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Article

The Extent to Which the Available Water Resources in Upper Egypt Can Be Affected by Climate Change

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Abstract: Over the past two decades, rapid climate change has severely impacted people's lives globally, affecting their safety and sustainability. Water, a vital human resource, has been severely affected, with drought and high temperatures leading to desertification, the drying up of rivers and lakes, spontaneous fires in forests, and massive floods and torrents due to melting ice and rising sea and ocean surface water levels. The expected impacts of climate change on the Nile, Egypt's primary water source, are significant. These impacts can vary across regions, depending on factors like local climate, socio-economic dynamics, topography, and environmental nature. Upper Egypt, characterized by arid and semi-arid regions, faces water scarcity and socio-economic development challenges. Climate change exacerbates these issues, posing significant threats to the region's ecological sustainability and socio-economic development. Therefore, it is crucial to address these impacts to ensure the Nile's continued vitality and sustainability. The study aims to analyze the climate change data over the past few decades, analyze its characteristics, and model its effects on Upper Egypt's water sources. The study expected a big decrease in the water resources of the Nile. While what is currently occurring in terms of fluctuating rainfall rates between scarcity and severity contradicts the results of those studies, that is the best evidence of the need for further research and studies to obtain more reliable and consistent results with the reality that it may help decision-makers to develop scenarios to manage climate change effectively, preventing or reducing negative effects, and finding suitable alternatives. Studies predict a 10% decrease in Nile revenue at Aswan High Dam Lake by 2095, with some predicting a 30% increase. This lack of credibility underscores the need for more comprehensive studies.

Keywords: climate change; upper Egypt; water resources; river Nile

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1. Introduction

The Upper Egypt region, as shown in Figure 1, is located in the southern part of Egypt and encompasses five governorates: Assiut, Sohag, Qena, Luxor, and Aswan. The Nile serves as the vital water source for Egypt, and any fluctuations in its water availability can significantly impact the water resources in the Upper Egypt region. It is expected that climatic changes will affect rainfall patterns, temperatures, and hydrological cycles, consequently influencing the availability of water resources in the study region. The anticipated effects of climate change on rainfall patterns, temperatures, and hydrological cycles are likely to impact the availability of water resources in this region.

One of the key concerns regarding climate change in Upper Egypt is the potential change in precipitation patterns. Climate models suggest that the region may experience shifts in the distribution of rainfall, including changes in the timing, intensity, and duration of precipitation events. These changes can have consequences for the recharge of groundwater aquifers and the availability of surface water resources. Additionally, rising temperatures associated with climate change can exacerbate water scarcity issues in Upper Egypt. High temperatures can increase evaporation rates, leading to greater water loss from surface water bodies and increased irrigation requirements for agricultural activities.

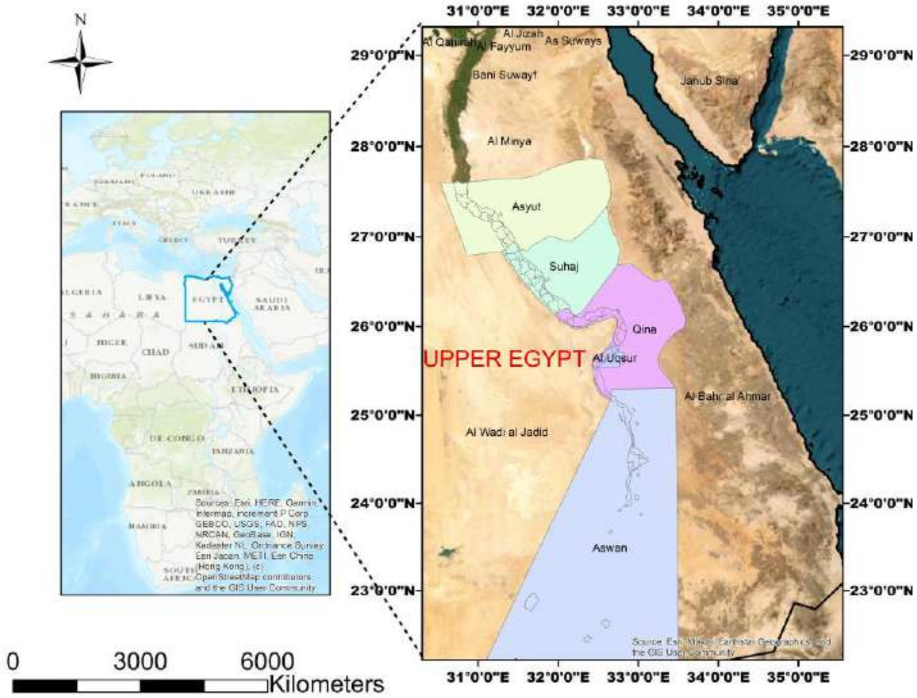
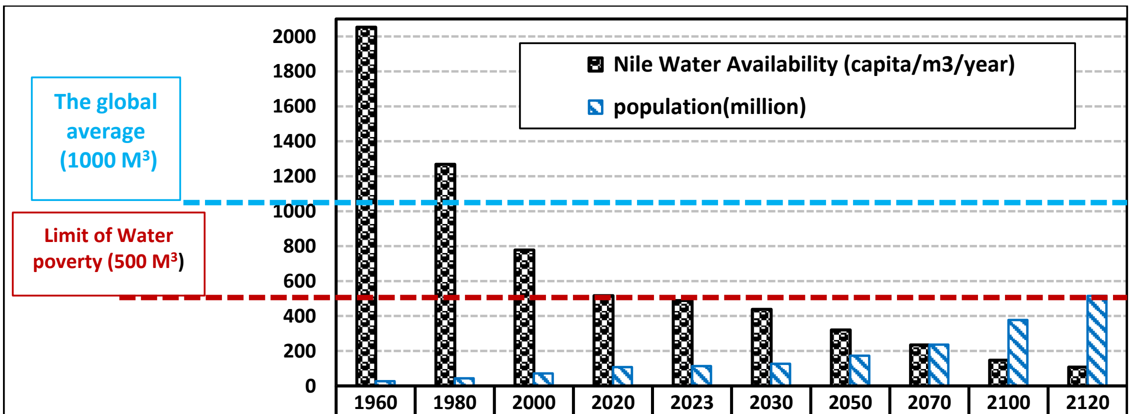


Figure 1. Map of Upper Egypt.

To address the potential impacts of climate change on water resources in Upper Egypt, it is essential to implement effective water management strategies. Currently, Egypt already faces water scarcity in meeting the demands for agriculture, industry, domestic use, and other purposes. Furthermore, there are threats to Egypt's allocation of Nile water due to development and improvement plans in upstream Nile Basin countries. Based on information from [1], the annual per capita availability of freshwater (Nile River) in Egypt is expected to decrease from about 2053 m^3/capita in 1960 to 108 m^3/capita in 2120. These values are below the global average of 1000 m^3/capita and also fall below the threshold for water poverty (500 m^3/capita), as shown in Figure 2.



	1960	1980	2000	2020	2023	2030	2050	2070	2100	2120
Nile Water Availability (capita/m3/year)	2053	1269	778	516	488	438	321	235	147	108
population(million)	27	44	71	107	114	127	173	236	377	515

Figure 2. Dynamics of fresh water (Nile River) per capita in Egypt [1].

The impacts of climatic changes are uncertain, particularly regarding the discharge of the River Nile. Some studies suggest that evaporation could increase, resulting in a potential 70% reduction in water availability. However, other studies predict that precipitation in Ethiopia's plateau could increase by 15–25% [2]. According to USAID [2], there are multiple stressors that contribute to climate change risks, including rising temperatures, changes in precipitation patterns, and increased drought, as summarized in Table 1. All of these risks will directly impact Egypt's share of water.

Table 1. Climate stressors and climate risks for water resources [2].

Stressors	Risks
Increased temperature	Increased variability in Nile River flow
	Increased water demand
Changes in precipitation	Decreased water availability for irrigation, drinking and energy generation
Increased drought	Decreased hydropower supply
	Increased domestic and transboundary water conflict

It is important to note that the extent to which available water resources in Upper Egypt will be affected by climate change can vary depending on specific scenarios, local conditions, and implemented adaptation measures. However, considering the significant reliance of the region on the Nile River and its vulnerability to water scarcity, proactive measures to address the potential impacts of climate change on water resources are crucial for the sustainable development of Upper Egypt.

In general, Africa has been classified as one of the most vulnerable regions to climate change by the Intergovernmental Panel on Climate Change (IPCC) in its Fourth and Sixth Assessment Reports, published in 2007 and 2023, respectively [3,4]. Despite the existence of popular studies on the topic in the literature, there is still a great need for further research, monitoring, and evaluation to explore the extent and impacts of the severe and rapid climate changes that the world is experiencing today. Consequently, there is a need for more investigations and studies in Upper Egypt to monitor the region's reality, environmental nature, climatic data, and domestic and drinking water requirements.

The region under study covers an area of approximately 112.5 km^2, representing 11.2% of Egypt's total area, and is inhabited by approximately 17.8 million citizens, accounting for about 15.5% of the total population, which is 115 million [5,6].

The current study provides a comprehensive analysis of observed data from previous studies and anticipated scenarios regarding the extent of expected climate changes and the appropriate strategies for addressing them. The study aims to analyze climate change data from the past few decades, examine its characteristics, and model its effects on water sources in Upper Egypt. The results of this analysis can assist decision-makers in developing effective scenarios for managing climate change, thereby preventing or reducing negative effects and identifying suitable alternatives.

2. Objective of the Study

Upper Egypt holds great significance at both local and international levels in terms of culture, heritage, history, and tourism. It is home to nearly a third of the ancient pharaonic antiquities, resembling an open museum that allows the world to explore the wonders of this miraculous pharaonic civilization and ancient Egyptian culture. Due to these reasons and its unique nature, this part of Egypt has gained special importance, becoming a top priority for Egyptians. In the past two decades, the severe climate changes observed worldwide have had devastating and unprecedented effects on various human activities. Therefore, it has become crucial to pay more attention and study the possibility of these well-known negative effects being reflected in Egypt as a whole, and particularly in Upper

Egypt. Given the region's local and international significance, as mentioned earlier, it is essential to develop various scenarios to effectively address climate change in a manner that aligns with the region's specific characteristics, geographical nature, and climatic conditions, as this `narrative` study will explain.

3. Materials and Methods

Climate change (CC) is a global phenomenon characterized by changes in the Earth's typical climate, including temperature, precipitation, and wind patterns, which are influenced by human activities [7]. Figure 3 shows the global temperature variations in 2023, with NASA announcing that it was the hottest year on record. This conclusion is based on an analysis of annual global average temperatures, comparing how much temperatures have changed compared to the baseline period of 1951–1980.

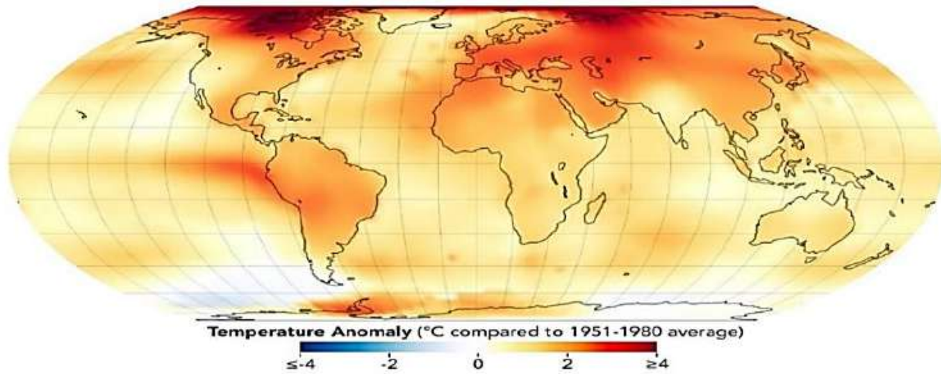


Figure 3. Global temperature anomalies in 2023 [7].

3.1. Climate Data Profile of Egypt

The World Bank's Climate Change Knowledge Portal provides access to historical data from 1901 to 2020, which reveals that Egypt had a mean annual temperature of 22.5 °C. Monthly temperatures range from 36 °C to 7 °C, and the city of Alexandria receives a maximum of 1.82 mm of precipitation, with an average annual rainfall of around 200 mm [2].

Figure 4 was constructed to illustrate the spatial variation in precipitation and temperature across Egypt from 1901 to 2020 [8].

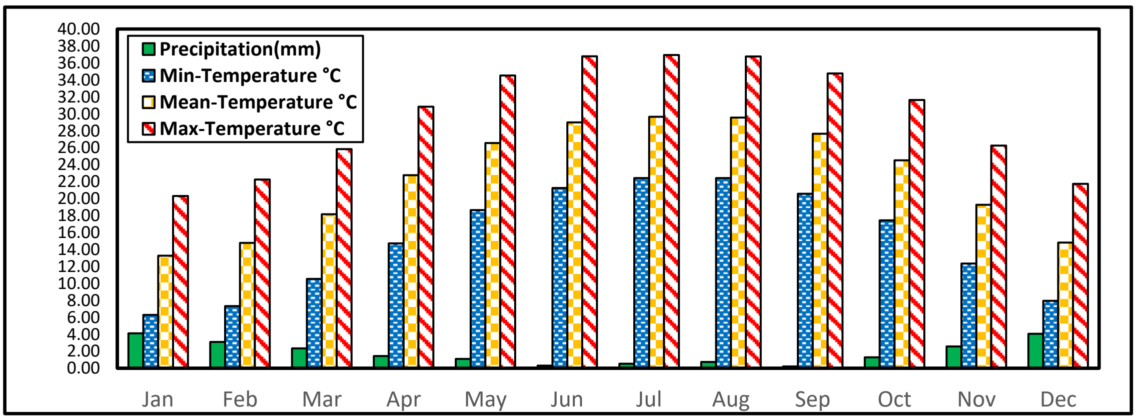


Figure 4. Historical monthly precipitation and temperature in Egypt for 1901–2020 [8].

3.2. Historical Climate Data of Upper Egypt

The study area experiences a dry climate, with no rainfall during the summer and rare to mild precipitation in winter, resulting in an annual average rainfall rate of approximately 0.5 mm/year. According to climate data for Upper Egypt from 1991 to 2022 (Figure 5), the annual average temperature is recorded as 24.14 °C. These data were collected for each governorate from the World Bank in 2024 [9].

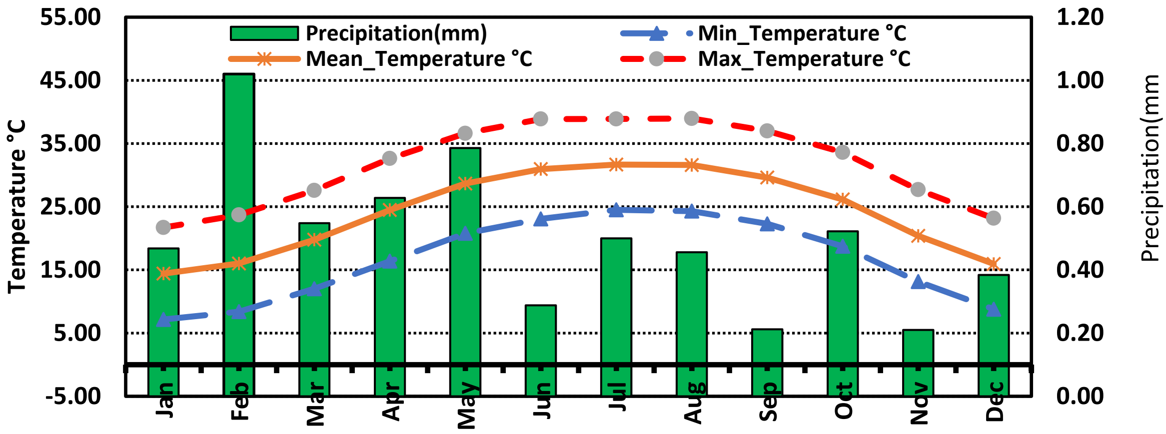


Figure 5. Historical climate change data in Upper Egypt for 1991–2022 [9].

Figures 6–9 depict the observed annual average mean air temperature, annual average minimum air temperature, annual average maximum air temperature, and annual precipitation in Upper Egypt for the period of 1991–2022. The observed historical data used in these figures were produced by the Climatic Research Unit (CRU) of the University of East Anglia.

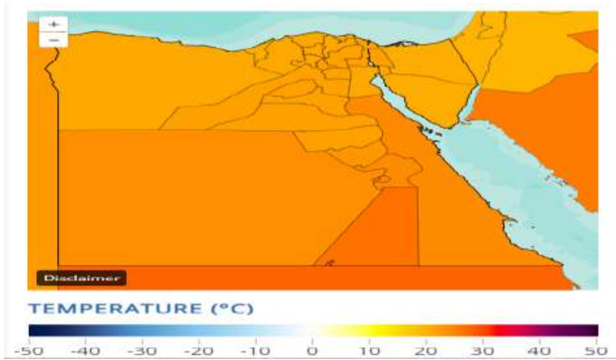


Figure 6. Observed annual average mean air temperature in upper Egypt in 1991–2022 [9].

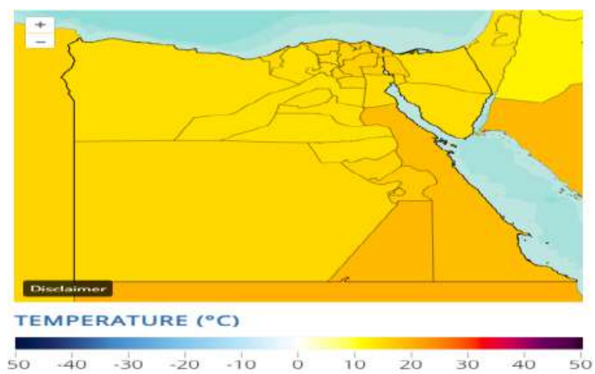


Figure 7. Observed annual average min air temperature in upper Egypt for 1991–2022 [9].

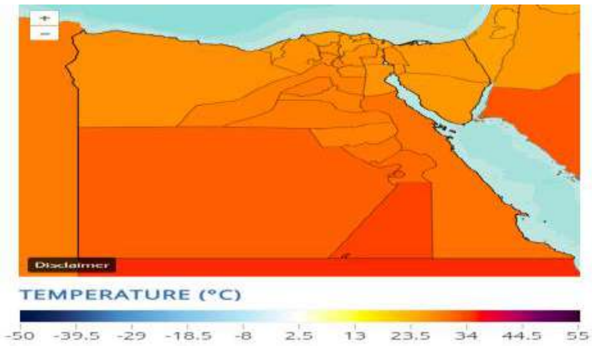


Figure 8. Observed annual average max air temperature in upper Egypt in 1991–2022 [9].

Figure 9. Observed annual precipitation in upper Egypt for 1991–2022 [9].

3.3. Water Resources in Egypt

Egypt's water resources are limited, comprising both conventional and non-conventional sources. Conventional water resources include the inflow of the Nile River, groundwater, and sporadic rainfall. Renewable water resources are also limited, with the main reliance being on the Nile River, which is allocated to Egypt based on the Nile Water Agreement of 1959. Approximately 10 billion cubic meters (BCM) per year is lost through evaporation from the Aswan High Dam reservoir [10,11]. The remaining value (about 3%) represents the limited amount of rainfall, shallow and renewable groundwater reservoirs in the Nile Valley, the Nile Delta, and the coastal strip, as well as deep groundwater in the eastern desert, western desert, and Sinai (see Figure 10).

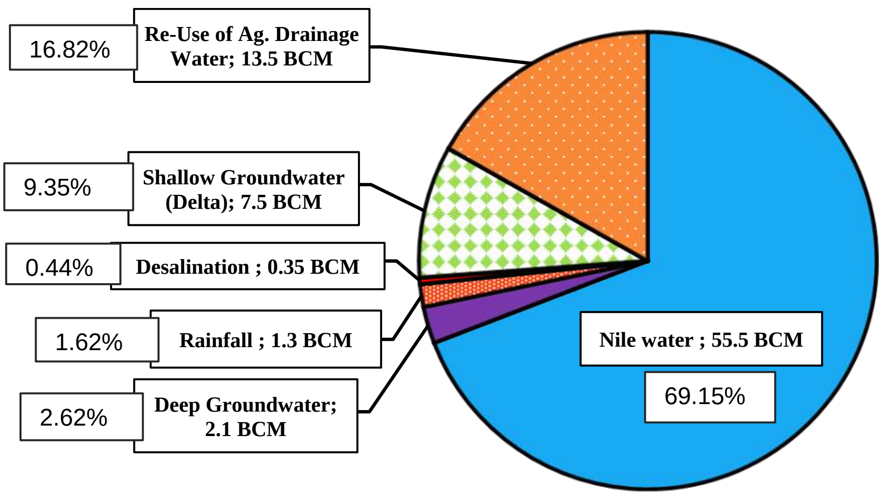


Figure 10. Egypt's water resources in billions of m^3 [10].

Non-traditional water resources encompass the reuse of agricultural drainage water and treated wastewater, along with the desalination of seawater and brackish groundwater resources. Egypt's total yearly water consumption is approximately 80 billion m^3 [12,13] with a difference of around 20 billion m^3 between the water budget and the annual consumption amounts.

3.4. Water Supplies and Allocation in Upper Egypt

The surface water in the study area mainly includes the Nile River, Asfoun Canal, Kelabia Canal, East Naga Hamadi Canal, West Naga Hamadi Canal, and Ibrahimia Canal. Groundwater in the study area is considered the second source of fresh water in the governorate and is utilized for various purposes, including domestic, agricultural, and industrial use [14].

4. Results

4.1. The Relation between Climate Change and Water Resources in Egypt

Numerous studies have explored the relationship between climate change and water resources, particularly rivers. The study of Strzepek et al. [15] developed nine scenarios for Nile flows and studied precipitation, temperature, and streamflow. Among these scenarios, one predicts an increase in the future, while the other eight scenarios project a long-term reduction ranging from 10% to 90% by 2095. Additionally, all nine scenarios indicate a short-term loss of 5% to 50% by 2020, as depicted in Figure 11.

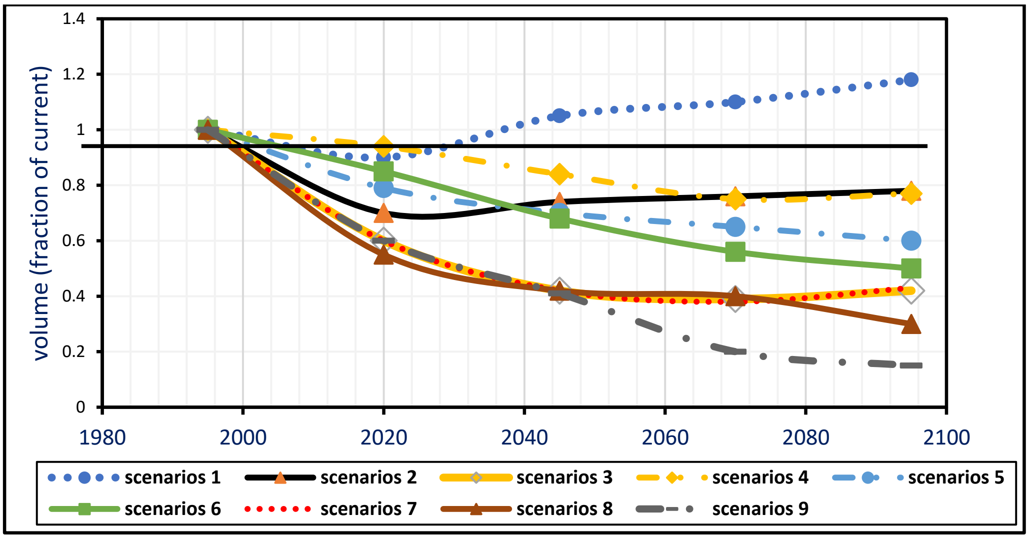


Figure 11. Nine scenarios for Nile flow [15].

According to Elshamy et al. [16], a 10% decrease in rainfall results in a 25% reduction in the expected flow increase to the River Nile basin at Dongola, while a 10% increase leads to a 30% increase. Additionally Agrawala et al. [17] combined 11 SCENGEN models for Egypt's study, examining scenarios with temperature changes of 0 °C, +2 °C, +4 °C, and rainfall changes of 10% and 20%. Beyene et al. [18] predicts near-term benefits of climate change, particularly increased precipitation. However, by the midcentury, managing Nile water resources will become more complex and challenging. Furthermore, IPCC [3] forecasts a 20% reduction in Nile water over the next 50 years due to rising temperatures and evaporation in natural ecosystems. In a study by Elshamy et al. [19], 17 GCMs were analyzed, revealing widespread precipitation projections for 2081–2098. While some models predict significant reductions, others indicate increases. Notably, more models predict reductions in the Blue Nile's flow than increases.

Beyene et al. [18] utilized a macroscale hydrology model to assess the impact of climate change on the Nile River basin. Their findings indicate that stream flow initially increased during the early study period (2010–2029) due to higher precipitation. However, stream flow would decline during the mid-2040s–1969s and late 2070s–1999s due to a decrease in precipitation and increased evaporative demand. Hammond [20] emphasized the intricate management of water resources in the Nile Basin, which is influenced by climate and socioeconomic changes.

Water scarcity is a global issue affecting 1.5 to 2.5 billion people living in exposed areas. Projections indicate a continuous increase, with the number expected to reach up to 3 billion at 2 °C and 4 billion at 4 °C by 2050 [3]. Socioeconomic factors, including population growth and food consumption patterns, also contribute to water scarcity. Climate change plays a significant role in exacerbating water scarcity through its impact on seasonal extremes, drier conditions, and consequently, water availability and soil moisture. Drier conditions can lead to increased contamination, runoff, and floods. Moreover, the variability of rainfall over space and time resulting from climate change increases the likelihood of such impacts. Higher temperatures also contribute to deteriorating water quality by reducing oxygen levels.

The impact of climate change on river flow characteristics and management alternatives has been the focus of numerous studies. Ahmed et al. [21] predicted a decrease in the Aswan High Dam (AHD) release to Egypt of 93.2 km^3 in 2050 would result in an 84.7% decrease in water balances. This decrease would exacerbate the water shortage in Upper Egypt (Qena) from 0.014 to 0.55 billion cubic meters (BCM), leading to a deterioration of water quality. The WB Model suggests adaptation measures such as implementing modern irrigation techniques, land leveling, controlling rice and sugarcane cultivation areas, and lining sensitive irrigation canals. These measures reduced the water shortage by 84.7%, bringing it down from 0.55 to 0.34 BCM/year in Qena.

The Nile River, which flows through arid northern Sudan and Egypt, experiences significant water loss due to evaporation. Changes in temperature and precipitation are crucial factors affecting water supply. Climate change has also reduced groundwater availability in the Nile Valley and Delta of Egypt, impacting both surface and groundwater supplies [22]. Research in water resources, agriculture, ecology, and other related disciplines has become a focal point under climate change-related global warming conditions [23].

In a study by Ashour et al. [24], the impact of climate and water supply changes on water balance elements in the Nile Delta Region of Egypt was investigated. The researchers utilized the DiCaSM model to compute water balance components and simulate groundwater levels and recharge values. The model was also employed to simulate different climate and water supply change scenarios for the area of interest.

Driouech et al. [25] studied future temperature and precipitation changes in the Middle East and North Africa, finding projected changes of 0.2 °C/decade to 0.5 °C/decade over land. Soha et al. [26] assessed the impact of climate change on Egypt's water resources, with a focus on General Circulation Models (GCMs). They found that future climatic changes in Middle Egypt will require more irrigation water to meet crop demands. The percentage increase in winter crop irrigation water needs ranged from 6.1% to 7.3% in 2050 and from 11.7% to 13.2% in 2100. Similarly, summer crop irrigation water requirements increased from 4.9% to 5.8% in 2050 and from 9.3% to 10.9% in 2100.

El Agroudy et al. [27] predict that water storage in front of the Renaissance Dam will result in a shortage of received water to Lake Nasser, leading to the wastage of 3–5 million acres of Egypt's cultivated area. Asit et al. [28] suggests that future storage reservoirs, like Lake Nasser, will play a crucial role in mitigating the impacts of climate fluctuations and climate change. Egypt must improve its management of Lake Nasser, its primary water storage, to ensure water security. Global warming and rising temperatures contribute to high evaporation rates, resulting in reduced water availability in the lake [13].

El Sheikh et al. [29] indicated that climate change could lead to drier conditions in Lake Nasser. The average annual inflow reductions at the High Aswan Dam due to climate change are estimated to be 24%, 35%, and 36% for the near future (2011–2040), intermediate future (2041–2070), and far future (2071–2100), respectively.

4.2. Impact of Climate Change in Upper Egypt

Ghany et al. [30] estimated that in Egypt, the groundwater sector will experience a rapid decline in levels due to the decrease in water recharge in the renewable aquifers (Nile Valley and Delta aquifers). This decline is expected as a result of climate change and the construction of the GERD reservoir. Additionally, the reduction in surface water availability will further strain the renewable and non-renewable aquifers in Egypt.

Heba et al. [31] assessed three scenarios in Table 2 in their case study of Qena Governorate (Upper Egypt). The scenarios included the base case in the year 2018, a realistic future scenario in 2050, and an optimistic future scenario with adaptation measures in 2050. For both future scenarios, the impact of climate change on Nile water flows to Egypt was selected based on the worst predicted output from the study conducted by McCluskey et al. [32]. This study developed a rainfall–runoff model to represent a range of future scenarios using five different global circulation models. The study derived 20 scenarios based on two different emission scenarios, as presented in the following Table 2. The result of the CGCM2 model with the A2 scenario was selected for the year 2050, assuming 75% of the current inflows to Lake Nasser in the base case scenario. The A2 scenario describes a world with high population growth, slow economy, and slow technological change, while the B2 scenario describes a world with intermediate population growth, economic growth, local solutions to economic, social, and environmental sustainability.

Table 2. Percentage change in Nile flow [31].

Global Circulation Model		CGCM2	CSIRO2	ECHAM	HadCM3	PCM
year	Baseline	2050	2050	2050	2050	2050
% of changes in scenario A2	100	75	92	107	97	100
% of changes in scenario B2	100	81	88	111	96	114

Radwan et al. [33] studied the impact of climate change on irrigation water requirements in Upper Egypt and utilized the Representative Concentration Pathway (RCP) scenarios (RCP2.6, RCP4.5, RCP6.0, and RCP8.5) shown in Figures 12 and 13 for three-time series (2011–2040, 2041–2070, and 2071–2100). The results obtained revealed that the mean air temperatures increased under all RCP scenarios compared to the current data. Furthermore, the RCP8.5 scenario exhibited the highest mean air temperature among the other RCP scenarios.

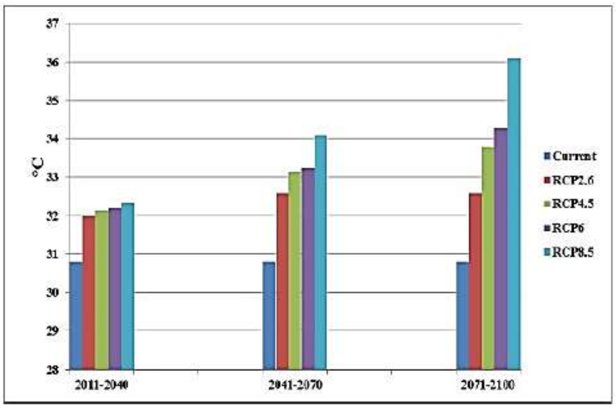


Figure 12. The average annual maximum air temperature in Upper Egypt region under current and future conditions for different RCPs scenarios [33].

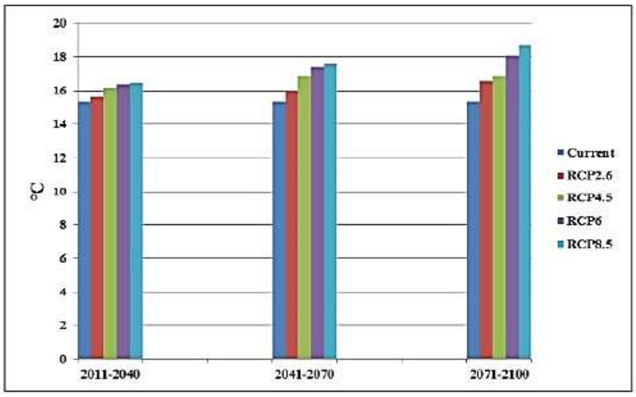


Figure 13. The average annual minimum air temperature in Upper Egypt region under current and future conditions for different RCP scenarios [33].

Global climate change poses serious impacts on water resources and agriculture in the future. Hesham et al. [34] calculated water requirements for six governorates in Egypt (Menya, Assiut, Sohag, Qena, Luxor, and Aswan) under current climate conditions and ongoing climate change scenarios up to 2100. They used the Representative Concentration Pathway (RCP) scenarios (RCP2.6, RCP4.5, RCP6.0, and RCP8.5) during three time series (2011–2040, 2041–2070, and 2071–2100). The results revealed that both maximum and minimum air temperatures increased under all RCP scenarios compared to current data. Furthermore, the RCP8.5 scenario exhibited the highest maximum and minimum air temperatures among the other RCP scenarios. The results indicated that water requirements and water budget will increase by approximately 12% to 18% compared to current water use, depending on the governorate's location.

4.3. Summary of the Most Popular Works concerning Climate Change and Water Resources

Table 3 is compiled based on an analysis of the existing literature on climate change, encompassing a wide range of research studies that focus on predicting climate change impacts on the Nile River's flow, evapotranspiration, and the Aswan High Dam (AHD).

Table 3. Summary of the previous studies about the impact of climate change on water resources.

Reference	Studied Parameters	Case Study	Impact
[35]	Flow projections.	Blue Nile for 2025.	Flow ranges between +15% and −9%.
[19]	Flow projections	Studied 17 GCMs on (Blue Nile)	Reductions by 15%. Others predict increases by 14%.
[36]	Rainfall, evaporation, tributary inflow	Change by 1% on Lake Victoria.	Flows are in the order of 7–10%
[16]	Rainfall	River Nile basin	A 10% decrease in rainfall reduces the expected flow increase in the Nile basin by 25%, while a 10% increase results in a 30% increase.
[17]	Changes in temperature duo to rainfalls.	11 best SCENGEN models For Egypt	Changes in temperature of 0 °C, +2 °C, and +4 °C and for changes in rainfall of 10% and 20%.
[16]	10% increase in rainfall	Lake Victoria basin	A 5.7% increase in Lake
	10% increase in rainfall	Upper Blue Nile and Atbara sub-basins	Increases of 34% in upper Blue Nile & 32% in Atbara.
	Reductions of 10% in rainfall	Atbara, Blue Nile, and Lake Victoria	Reductions in outflows by 24%, 24%, and 4% for the Atabra, Blue Nile, and Lake Victoria, respectively.

Table 3. *Cont.*

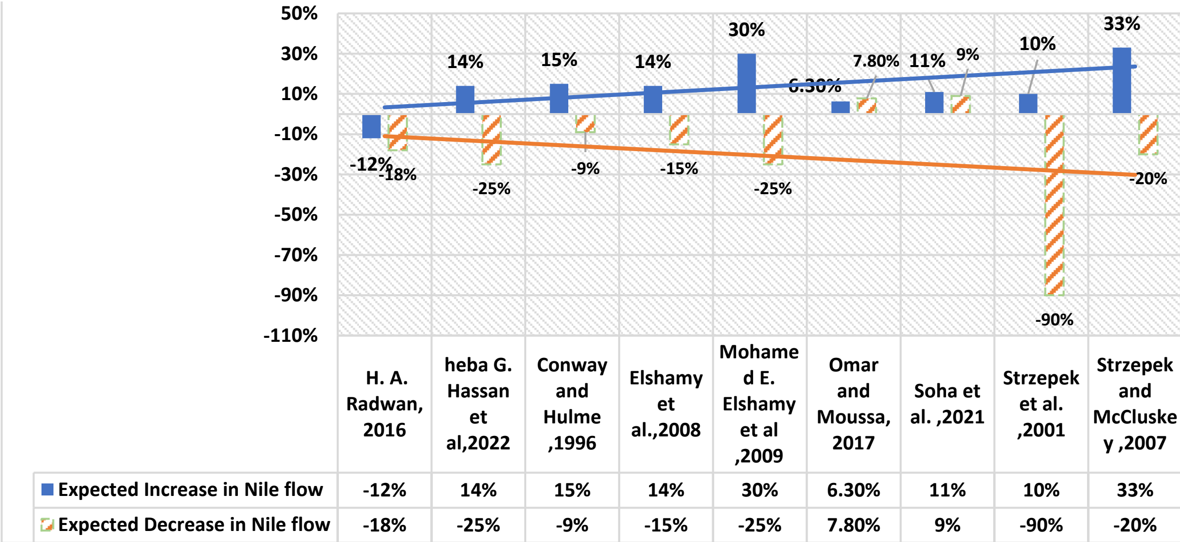
Reference	Studied Parameters	Case Study	Impact
[35]	1 °C increase in temperature in Upper Egypt	AHD reservoir	Increase losses by 0.4 km^3
[11]	climate change on AHD	using the Blue model	Flow to AHD will decrease to 93.2, or 84.7% of the current release, in 2050.
[31]	20 scenarios based on two different emission scenarios.	Lake Nasser's flow.	The worst flow in 2050, is predicted to be 75% of the current flow
[26]	GCMs, Future climatic changes in middle Egypt	Irrigation water	A rise in demands for winter crops from 6.1 to 7.3% in 2050 and 11.7 to 13.2% in 2100, while summer crops' needs increase from 4.9 to 5.8% in 2050 and 9.3 to 10.9% in 2100.
[15]	Different scenarios for Nile flows	Nile flow	Reduction by 10–90% by the year 2095
[32]	20 Nile flow variations in Lake Nasser using five GCMs and two emission scenarios.	Nile flow	Provided 12 reduced flows and 8 increased flows.
[18]	Nile River basin using macroscale hydrology model. Precipitation and evaporative.	Nile flow	Increase in stream flow early in the (2010–2039). Decline during mid-(2040–2069) and late (2070–2099) century
[32]	Runoff, actual evaporation, and hence flow	16 scenarios using four different models.	In 2050, the range is 15% to 5% above 1961–1990, resulting in a 20% decrease, while in 2100, it ranges from 19% to 14%, resulting in a 33% increase.

According to a condensed review of climate change and water resources studies reveals varying predictions of the Nile River's revenue. Some predict a decrease in revenue at the Aswan High Dam by 2095, while others predict a 30% increase. The study also highlights the uncertainty surrounding future climate changes and the challenge of accurately predicting the Nile River's actions. Further research is needed to understand the impacts of climate change on water resources.

5. Discussion

Based on previous research on the effects of climate change on the Nile River carried out by various researchers, Figure 14 shows how the river's behavior changed over time. The majority of research confirms the considerable alterations that may occur in the Nile River. A drop of roughly 9–10% in Nile River flow is predicted by some research [15,35], whereas an increase of up to 33% of the current flow is predicted by others [16,32].

The review of popular studies and research on climate change and water resources, diverse results have been obtained. Some studies predict a decrease in the Nile's revenue at the Aswan High Dam by approximately 10% to 90% of Egypt's current water share by 2095, while others anticipate an increase of up to 30% during the same period. This contradiction among studies highlights the uncertainty surrounding predictions of Nile River revenues due to projected future climate changes. Furthermore, it has been estimated that by 2050, the flow of Lake Nasser will reach 75% of its current level. This uncertainty underscores the challenge of accurately predicting the actions of the Nile River. Researchers also differ in their expectations regarding the flow of the Blue Nile, with some anticipating an increase while others expect a decrease. However, there is consensus among researchers regarding Lake Victoria's flow, where a 5–10% increase in precipitation is expected to lead to a corresponding rise in flow. Lastly, the study emphasizes the pressing need for further research on the impacts of current and anticipated climate changes on the income derived from the Nile River's water.



	H. A. Radwan, 2016	heba G. Hassan et al,2022	Conway and Hulme ,1996	Elshamy et al.,2008	Mohamed E. Elshamy et al ,2009	Omar and Moussa, 2017	Soha et al. ,2021	Strzepek et al. ,2001	Strzepek and McCluskey ,2007
Expected Increase in Nile flow	-12%	14%	15%	14%	30%	6.30%	11%	10%	33%
Expected Decrease in Nile flow	-18%	-25%	-9%	-15%	-25%	7.80%	9%	-90%	-20%

Figure 14. Expected change in the Nile flow in Egypt due to climate change with different researcher [15,16,19,21,26,31–33,35].

It is important to note that the impact of climate change on river flows is complex and can vary depending on regional and local factors. While it is true that increased temperatures and evaporation can lead to increased water loss and potential concerns about water availability, it is also important to consider other factors that can influence river flows, such as rainfall patterns, land use changes, and hydrological processes.

6. Conclusions

Following the condensed review of popular studies and research discussed earlier, related to our research topic, the following main conclusions can be drawn:

1. Climate change's impact on River Nile Water Resources, in general, still lacks sufficient studies, technical analysis of available data, and extensive field measurements at local and regional levels.
2. Previous studies and research have demonstrated that the rise in global temperature leads to increased evaporation in the Nile Basin, resulting in reduced water flow and increased water scarcity in the basin countries.
3. The results obtained from previous studies predict a potential 10% decrease in the Nile's revenue at Aswan High Dam Lake by 2095, while other studies predict a 30% increase. This lack of credibility and accuracy highlights the urgent need for more comprehensive studies to attain confirmed and non-conflicting results. This will enable the implementation of the necessary scenarios to effectively address such phenomena.
4. By 2050, research projects suggest that the inflow to Aswan High Dam Lake is projected to reach 75% of its current level. This indicates that the actions of the River Nile cannot be accurately predicted, and researchers are divided on whether the flow of the Blue Nile will increase or decrease.
5. As climate change accelerates, Egypt will face challenges in bridging the gap between limited water supplies and the required quantities. This presents new challenges in securing additional water to mitigate losses caused by climate change.
6. Studies have shown a consensus among researchers regarding the expectations of Lake Victoria's flow. It is anticipated that its flow will rise by 5–10% for every 1–10% increase in precipitation.

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