation, poor water management, and inefficient farming practices, exacerbate the issue.



This confluence of factors has pushed Iraq to the brink of agricultural collapse, with an annual loss of 100 square kilometers of arable land due to desertification. Over 40% of the country is already classified as a desert, and the agricultural sector continues to decline. Between 1970 and 2010,



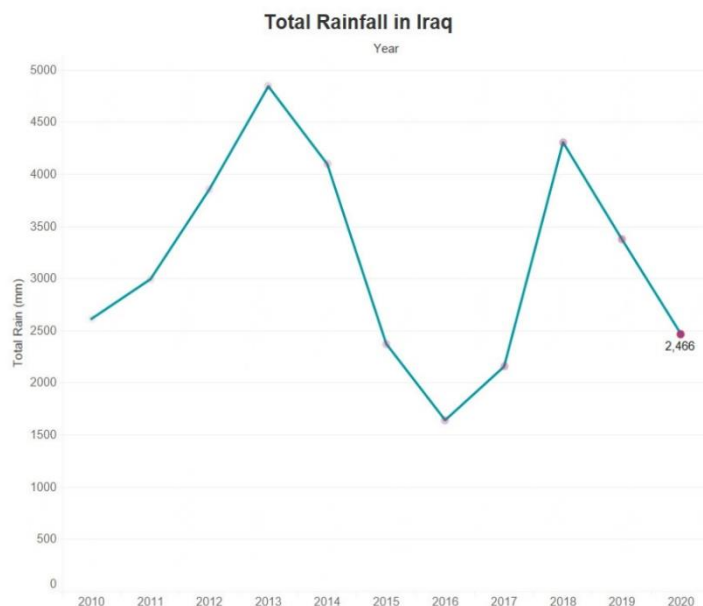
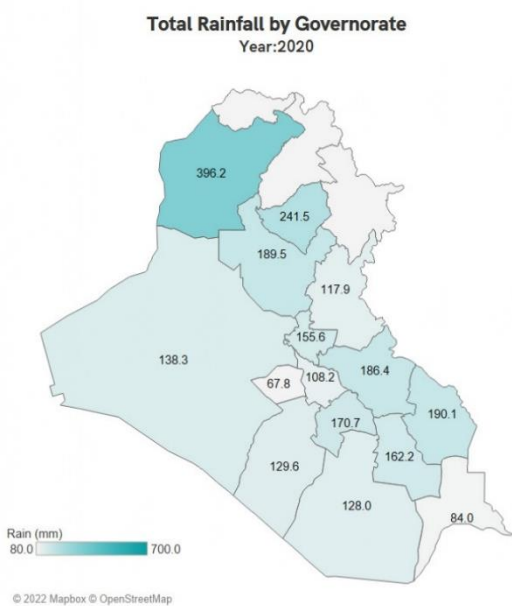
Declining Precipitation

Rainfall plays a pivotal role in shaping the Earth's biosphere, and fluctuations in precipitation levels can have profound effects on ecosystems and various aspects of life. In Iraq, a country highly vulnerable to climate impacts, a looming calamity is evident due to a significant decrease in precipitation and its detrimental consequences on the ecosystem.

Iraq experiences notable variability in precipitation both seasonally and regionally. The northern and north-eastern regions receive the highest rainfall, ranging from 400 to 1,000 millimeters per year, predominantly occurring between November and March. The steppe, with an annual average of 200 to 400 millimeters, and the southern part of the country, receiving only 40 to 60 millimeters, witness precipitation primarily from October

The winter season of 2020–2021 marked the second-lowest record in four decades, characterized by below-average rainfall, especially in Iraq's northern governorates. This weather pattern persisted from November 2020 to January 2021. However, between February and April 2021, precipitation levels were above average in the central regions, particularly the Diyala and Wasit governorates.

Conversely, the northern regions, including Nineveh, Duhok, and Erbil, experienced below-normal precipitation during this period. This had severe consequences for communities relying heavily on rainwater for agriculture. The seasonal overview from November 2020 to April 2021 highlighted rainfall below normal in several northern regions, with precipitation up to 40% below average. This likely led to reduced planted areas, crop failures, and a significant impact on the production of wheat and barley, the major rainfed winter crops. These trends underscore the immediate and tangible consequences of changing precipitation patterns on Iraq's agricultural sector and food security.



Soil Erosion and Salinization

Land degradation in Iraq is exacerbated by a range of challenges, with increasing soil salinity emerging as a particularly threatening issue that contributes significantly to land degradation and soil erosion. Over the past decades, this problem has escalated, posing serious concerns for the already beleaguered agriculture sector, and there are anticipations of further growth in the future. The compounding impacts of climate change, coupled with inefficient agricultural and water practices, reduced precipitation, high evaporation rates, drought, and desertification, collectively contribute to the deterioration of natural plant cover, soil quality, and crop production.

A map illustrates that the saline content rises within irrigated areas downstream through central and southern provinces, where the salinization process becomes a major impediment to crop production and farming development. The inefficient use of diminishing irrigation water and the damage caused to irrigation and drainage infrastructure by conflicts have resulted in rising groundwater tables and induced "soil salinity-induced land degradation."

Salinization has impacted 70% of Iraq's total irrigated area, with up to 30% converted into wastelands. Severe salinity (>16 dS/m) affects 4% of irrigation-fed regions, while 50% experience moderate salt content (>4 dS/m), and 20% are slightly saline (>2 dS/m). Salinity also affects the Tigris and Euphrates rivers as they flow downstream in Iraq, where entering waters' saline levels have been stable since the 1980s, primarily resulting from irrigation drainage and salted groundwater.

Over the last two decades, soil degradation and salinization have inflicted substantial damage on agriculture, causing the annual loss of 5% of used areas to salinization and waterlogging. The situation underscores the urgent need for comprehensive measures to address soil salinity and its detrimental effects on Iraq's agricultural landscape.

Affected Soil by Salinity

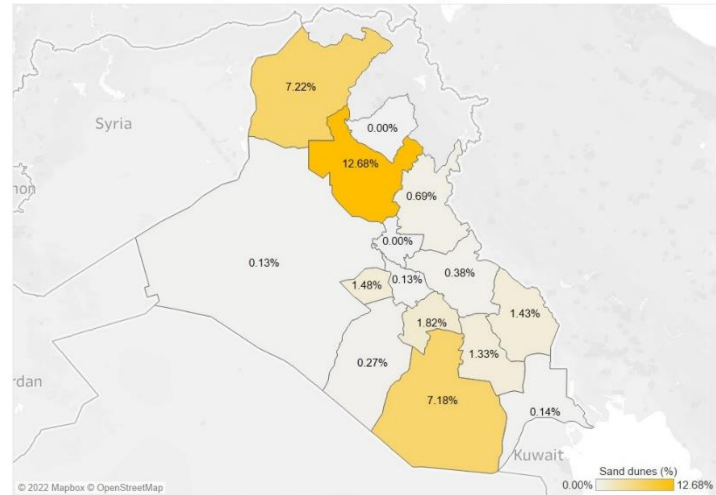


Dust and Sand Storms

The formation of dust storms occurs when strong winds blow over soils that are loose and bare, lifting substantial amounts of sand and dust into the air. For the people of Iraq, sandstorms are a regular phenomenon, particularly prevalent in the summer and spring seasons due to the country's desert environment. These storms are generated by the "Shimali," a northwest wind capable of sweeping through the sand dunes at any time, persisting for multiple consecutive days and intensifying during the day while diminishing at night, leading to destructive dust storms.

In recent times, Iraq has witnessed a concerning rise in the frequency of sandstorms, attributed to drastic fluctuations in annual rainfall, escalating temperatures, inadequate water management, and the abandonment of agricultural fields. These dust storms pose various threats to human health, transportation, agriculture, and the national economy. The surge in prolonged dust storms in 2022 in Iraq resulted in numerous cases of hospitalization due to respiratory illnesses induced by dust.

Sand Dunes
(As % of the total surface area of each governorate)



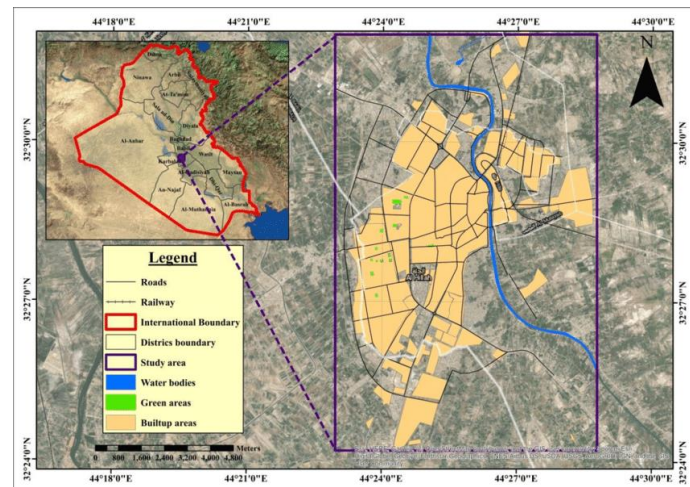
Crime and Climate

The shift in criminology research towards understanding the influence of climate on criminal behavior, specifically temperature, is evident. Studies in Germany, Italy, and France have highlighted variations in crime phenomena based on climate, prompting a closer examination of the relationship between temperature and criminal activity. Notably, there is a research gap in understanding the impact of climate on crime in regions with unique climatic conditions, such as Babylon, Iraq, known for its hot summers and mild winters.

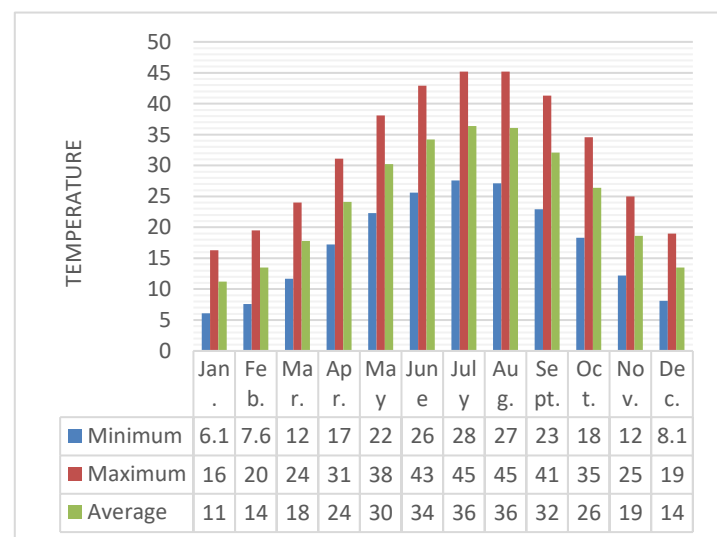
Motivations for this study are diverse, with a primary focus on unraveling the interplay between temperature characteristics and criminal activities in Babylon. The objectives include observing the relationship between temperature and specific crimes, identifying seasonal variations, and comprehending the overall impact of climate on crime in the study area.

The methodology involves collecting monthly temperature data and crime statistics for Babylon, Iraq. Quantitative methods, descriptive statistics, and Geographic Information Systems (GIS) are employed for data analysis. Additionally, statistical techniques, including correlation and regression analyses, are applied to assess the relationships between temperature variables and crime rates.

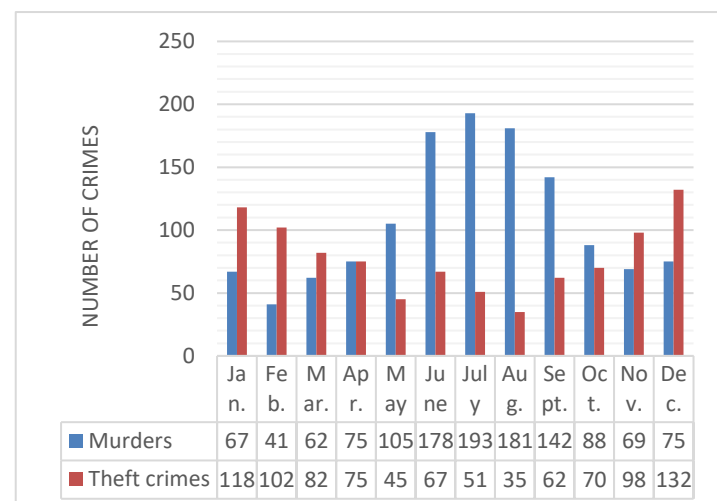
Results and discussions reveal monthly and seasonal variations in temperature, influencing climatic patterns. Murder crimes peak in summer, while theft crimes show a higher prevalence in winter due to extended darkness and increased needs. Statistical analyses confirm a strong direct correlation between temperature and murder rates, and a strong inverse correlation with theft crimes. Further exploration of the correlation between temperature and homicide crimes reveals higher rates during summer months.



The study area in the city of Al-Hillah, Babylon governorate



Monthly and annual averages of the maximum and minimum temperatures for the study stations



The numerical distribution of crimes by months of the year in the study area

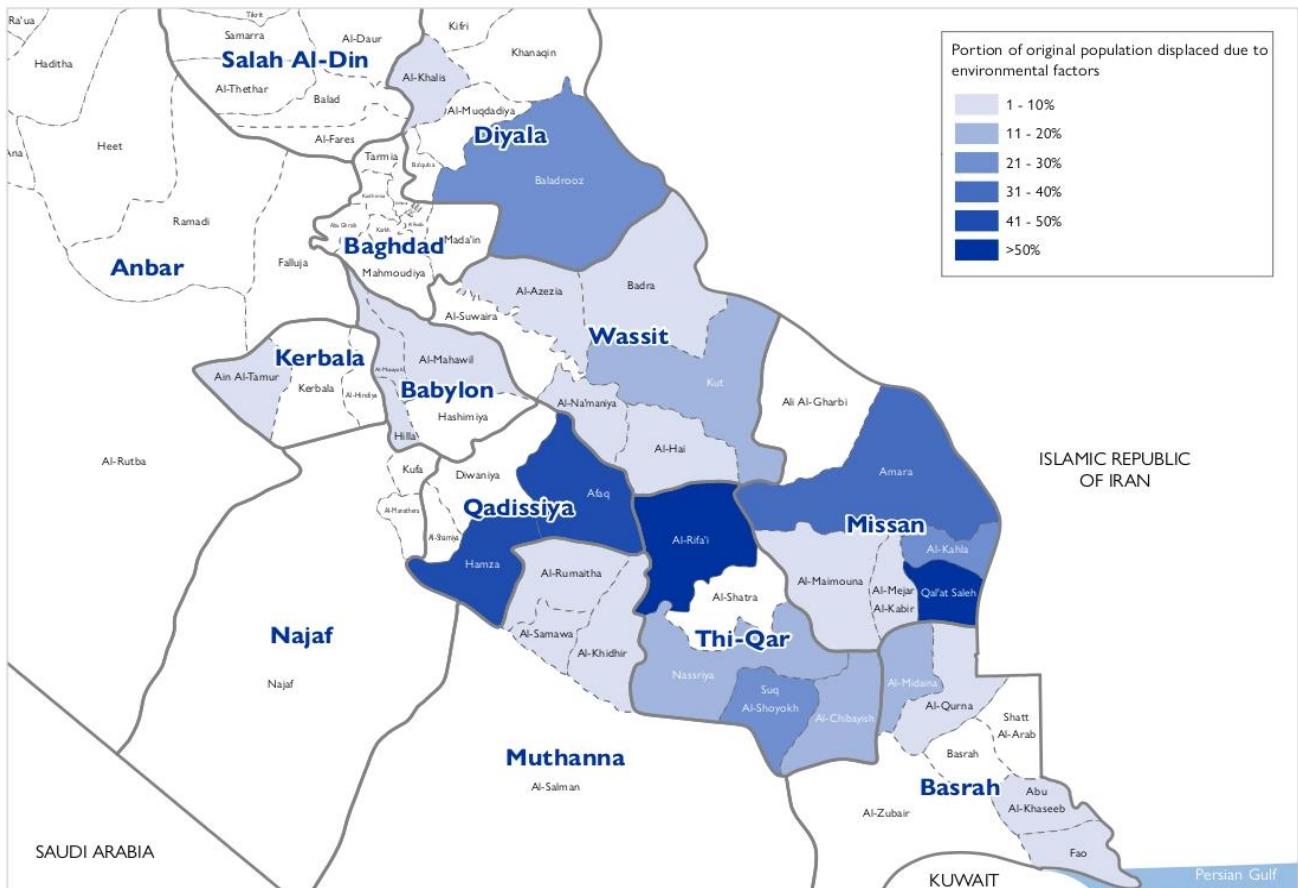
Migration and Displacement

The trend of migration in response to environmental degradation and natural hazards is on the rise. Climate change is amplifying the intensity and frequency of environmental hazards such as droughts, floods, and storms, prompting an increasing number of people to abandon their homes. Unpredictable temperature and rainfall patterns particularly affect those engaged in land- and water-based livelihoods, leading to significant consequences for both food security and living conditions.

Iraq is already experiencing the consequences of climate change and environmental degradation. Rising temperatures, decreasing rainfall, intensified droughts, growing water scarcity, and more frequent sand and dust storms and flooding are evident. Notably, temperatures in Iraq are increasing up to seven times faster than the global average, and annual rainfall is projected to decrease by 9 percent by 2050. Compounding these challenges, water supply to Iraq has been reduced due to damming and other water management policies in neighboring countries.

Simultaneously, Iraq's demand for water is rising due to population growth, urban expansion, and inefficient agricultural and industrial practices. As the impacts of climate change and environmental degradation escalate, the number of environmental migrants is expected to significantly increase. Understanding the drivers of environmental migration and their effects on vulnerable communities is a crucial area of research, essential for informing targeted programming and advocacy efforts.

In 2022, the rate of migration was notably elevated in Babylon governorate, reaching 84%. The primary factors influencing movement in these areas over the past year include diminished rainfall and low water levels in rivers and tributaries. Compounding these challenges are low levels of groundwater, water salinization, conflicts over water allocation, and governmental restrictions on water usage.



Climate Change and Human Health

The existing food insecurity challenge in Iraq is worsened by the adverse effects of climate change on agricultural productivity and water availability. Approximately 1.9 million Iraqis (5.2% of the population) face food deprivation, while 4 million (11% of the population) are susceptible to food insecurity. Depletion of water sources and increased water pollution can heighten the risk of epidemics, particularly cholera. Cholera outbreaks may be linked to rising temperatures and extreme weather events, both of which are expected to become more frequent in Iraq. A cholera outbreak in late 2015 resulted in 2 deaths and nearly 3,000 cases across 17 governorates.

Moreover, the escalation of floods poses threats such as displacement, injuries, and loss of life. In 2006, flooding impacted over 60,000 people and claimed 20 lives. The health consequences of sand and dust storms, known for causing severe respiratory infections, are also a significant concern. The already strained healthcare facilities in Iraq struggle to cope with the surge in cases resulting from these storms. The projected increase in the frequency of these storms raises concerns about the potential overwhelming of healthcare facilities in the future.

Climate Stressors and Climate Risks HUMAN HEALTH	
Stressors	Risks
Increased temperatures	Reduced quality and quantity of drinking water, leading to increased risk of waterborne illnesses (e.g., cholera)
Decreased average rainfall	Heightened food insecurity leading to increased and severe malnutrition (particularly in children)
Increased drought	Respiratory infections from sand and dust storms
Increased intensity of rainfall events	Displacement, injuries, and death from floods and storms



Climate Change and Ancient Monuments

Iraq's ancient monuments face erosion due to climate change, with rising salt levels around ancient Babylon causing the corrosion of humanity's oldest monuments. Issues such as salt intrusion, extreme temperatures, flooding, and soil erosion, partially attributed to climate change, pose threats to heritage sites in Iraq and globally. The destructive impact of climate change is evident as some of the world's oldest buildings crumble under the influence of rising salt concentrations in Iraq, leading to the degradation of mud brick structures, exacerbated by more frequent sandstorms that erode ancient wonders.



Part 2: A funded Project:

The impacts of Climate Changes
in The Region Surrounding Al-
Mustaqbal University





13 CLIMATE ACTION

Take urgent action
to combat
climate change
and its impacts





Project Overview

Al-Mustaqbal University is a pioneer among Iraqi universities, committed to achieving excellence in the fields of education and scientific research. Its efforts are based on a deep-seated belief in the role of universities in addressing the issue of climate change and its clear impact on the environment and society. Building on the significant attention Al-Mustaqbal University devotes to supporting researchers and endorsing high-quality research projects that serve sustainable development in all its seventeen goals, and with a strong belief in the positive role that universities can play in addressing the issue of climate change and its impact on the environment and society, the university supports the research project titled:

"The Role of Universities in Confronting the Challenges of Climate Change"

The project aims to achieve distinguished research successes and publish collaborative research between Al-Mustaqbal University and prestigious international universities in high-level journals. Additionally, it involves participating in international conferences on climate change, adhering to the specifications mentioned in the tables below.

Through this research project, Al-Mustaqbal University enhances international collaboration by engaging in joint research with reputable global universities. The university seeks to contribute to the development of sustainable and effective solutions to confront the challenges related to climate change and encourages scientific dialogue on the international stage.

Project Objective

The research project aims to explore and analyze the vital role that universities play in addressing the increasing challenges associated with climate change. Through the project, a number of specialized activities will be undertaken to find solutions to climate change issues, such as energy and water pollution, carbon issues, and the role of governments in this field. Research related to these problems and modern measures will also be disseminated, highlighting the role of universities in mitigating the impacts of climate change through workshops, seminars, and conferences in collaboration with environmental, energy, and other related authorities.

The project will also include visits to foreign universities to stay informed about the latest technologies adopted in this field, enhancing cultural exchange and international cooperation. It is expected that this project will contribute to raising awareness of the importance of measures taken by universities in the field of climate change and promoting joint efforts to address these global challenges.

In addition, the results of the research project are planned to be presented at events and activities organized in collaboration with the Ministry of Higher Education. Informative presentations and lectures will be given on key discoveries and solutions developed to confront the challenges of climate change. This approach allows participants in these events to gain a deep understanding of the role of universities and innovative technologies adopted. Interactive dialogue sessions will also be organized with the audience, allowing participants to ask questions and exchange ideas about the applications of research in the context of higher education. It is expected that these activities will direct attention to the importance of integrating university efforts in the field of climate change and encourage collaboration among stakeholders to achieve better and more effective results.

Details of Project

Duration of the project	8 months (from 1/1/2024 to 8/31/2024)
Project field	Multidisciplinary engineering
Linkage with sustainable development goals	SDG13, SDG6, SDG7, SDG17

Project Objectives

No.	The main objectives of the project
1	Developing Partnerships with Foreign Universities: Activating or establishing effective and strategic collaboration with multiple foreign universities to enhance scientific and research exchange in the field of climate change.
2	Participation in an International Conference: The aim is to represent the university and take part in an international conference on climate change, energy, or water in Abu Dhabi. This participation is intended to exchange knowledge and experiences with global researchers and experts.
3	Research Publication: The expected objective of the project is to publish 8 research papers in peer-reviewed scientific journals, contributing to scientific knowledge and enhancing the university's standing in the field of sustainable development research. The research will be conducted in collaboration with researchers from various disciplines and will align with the objectives of sustainable development.
4	Organizing Workshops and Seminars on Campus: The aim is to facilitate the exchange of expertise, knowledge transfer, and raise awareness among university staff about climate change issues. Collaboration with the university's Continuing Education Center will be established to achieve this objective. Additionally, collaborative seminars will be conducted in partnership with government entities.
5	Creating Posters and Awareness Campaigns: Designing professional posters and installing them within the university campus, as well as organizing awareness campaigns in collaboration with students to spread awareness about climate change issues. This will be done in cooperation with the engineering departments.
6	International Reputation: Participation in one of the conferences organized by TIMES or QS and the creation of presentations or brochures introducing the university for the purpose of introducing more about the achievements achieved by the university.

Achieving these objectives requires integrated efforts and effective collaboration with the faculties, as well as the universities that have established partnerships. This is what we aim for through this project. The accomplishment of the aforementioned objectives holds great significance in realizing the desired positive impact in the field of climate change in Iraq.



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