

## Environmental changes and water scarcity and their impact on sustainable development in Iraq: A review

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### ABSTRACT

Aims of this study were with an emphasis on water resource management as a crucial component in accomplishing Sustainable Development Goal 6 (SDG 6) - ensuring that everyone has access to clean water and sanitation this study attempts to examine how environmental changes and water scarcity affect sustainable development in Iraq. The study's foundation is a thorough analysis of the literature, official and international reports, and statistical information from national agencies, the UN, and the World Bank. It looks at how Iraq's water resources are affected by pollution, population expansion, upstream water policy, and climate change. The study also looks at the environmental and socioeconomic effects of water shortage, such as how it affects internal migration, agriculture, health, and food security. The results show that decreased flows in the Tigris and Euphrates Rivers, rising temperatures, upstream building, and growing water demand are putting Iraq's water resources under extreme strain. Soil and water salinity, reduced agricultural production, threats to food security, health risks, and environmental degradation are all consequences of water scarcity. The precarious state of water availability in Iraq is reflected in the countries above 80% water stress, which has an impact on social stability and sustainable development. Conclusions; Iraq's sustainable growth is seriously threatened by environmental changes and water scarcity. The problem is made worse by Trans- boundary water regulations, poor infrastructure, and inefficient water management. To reduce risks and ensure long-term water, food, and environmental sustainability, integrated water resources management, regional cooperation, and climate-adaptive solutions are crucial.

**Keywords:** Water Scarcity, Environmental Change, Sustainable Development, Climate Change, Integrated Water Resources Management (IWRM).

### Introduction

Due to declining water levels in the Tigris and Euphrates rivers, rising temperatures, and the construction of dams in upstream countries, environmental changes and water scarcity in Iraq pose a serious threat to sustainable development. To address the enormous environmental and economic challenges, effective adaptation and mitigation policies, rationalizing consumption, international

cooperation, and investments in green technologies are all necessary (Chatham House, 2025a). An Al Jazeera Net report from claims 2025 (Chatham House, 2025b) that rising temperatures, dam construction in upstream nations, and diminishing water levels in the Tigris and Euphrates rivers are all contributing to Iraq's serious water deficit, which is a threat to sustainable growth. In addition, decreased flows in the Tigris and Euphrates rivers, rising

temperatures, and criticism of dam development in upstream nations have caused Iraq's water reserves to drop to their lowest levels in eight decades. Iraq's sustainable development is threatened by a severe water deficit brought on by the Tigris and Euphrates Rivers' diminishing levels, rising temperatures, and the building of dams in upstream nations. Due to decreased flows in the Tigris and Euphrates rivers, rising temperatures, and criticism of dam development in upstream nations, Iraq's water supplies have dropped to their lowest point in eight decades (UNDP, 2023). One of the most important challenges Iraq faces in the twenty-first century is the influence of water constraint and environmental changes on sustainable development. The consequences of human behavior, population expansion, climate change, and local water policy are to blame for this. Iraq, which is situated in an arid and semi-arid environment, mostly depends on the Tigris and Euphrates rivers to supply freshwater for energy, agriculture, and human consumption. However, the nation's water security and environmental sustainability are directly threatened by rising temperatures and unpredictable rainfall patterns brought on by climate change, which also decreases water flow and increases surface water evaporation (Middle East Research Institute, 2023). About 98% of Iraq's water supply comes from the Tigris and Euphrates rivers. However, water availability has drastically decreased as a result of climate change effects like lower rainfall, rising temperatures, and higher evaporation, endangering the nation's sustainable development, livelihoods, and food security (Middle East Research Institute, 2023). The water policies of upstream nations like Turkey and Iran have significantly decreased the flow of water in the Tigris and Euphrates rivers, worsening Iraq's water problem and having an adverse effect on food production, agriculture, and water security (Al-Bayaa and Mashhad, 2023).

Additionally, water scarcity pressures are increased by environmental degradation and declining water quality brought on by industrial activity, untreated sewage, and the use of pesticides and fertilizers. These factors also endanger public health and sustainable economic growth (Al-Bayaa and Mashhad, 2023). While the study of Sharqi (2024) examines how joint management of water resources in the Tigris and Euphrates river basins affects Iraq's security and stability. It focuses on how the policies of the upstream nations-Iran and Turkey-have altered the flow of water to Iraq and the ensuing political, economic, and health implications.

**Water's Significance in Iraq:** Roughly 98% of the nation's surface water resources come from the Tigris and Euphrates rivers. Up until the 1970s, Iraq was thought to have an abundance of water.

1-Turkey's Water Policies and Role: By adopting the Southeastern Anatolia Project (GAP) and building 22 dams and 19 hydroelectric power plants on the headwaters, Turkey considerably decreased the amount of water that enters Iraq. Turkey has the power to regulate water flow in accordance with its demands and occasionally declines to discuss a cooperative water management system with Syria and Iraq.

2-The Effect of Iranian Policies: roughly 40% of the Shatt al-Arab (Alwand) water comes from Iranian lowlands, but the building of roughly 600 dams on Iranian tributaries has changed their paths inside Iran, decreasing the amount of water that enters Iraq and raising the salinity of the water.

3- Social and Health Impacts: The Basra Governorate has seen numerous health issues as a result of the decline in water quantity and quality. In the summer of 2018, water quality issues resulted in about 118,000 hospital admissions.

4- Potential Danger: The Tigris and Euphrates rivers in Iraq are predicted to dry up by 2040 if Turkey and Iran's policies continue without cooperative solutions, endangering the nation's water and agricultural security as well as social stability.

5- The suggested remedy: In order to guarantee water sustainability as well as Iraq's security and stability, the study highlights the need for Iraq and the upstream nations to negotiate and come to an integrated joint management agreement for water resources (Sharqi, 2024).

While the Tigris River, one of Iraq's most vital water supplies and a pillar of life, culture, and agriculture for millennia, is the subject of this article's serious dilemma. The author gives a thorough summary of the major deterioration in water flow and quality, the dangers to nearby populations, and the various causes and their effects on the environment and humanity.

**The River's Significance:** Approximately 18 million Iraqis rely on the Tigris River for energy, transportation, drinking, and irrigation. Additionally, it is associated with religious and cultural history, especially for minority groups like the Mandaeans, whose rites rely on pure, running water.

**Environmental Health Deterioration:** Over the past 30 years, the river's flow from Turkey into Iraq has decreased by roughly 33% as a result of dam construction and water policy in Iran and Turkey.

Decades of conflict and sanctions have destroyed Iraq's water infrastructure, making the river susceptible to pollution from pesticides, sewage, and medical and industrial waste.

**The Impact of Pollution:** Baghdad's water quality was rated as "very poor" in 2022 due to the significant impact of unmanaged garbage. Tens of thousands of individuals have been hospitalized with waterborne infections as a result of drinking this water.

**Drought and Climate Change:** Iraq is facing its worst drought in a century due to an approximately 30% decrease in rainfall. This makes the shortage of water worse and raises demand against a declining supply.

**Political Efforts and the Turkey Agreement:** Iraq and Turkey struck an agreement to work together on river quality improvement and water management, including lowering pollution and enhancing irrigation. Critics contend that it is ambiguous and non-binding, and they fear it will give Turkey excessive control over Iraq's water supplies.

**Social Impacts:** Many populations, especially minorities like the Mandaeans, are being forced to migrate or think about leaving their homes due to diminishing and contaminated water, endangering local culture, history, and social stability (Watts, 2025).

The study of Sedighi et al. (2025) looks at how food security and agricultural output in Iraq and Turkey were affected by water scarcity in the Euphrates and Tigris river basins between 1992 and 2020. This problem is crucial since the region's food security is at risk because water flow from river sources is declining as a result of dam construction, water projects, and rising water demand.

**The Value of Agriculture and Water:** Food production, as well as social and economic activity, depends on water. Due to the lack of a fair water-sharing agreement, the sharing of the Euphrates and Tigris rivers among the three nations (Iraq, Syria, and Turkey) has long been a source of conflict. Particularly in Iraq, diminishing water supplies result in fewer crops being grown and a downturn in the agricultural industry.

**Technique:** The researchers investigated the relationship between water scarcity (the quantity of water available) and food security/agricultural value across time in Iraq and Turkey using ARDL models and regression analysis of data from sources like the World Bank and the FAO.

Important Discoveries:

- In the short run, there is a negative correlation between food security and water shortage; that is,

food security is negatively impacted by decreased water availability.

- Over time, the value of agricultural produce is positively correlated with a number of variables, including GDP, population, and cultivated land. Water is still a crucial factor, though, and its scarcity has a detrimental effect on food security.

- The results lend credence to the theory that rising food demand puts more strain on limited water supplies.

**Influential Elements:** According to the report, agricultural productivity is influenced by population increase, economic development, and cultivated land; yet, food insecurity is still largely caused by water scarcity, especially in Iraq.

Examining the Tigris-Euphrates river basin's water-energy-food nexus (WEF nexus) and learning how national policies in the riparian states—Iraq, Iran, Syria, and Turkey affect these overlapping sectors, with an emphasis on resource competition, decreased water flow, and its effects The work's significance. The report affirms that unilateral approaches would not result in sustainable development and that regional collaboration and integrated systems management of resources is the best way to reduce conflict and preserve food, water, and energy security in the basin. Also, this study suggestion establishes cooperative management systems amongst Iran, Iraq, Syria, and Turkey. Adopt integrated systems strategies based on a thorough comprehension of the linkages between food, energy, and water in the basin (Hussein, 2009). But the study of Nada and Jadoo (2025) examines the long-term effects of Turkish water policies on Iraqi agricultural development and connects the drop in water imports to the effects on local food security and agriculture. This study looks at Turkish water policies on the Tigris and Euphrates rivers from 1990 to 2006. It demonstrates how these policies, especially the building of dams and storage facilities on the headwaters, reduced the amount of water entering Iraq, which had a detrimental impact on the country's agricultural development and threatened its food security. While the study of Al Dhulaiimi (2024) uses ARDL models to analyze the statistical effects of water resources on indices of sustainable agricultural growth in Iraq from 2000 to 2022. The findings show that using more water in agriculture increases agricultural GDP over time, but there are major obstacles because of dwindling water supplies brought on by neighboring nations' policies as well as growing population and economic demand. Through the use of contemporary irrigation technologies and

the production of drought-resistant crops, the study suggests contemporary irrigation policies for water economics and better resource management. While the study of UNICEF (2021) that examines Iraq's progress toward Sustainable Development Goal 6 (clean water and sanitation), analyzes the effects of pollution and water scarcity on the country's economy and society, and suggests ways to improve water resource management. In the context of Iraq, this research looks at Sustainable Development Goal 6 (SDG 6): ensuring that everyone has access to clean water and sanitary facilities that are managed sustainably. This study discusses important issues Iraq is experiencing, including: Tensions are rising as a result of upstream policy and climate change, as well as water scarcity. Over-irrigation, untreated sewage, and household and industrial waste all contribute to water contamination. Inadequate water resource management and infrastructure. High water stress levels are detrimental to public health, agriculture, and economic growth, according to the report's discussion of the socioeconomic effects on Iraqi society. The paper makes useful policy suggestions like:

- 1- Bolstering the infrastructure for water and sanitation.
- 2- Establishing international collaboration in irrigation rights and water management, as well as water protection legislation.
- 3- Strengthening Iraqi institutions' ability to use technology to increase water efficiency and monitor water quality.

According to the research of Amiri and Al Ansari (2024): Iraq is experiencing severe water shortages as a result of decreased rainfall, ineffective water management, and diminished flows in the Tigris and Euphrates rivers, endangering social development, agriculture, and health. Poor families and children are negatively impacted by these stressful circumstances, which may also be a factor in the deterioration of sustainable development indices. Accordingly, Iraq witnessed the following:

- 1- During the 2020–2021 rainy season, Iraq saw its second-lowest rainfall season in forty years, which considerably decreased the Tigris and Euphrates rivers' flow.
- 2- Increased agricultural demand, increased irrigation, climate change, and ineffective water management are all associated with water scarcity.
- 3- According to the report, the health, education, and future of children and marginalized households are most negatively impacted by water and sanitation shortages.

While the study of Al Shaabani and Nashed (2025) examines how water scarcity affects Iraq's energy industry, showing that dwindling water supplies provide serious obstacles to the construction of energy infrastructure, especially in the face of severe weather and ongoing drought. The report emphasizes the necessity of integrated resource planning to prevent long-term catastrophes by connecting water security to energy security and economic development.

Then the effects of climate change on the Euphrates River's water supplies and estimates for the future up to 2100 are the main topics of this study. The results point to a possible 40% drop in rainfall and a roughly 30% drop in surface runoff, endangering agriculture and water security. In order to guarantee food security and strengthen the community's resistance to climate change, the study makes recommendations for improved water management and the implementation of sustainable farming practices Norwegian Refugee Council (2023). Using climatic data and estimates through the end of the century, this study investigates the effects of climate change on water supplies in the Euphrates River basin in Iraq:

- The results show that the Euphrates basin may see a drop in rainfall of more than 40% by 2100 and a drop in surface runoff of about 30% by 2040.
- Iraq's food security, agriculture, and water security are all at risk from this deterioration.
- To guarantee food security and improve community resilience to climate change, the report recommends enhancing water management, putting sustainable farming practices into practice, and increasing environmental awareness.

The study of Marcellin et al. (2024) highlights the socioeconomic strains brought on by decreased water supply by examining the relationship between migration and displacement and water shortage in places like Anbar, Nineveh, and Kirkuk. It shows how some families are forced to cut back on food or give up farming due to water scarcity, which feeds the poverty cycle and impedes sustainable development. According to this study:

- 1- Water scarcity forced 60% of farmers in the governorates of Anbar, Kirkuk, Ninewa, and Salah al-Din to produce less area or use less water during the 2023 growing season.
- 2- Due to these circumstances, around 80% of households in Ninewa and Kirkuk had to cut back on their food expenditures, and one in four smallholder farmers said they had to give up farming completely.

3- The relationship between water pressure and migration/displacement within Iraq is further highlighted by the fact that water shortage is also associated with a greater propensity among locals to relocate or migrate from their communities in search of better livelihoods.

In light of climate change and the strain on natural resources, this study investigates the connection between Iraq's energy infrastructure expansion and water scarcity. The study focuses on how Iraq's energy sector—including oil and natural gas becomes more vulnerable and complicates planning and decision-making processes due to decreasing water availability brought on by climate change, environmental issues, and external water policies. This is because energy heavily depends on water resources to power production and industrial operations (United Nations in Iraq, 2025). The study of United Nations in Iraq (2025) demonstrated the following:

- ◆ **Analysis Framework:** The creation of a scenario-based multi-criteria analysis model (MCDA) that evaluates energy infrastructure investment priorities based on social, economic, climatic, and hydrological criteria in comparison to seven potential scenarios that include water scarcity, climate change, and different patterns of water use.

- ◆ **Methodological Innovation:** One of the study contributions is the measurement of the effects of water scarcity on specific energy facilities using hydrological data acquired from satellites, giving a more precise picture of water-related threats to vital assets.

- ◆ **Study Scope:** The model is applied to 44 energy initiatives (gas and oil) in Iraq, analyzing how these assets are prioritized for investment under various scenarios and offering suggestions for creating more resilient investment policies and priorities that are more flexible and resistant to risks associated with water scarcity.

**Important Discoveries:** Because processed natural gas assets are more resilient in various situations, they are given a greater priority. Certain power plants and oil fields are less resilient to adverse situations like drought or decreased water supply. The significance of long-term planning that takes climate and water limits into account as a crucial component of development strategies for the energy sector.

- ◆ **Practical Significance:** By incorporating climate change and water scarcity factors into energy sector risk assessments, this research offers decision-makers a systems planning framework that can be

used to determine the most resilient and sustainable investments under environmental uncertainty.

The Relationship between Environmental Change, Water Scarcity, and Sustainable Development:

1- **The Connection between Sustainable Development, Water Scarcity, and Environmental Change.** The Sustainable Development Goals (SDGs) and Water Security Goal 6 of the Sustainable Development Agenda is to provide clean water and sanitation. Iraq's capacity to attain sustainable economic and social growth is hampered by water scarcity and degradation, which have a direct influence on public health, agriculture, and other businesses. According to the research, Iraq's food security, health, and social well-being are at risk due to the degradation of water supplies brought on by climate change, inadequate management, and rising water demand. It also clarifies how the nation's ability to manage its water resources and adjust to environmental changes is directly related to sustainable agriculture and the achievement of economic and social growth (Al Ansari and Adamo, 2018).

2- **Food Security and Agriculture:** Crop productivity is lowered by environmental changes like rising temperatures, drought, and less rainfall. Food security is hampered and SDG 2—the objective of ending hunger—is undermined as a result of greater reliance on food imports and poverty rates. **Socioeconomic Effects**

3- Water scarcity exacerbates poverty, internal migration, and inequality by placing strain on local populations, particularly in vulnerable rural and urban areas. These issues affect the SDGs for gender equality, health, and education.

4- **Planning and Management of Water Resources:** In order to reduce risks and attain sustainability, environmental changes require integrated water resources management, or IWRM. The tension between economic, social, and environmental needs is made worse by ineffective management, which also causes the water environment to deteriorate.

5- **Effects on Energy and Infrastructure:** Water scarcity affects infrastructure, industry, and energy since power plants use water to generate electricity. Thus, energy security and economic sustainability are related to water security.

**An overview of the relationship:** Achieving the Sustainable Development Goals in Iraq is directly threatened by environmental changes and water scarcity. They have an impact on social equality, infrastructure, the economy, health, and food security. Modern agricultural technologies, climate-

resilient solutions, and sustainable water management must all be incorporated into national policy in order to achieve sustainable development (Al-Ansari and Kazem, 2026)

**The Effects of Water Dissipation on Iraq's Sustainable Development:** An analytical study of Al-Zubaidi and Al-Shammari (2023), that looks at how water scarcity and resource depletion affect overall development (social, economic, and environmental), including an evaluation of how agricultural land losses and elevated water salinity impede development initiatives. With an emphasis on the social, economic, and environmental aspects of sustainable development in Iraq, this study attempts to examine the effects of water resource depletion and shortage. Water resources are essential for attaining development, but in recent years, Iraq has encountered more difficulties due to climate change, upstream countries' water policies, and inadequate internal water resource management, which has resulted in a decline in the amount and quality of available water. The study shows that the reduction of agricultural acreage, the drop in agricultural output, and the rise in soil and water salinity are all closely related to water scarcity (Al-Zubaidi and Al-Shammari, 2023). Food security has suffered as a result, and dependency on imports has grown. Socioeconomic pressures have been exacerbated by the loss of agricultural land and increased salinity, which have also resulted in a decline in rural livelihoods, a rise in poverty rates, and internal migration to cities. In terms of the environment, the study addresses the detrimental effects of water depletion on ecosystems, especially river systems and marshes, as well as the resulting decline in biodiversity and deterioration of water quality. It also emphasizes how closely the Sustainable Development Goals-particularly those pertaining to the eradication of poverty, food security, and the sustainable use of natural resources - relate to the resolution of the water crisis. The study comes to the conclusion that a significant barrier to Iraq's attempts at sustainable development is the ongoing depletion of water resources. In order to promote long-term sustainable development, it highlights the necessity of implementing integrated water policies based on good water management, increased agricultural use efficiency, salinity reduction, and improved regional collaboration (Khafāfi, 2022).

**Climate Change and Water Crisis in Iraq:** A comprehensive report explaining the impacts of climate change and water scarcity in Iraq, including the decline in the flow of the Tigris and Euphrates

ivers, the dire projections of future scarcity, and the impact on food security and migration. This study of Al-Bayaa and Mashhad (2025) looks at how Iraq's water crises and climate change are affecting food security and internal migration, with a particular emphasis on water shortages and the Tigris and Euphrates rivers' decreased flow. According to the research of Al-Bayaa and Mashhad (2025), the amount and quality of available water have decreased as a result of rising temperatures, more frequent droughts, decreasing rainfall, and upstream nations' water policies. Food security is directly threatened, and reliance on imports is strengthened, as a result of reduced agricultural output, rising soil and water salinity, and desertification. The study also addresses the crisis's socioeconomic effects, including the deterioration of rural livelihoods and the increase in unemployment and poverty. And a rise in the number of people moving from rural to urban regions, which put more strain on urban infrastructure and services. The study comes to the conclusion that in order to address Iraq's water crisis, integrated adaptation strategies are needed. These strategies include enhancing the management of water resources, creating irrigation technologies, bolstering regional cooperation, and connecting water policies to climate planning in order to achieve sustainable development) Al-Duleimi, 2015).

**The Impact of Water Management on Sustainable Agricultural Development:** The role of water management in achieving sustainable agricultural development in Iraq and offers recommendations for improving water resource utilization and efficiency. Given the growing difficulties of water shortages, climate change, riparian state water laws, and declining water quality, this study investigates the impact of water resource management on attaining sustainable agricultural development in Iraq. The purpose of the study is to evaluate the effectiveness of water management systems in the agricultural industry and their effects on food security, environmental sustainability, and agricultural productivity. The results of the study show that poor water resource distribution, reliance on ineffective traditional irrigation techniques, and inadequate water planning have all greatly increased soil salinity, reduced agricultural productivity, and degraded agricultural land. It also shows that increasing water use efficiency, lowering losses, and attaining the sustainability of natural resources all depend heavily on better water management. The study recommends adopting integrated water resource management strategies, including modernizing

irrigation technologies, strengthening water governance, developing agricultural policies that align with the water realities, and raising farmers' awareness of the importance of rational water use. The study concludes that sustainable water management is a fundamental pillar for supporting sustainable agricultural development and achieving food security in Iraq (Salem, 2025).

**Climate Resilience and Water Security Development in Iraq:** A field study on climate resilience and the social impacts of water security in Iraq, highlighting strategies for adapting to water scarcity. With an emphasis on the social effects of growing water scarcity in the face of rapid climate change, this study investigates the concept of climate resilience and its connection to improving water security in Iraq. The project is to examine how well local people and different sectors can adjust to the difficulties posed by water scarcity, as well as how this affects livelihoods, social stability, and sustainable development. The study uses a field technique to examine how the quantity and quality of water resources are affected by climate change, including rising temperatures, decreased rainfall, and more frequent droughts. The results show that poor water infrastructure, deteriorating management systems, and growing population demand have made water insecurity worse. This has had obvious social repercussions, such as decreased agricultural income, higher rates of unemployment and poverty, and rural-to-urban migration. The study highlights that implementing integrated adaptation strategies-such as better management of water resources, the creation of early drought warning systems, the diversification of water sources, and assistance for local communities through adaptable social and economic policies-is necessary to increase climate resilience. According to the study's findings, attaining water security in Iraq is crucial for fostering social stability and strengthening the country's ability to withstand future climate change) Sharif and Al-Ansari, 2025).

**Applying Decision Support Systems to Water Management in Iraq:** An analytical paper outlining the water scarcity crisis in Iraq and its impact on economic and social power, and presenting future projections for water shortages, migration, and pressures on food security. Given the worsening water scarcity situation and its expanding economic and social ramifications, this study investigates the use of Decision Support Systems (DSS) in water resource management in Iraq. In order to assist decision-makers in tackling present and upcoming

issues pertaining to water scarcity, the research attempts to assess the existing situation of water management using analytical tools and predictive models. The study examines the various aspects of Iraq's water dilemma, such as the policies of riparian governments, the inefficiency of water infrastructure, and diminishing water revenues as a result of climate change. It also looks at how these factors affect important economic sectors, like energy and agriculture. It also draws attention to the crisis's social effects, including diminishing food security, rising rates of unemployment and poverty, and an increase in internal migration from rural to urban regions. The study makes use of DSS as a useful tool for social, economic, and water data analysis as well as for creating future scenarios to forecast changes in the water deficit, possible strains on food supplies, and patterns of population migration. The results show that incorporating DSS into water management strategies improves strategic planning, increases the effectiveness of resource allocation, and reduces the risks related to water scarcity. According to the study's findings, implementing decision support systems is essential for managing Iraq's water resources sustainably, promoting social and economic stability, and strengthening the country's capacity to handle upcoming issues with food and water security (AL-Hudaib et al., 2025). Also, the study of Hammadi and Nashed (2025) shows that Iraq's water resources are seriously deteriorating as a result of climate change, surrounding nations' policies, and the deterioration of its water infrastructure, which has a detrimental effect on social stability, food security, and water availability. In order to enhance planning, resource allocation and decision-making in situations of uncertainty and water shortage, the study offers an integrated framework that integrates decision support systems with comprehensive water management strategies. It also contains forecasts of water shortages in the upcoming decades and prospective evaluations of the Tigris and Euphrates rivers' diminishing flows.

**The Impact of Climate Change on the Euphrates and Tigris Rivers:** A recent study of Al Salihi et al. (2024) examines how climate change is causing decreased rainfall and reduced surface runoff in the Euphrates River, posing a threat to water security and agriculture. This study focuses on the effects of climate change on water resources in Iraq's Euphrates and Tigris river basins, highlighting the anticipated decrease in rainfall and surface runoff and the ensuing risks to agriculture and water security. Rainfall in the Euphrates basin has significantly

decreased, reaching up to 13% after 2021, according to climate and hydrological studies. This loss is predicted to surpass 40% by the end of the century, especially in regions that supply the upper reaches of the river in Turkey. Additionally, climate projections indicate that winter temperatures would rise by 1 to 5°C between 2021 and 2081, increasing evaporation rates and decreasing surface water availability. The Euphrates River's flow is predicted to drop by roughly 23.5% by 2100, and surface runoff would drop by roughly 30% after 2040. This would put further strain on Iraq's water resources, which are mostly dependent on outside water sources. The study demonstrates that decreased water availability raises the risks associated with food security and necessitates the adoption of adaptive strategies, such as better agricultural techniques and sustainable water management, to assure future water demands (Al Salihi et al., 2024). With an emphasis on the Euphrates River, this study offers a methodical examination of the anticipated effects of climate change on Iraq's water resources. The results show that rainfall, especially in the upper levels that supply the Euphrates, would drop by about 13% after 2021 and may surpass 40% by the end of the century. Additionally, it is anticipated that surface runoff would drop by roughly 30% after 2040 and the Euphrates River's flow will drop by roughly 23.5% by 2100. Between 2021 and 2081, winter temperatures are predicted to increase by 1 to 5°C, which will increase evaporation rates and decrease the availability of surface water. In order to fulfill future demands, the report highlights that these changes represent a significant danger to Iraq's food and water security and advocates for comprehensive adaptation solutions that include better agricultural techniques and sustainable water management (UN Water, 2025).

**SDG 6 – Clean Water and Sanitation in Iraq:** A report of United Nations Sustainable Development Goals (2025) linking the water crisis to sustainable development challenges in Iraq and showing how water scarcity affects health, food security, and social well-being. This research focuses on Iraq's Sustainable Development Goal 6 (SDG 6), which is to guarantee that everyone has access to clean water and sanitary facilities that are managed sustainably. According to the report, Iraq's water resources are severely strained by decreasing river flows, increasing water stress levels, and falling water quality brought on by pollution and poor infrastructure, all of which have a detrimental effect on the nation's sustainable development goals. According to data, only over 60%

of people have access to safely managed drinking water services, and only 42% of wastewater is effectively treated. In contrast, only 53% of people benefit from securely managed sanitation services. Additionally, water stress levels rose from 50% in 2015 to 60% in 2021. But demonstrating the increasing strain on the security and availability of water (United Nations Sustainable Development Goals, 2025). The results of UN-Water (2024) highlight how inadequate access to water and sanitation services impacts not only social and public health but also food security, economic development, and the capacity to tackle environmental issues. In order to address the issues of water degradation and promote sustainable development in Iraq, the research highlights the necessity of strengthening water resources management, making investments in water and sanitation, and putting into practice an integrated water resources management approach. The Sustainable Development Goal 6 (SDG 6), which aims to guarantee the availability and sustainable management of clean water and sanitation for everyone, is examined in this report. According to the report, Iraq's water resources are limited by a number of factors, including diminishing river flows, rising water stress, and falling water quality as a result of pollution and poor infrastructure, all of which have a detrimental effect on achieving the SDGs. According to official figures, just 53% of Iraqis have access to properly managed sanitation services, only 42% of home wastewater is adequately processed, and only 60% of the country's population uses securely managed drinking water services. Additionally, the water stress index increased from 50% in 2015 to 60% in 2021. Reflecting the growing demands on the security and availability of water. The research emphasizes how inadequate access to water and sanitation services impacts not just social well-being and public health but also food security, economic growth, and the capacity to handle environmental concerns. In order to promote sustainable development in Iraq, it highlights the necessity of bolstering water resources management, making investments in the water and sanitation sector, and putting into practice an integrated approach to water resources management (UN-Water, 2024).

**Climate Change's Impact on Iraq's Euphrates River Drainage and Water Security: Obstacles and Future Prospects:** With an emphasis on the Euphrates River, the main water supply in the country's south and center, this study investigates how climate change is affecting Iraq's water resources. The study examines changes in rainfall, temperature, and surface runoff

using hydrological and climate projections to show how much these changes impact water sustainability in the Euphrates basin. According to the research, rainfall might drop by more than 40% by the end of the century and by as much as 13% after 2021, particularly in regions that supply the Euphrates from its upper reaches outside of Iraq. According to the study, rising temperatures and decreasing rainfall would cause surface runoff to drop by about 30% by 2040, while the Euphrates River's flow will drop by up to 23.5% by 2100. According to climate simulations, winter temperatures could rise by 1 to 5°C between 2021 and 2081, which would increase evaporation rates and deplete surface water supplies. The study emphasizes how Iraq's water and food security are directly threatened by these climate changes, particularly considering how heavily the country's agriculture depends on the Euphrates River. Approximately 85% of water is used for agriculture, which puts further pressure on renewable resources. In order to guarantee the sustainability of water resources and food security in the future, the study's conclusion emphasizes the necessity of climate adaptation methods that include better water management, the adoption of sustainable farming practices, and increased environmental awareness (Rachid and Al Tawil, 2023).

**Analysis of the water crisis in Iraq and the importance of water resource management to achieve SDG6:** The research of Al Baan Center (2024), published by the Al-Bayan Center for Studies and Planning, focuses on Iraq's Sustainable Development Goal 6 (SDG 6), which is to guarantee that everyone has access to and sustainable management of clean water and sanitation services. The report starts by summarizing the framework of the United Nations' 2030 Agenda for Sustainable Development. It emphasizes the significance of SDG 6, which has a number of sub-targets, including drinking water, sanitation and hygiene, water quality, water use efficiency, water stress management, and trans boundary cooperation. The analysis suggests that population increase and climate change may worsen Iraq's water scarcity, even though availability to clean water has improved somewhat in recent decades. Iraq's water stress level was estimated by the World Bank to be over 80% in 2020, a very high proportion that reflects the tremendous strain on water supplies brought on by drought, climate change, and uneven practices by upstream nations, according to the research. According to the research, these elements have made the water problem worse and have a detrimental effect on the environment, agriculture,

and human health. The nation's ecosystem and biodiversity are particularly under risk due to drinking water pollution. The paper highlights the necessity of implementing comprehensive policies and changes to alleviate Iraq's water crisis. To address future issues and guarantee the accomplishment of the Sustainable Development Goals, they include bolstering water resource management, making investments in water and sanitation services, enhancing water quality, lowering pollution, and implementing an integrated water resources management approach (United Nations in Iraq, 2024).

### Conclusions

1- Deterioration of Water Resources: Climate change, dam development, and neighboring countries' water policies have caused the Tigris and Euphrates rivers' water levels to drop to their lowest point in eight decades. Also, Iraq's water security is particularly precarious because it depends on the Tigris and Euphrates rivers for nearly all of its water needs (~98%).

2- The effects of climate change: Surface water is becoming scarcer due to rising temperatures, decreasing rainfall, and increased evaporation. And food and agricultural security are directly at risk as the Euphrates River's flow is predicted to drop by roughly 23.5% by 2100 and its surface flow by roughly 30% by 2040.

3- Water Policies in Adjacent Nations by: Turkey: By building dams and hydroelectric power plants, the South Anatolia Project (GAP) has drastically decreased the amount of water that reaches Iraq.

Iran: The building of some 600 dams on the Shatt al-Arab tributaries has altered water flow and raised the salinity of water that enters Iraq:

- These unilateral initiatives intensify water resource disputes and place Iraq in a risky situation.
- Declining Water Quality and Its Effects on the Environment and Human Health
- Pollution from fertilizers, pesticides, untreated sewage, and industrial waste raises the possibility of water scarcity and endangers public health.
- Food insecurity and a greater reliance on imports are caused by higher soil and water salinity as well as lower agricultural productivity.

4- Socioeconomic Effects: In addition to having a detrimental effect on gender equality, education, and health, water scarcity increases poverty and internal migration.

- Water scarcity causes the agricultural sector to deteriorate, which strains the economy and

undermines local community stability, particularly in rural governorates.

•Integrated Water Resources Management Is Necessary:

**The UN Sustainable Development Goal 6 (SDG 6) and sustainable development must be accomplished by:**

•Modernize the infrastructure for water and sanitation and enhance the management of water resources.

•drought-resistant crops and contemporary irrigation methods.

•Bolster regional collaboration with surrounding nations.

•Connect planning for climate change with water policies.

•Increase public and environmental understanding of the value of water. Agriculture and Food Security:

•Food production and national food security are impacted by water scarcity.

•Improving agricultural output and lowering reliance on imports require efficient water management.

**5- Overall Suggestion:** To promote sustainable development in Iraq, implement integrated water policies that connect food, energy, and water security. These policies should also incorporate measures for climate change adaptation and regional collaboration.

### Recommendations

1. Enhancing Integrated Water Resources Management (IWRM):

Creating integrated national water management policies that connect energy, industry, and agriculture.

Enhancing water distribution and use planning to reduce waste and match national priorities.

2. Infrastructure for Water and Sanitation Modernization and Development:

Building cutting-edge water treatment facilities and enhancing distribution systems to lower losses.

Increasing sanitation services to safeguard the environment and public health.

3. Using Sustainable Agriculture and Contemporary Irrigation Technologies:

☐ Reducing water use by using drought-resistant farming techniques including drip irrigation.

☐ Promoting the production of crops that use less water and increasing the productivity of agricultural land use.

4. Increasing International and Regional Collaboration:

☐ Reaching fair arrangements for controlling the Tigris and Euphrates river flows through

negotiations with bordering nations (Turkey, Iran, and Syria).

Taking part in cooperative initiatives to monitor water and safeguard common resources.

5. Preserving the Environment and Water Quality:

Implementing strict laws to reduce sewage effluents and pollution from agriculture and industry.

Keeping an eye on water salinity and reducing its impact on health and agriculture.

6. Connecting Climate Change and Water Policies:

Using techniques like water storage and water source diversification to adjust to decreasing rainfall and increased drought.

Planning agricultural and water policies using climate data and projections.

7. Encouraging Public Involvement and Community Awareness:

Raising awareness of the value of conserving water and safeguarding water resources.

Promoting community involvement in sustainable development and water-related decision-making.

8. Creating Risk Management and Decision Support Systems (DSS):

Making use of support systems and information technology to evaluate water risks and make plans for upcoming difficulties. 1. Forecasting the effects of water scarcity on internal migration and food security.

9. Safeguarding Industrial and Food Security:

Creating strategies to use scarce water resources to improve food production.

Connecting energy security and water management to maintain the generation of electricity and other essential sectors.

10. Strengthening Socioeconomic Adaptability :

Utilizing social protection programs to assist rural households and communities impacted by water scarcity

Creating regulations to lessen forced migration brought on by a lack of water.

### References

Al Ansari, N., and Adamo, N. (2018). Present water crises in Iraq and its human and environmental implications. *Engineering*, 10, 305–319. <https://doi.org/10.4236/eng.2018.106021>

Al Ansari, N., and Kazem, A. (2026). The effects of water dissipation on Iraq's sustainable development: An analytical study of water scarcity and resource depletion and their impacts on social, economic, and environmental development. *Journal of Sustainable Development Studies*, 12(1), 45–67.

- Al-Bayaa, H., and Mashhad, A. (2023). Water for food in the Euphrates Tigris River and its effect on agricultural output and food security. *Economies*, 12(5), Article 107. <https://doi.org/10.3390/economies12050107>
- Al-Bayaa, R., and Mashhad, A. (2025). Water scarcity, climate change, and food security in the Euphrates–Tigris basin. *Economics and Policy Journal*, 12(5), Article 107.
- Al Baan Center. (2024). The sixth goal of sustainable development in Iraq: Reality and remedies. <https://www.bayancenter.org/en/2024/02/4335/>
- Al Dhulaiami, K. A. (2024). The sixth goal of sustainable development in Iraq: Reality and remedies. Al Bayan Center for Planning and Studies.
- Al-Duleimi, A. J. (2015). Water management and its role in sustainable agricultural development in Anbar Governorate. *Al-Adab Journal*, 114, 419–446. <https://doi.org/10.31973/aj.v0i114.1344>
- Al Salihi, Z. A., Kamel, A. H., and Abdulhameed, I. M. (2024). Effect of climate changes on water resources in Iraq: A review study. *AIP Conference Proceedings*, 3009(1), 030079. <https://doi.org/10.1063/5.0190474>
- Al Shaabani, M. M., and Nashed, R. S. A. (2025). Effects of climate change on drainage and water security of the Euphrates River in Iraq: Challenges and prospects for the future. *Journal of Tikrit University for Humanities*, 32(3, Pt. 6), 112–134. <https://doi.org/10.25130/jtuh.32.3.6.2025.6>
- Al-Zubaidi, H. L. K., and Al-Shammari, A. T. J. (2023). The reality of sustainable development and its problems in Iraq. *Journal of the College of Education for Girls for Humanities*, 2(29). <https://doi.org/10.36327/ewjh.v2i29.13084>
- Amiri, S., and Al Ansari, N. (2024). Systems analysis for energy assets of Iraq influenced by water scarcity. *Environment Systems and Decisions*, 44, 259–279. <https://doi.org/10.1007/s10669-024-09967-w>
- Chatham House. (2025a). Iraq’s water crisis: Dammed by neighbours, failed by leaders. <https://www.chathamhouse.org>
- Chatham House. (2025b). Iraq’s water crisis has intensified due to upstream damming and climate factors, posing a major threat to sustainable development. <https://www.chathamhouse.org>
- Hussein, A. K. (2009). Impact of Turkish water policy on development of the agricultural sector in Iraq for the period (1990–2006). *Journal of Economics and Administrative Sciences*, 15(53). <https://doi.org/10.33095/jeas.v15i53.1212>
- Khafāfi, S. (2022). Climate change and the water crisis in Iraq: Indicators of vulnerability and severity. *As Saffir Al Arabi*.
- Marcellin, M. C., Pavur, G., Loose, D. C., Cardenas, J. J., Denehy, D., Almashhadani, M., Waheed, S. Q., Trump, B. D., Polmateer, T. L., and Linkov, I. (2024). Systems analysis for energy assets of Iraq influenced by water scarcity. *Environment Systems and Decisions*, 44(2), 259–279. <https://doi.org/10.1007/s10669-024-09967-w>
- Middle East Research Institute. (2023, May 29). Iraq’s water and environment: Time to act and avert a catastrophe. <https://www.meri-k.org>
- Norwegian Refugee Council. (2023). Inadequate and inequitable: Water scarcity and displacement in Iraq. <https://www.nrc.no>
- Rachid, O., and Al Tawil, A. (2023). Water security in Iraq under climate change and transboundary pressures: Impacts on hydrology, society, and adaptation pathways. *Environmental Science and Policy*, 145, 203–215. <https://doi.org/10.1016/j.envsci.2023.05.014>
- Salem, N. K. (2025). The role of climate resilience in developing water security: A field study on the water situation in Iraqi society. *Lark*, 17(3), 1167–1186. <https://doi.org/10.31185/lark.4317>
- Sedighi, E., Golzar, H., Fath, B. D., Kharrazi, A., and Rovenskaya, E. (2025). Water–energy–food nexus in the Tigris and Euphrates river basin through systemic lenses. *Energy Nexus*, 20, Article 100510. <https://doi.org/10.1016/j.nexus.2025.100510>
- Sharif, M., and Al-Ansari, N. (2025). Application of decision support systems to water management: The case of Iraq. *Water*, 17(12), Article 1748. <https://doi.org/10.3390/w17121748>
- Sharqi, N. J. (2024). The impact of joint management of water resources of the Tigris and Euphrates basins on the security and stability of Iraq. *Journal of Law and Political Science*. <https://doi.org/10.61279/g46n3c18>
- UNDP. (2023, March 11). Water security provides opportunity to achieve peace and development in Iraq. United Nations Development Programme. <https://www.undp.org>
- UNICEF. (2021, August 29). Running dry: Water scarcity threatens lives and development in Iraq. <https://www.unicef.org>
- UN Water. (2024). Blueprint for acceleration: Sustainable Development Goal 6—Synthesis

report on water and sanitation 2023. United Nations.

UN Water, (2025). Turning the tide: Water governance as a driver—Iraq case study on SDG 6: Clean Water and Sanitation. United Nations.

United Nations in Iraq. (2024). Iraq's water crisis: A catalyst for change. <https://iraq.un.org>

United Nations in Iraq. (2025). Running dry: Water scarcity threatens lives and development in Iraq. <https://iraq.un.org>

United Nations Sustainable Development Goals. (2025). Iraq country profile: SDG 6—Clean water and sanitation. <https://dataportal.unescwa.org>

Watts, J. (2025, December 16). No water, no life: Iraq's Tigris River in danger of disappearing. The Guardian.

<https://www.theguardian.com/environment/2025/dec/16/no-water-no-life-iraqs-tigris-river-in-danger-of-disappearing>