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## THE ROLE OF THE WATER SITUATION IN IRAQ IN EXACERBATING THE PROBLEM OF FOOD SECURITY IN IRAQ

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**ABSTRACT.** Water is of great importance in human life, as no human society can live without it since the first human communities were established on the banks of rivers. The research problem is the limited water supply in Iraq compared to the growing demand due to improved living standards and rising populations, fluctuating from year to year and high levels of pollution and problems with upstream countries Turkey, Syria, and Iran. This article examines the real economic consequences of demand-driven water scarcity in Iraq's 'midstream' socioeconomic growth route, taking into account trade-offs between macroeconomic effects and food security. The study employs an advanced degree of detail in its exploratory analytical water usage model in economic activities, allowing for internal adaptation of a specific sector to water shortage. The results indicate the absence of a valid international agreement regulating the water quotas of the rivers shared between Iraq, Turkey, and Syria to control shared water. As a result, the country's water losses are high, with up to 70 percent of agricultural losses and up to 40 percent in domestic use. Moreover, the continuing problems between Iraq and the upstream countries are likely to increase due to the growing demand for water, which is not limited to river water but may include the management of shared groundwater in the future.

**JEL Classification:** Q25, Q18, E27

**Keywords:** water Conservation, Agricultural Technology, Agricultural Policy, Food Policy

### Introduction

Having a secure supply of water, energy, and food is necessary to the survival and development of human beings and the progression of human civilization (Almagtome, Al-Yasiri, Ali, Kadhim, & Bekheet, 2020). Water, energy, and food security are also crucial to the advancement of human society. Production, distribution, processing, and storage of food are all intertwined with the provision of water and energy (Giroto, Alibardi, & Cossu, 2015). Because of the purification and deployment of water, energy consumption is inevitable. The production and supply of power necessitate a significant quantity of water use as part of their respective

processes. Initially described at the World Economic Forum in 2011 as an overview of concepts related to the nexus, and then listed as one of three major risk groups that received significant attention at the Bonn Conference in 2011, the water-energy-food (W-E-F) nexus has gained increasing attention in recent years. Faced with world-class challenges like population growth at an alarming rate, severe climate change, and resource scarcity, the world has gradually realized the importance of rational and effective use of water, energy, and food resources for the long-term development of different countries and regions. A study on the water-energy-food nexus for the Asia-Pacific region was produced by the United Nations Economic and Social Council for Asia and the Pacific (ESCAP) in 2013, concentrating on the intimate interaction between the water-energy-food system in both time and place. After a lengthy debate, the United Nations established the "2030 Sustainable Development Goals," including water, energy, and food as essential components. In turn, this contributes to a shift in international emphasis from environmental challenges to resource systems and the inclusion of these concerns within the policy framework of sustainable development (Zhang, 2019). There is a growing population and a perception of lack of resources. During the last quarter-century, water has become one of the most contentious issues in international relations. Several academics have projected battles between water-coastal countries during the next century, based on various worldwide studies and papers that warn of water scarcity and shortage dangers. According to some experts, specialized research institutes and centers, including the World Bank and the World Water Council Fresh water may be more valuable than oil in the future. Iraq's water supply is insufficient to meet the increased demand brought on by rising living standards and an increasing population. The year-to-year fluctuations and high pollution levels, and the wars with upstream nations Turkey, Syria, and Iran (Ghorbani, Deo, Karimi, Yaseen, & Terzi, 2018). The study claims that the reality of water in Iraq, as shown and exacerbated by numerous concerns, is an essential factor in the food security crisis. Society can live without it since the first human communities were established on the banks of rivers.

The Historical documents reveal that the discovered important civilizations were associated throughout history with water and the existence of rivers. The Mesopotamian civilization was on the banks of the Tigris and Euphrates rivers. As for the society of the Nile Valley, it was on the banks of the Nile. The Babylonians believed that when he was angry with his parish, he punished them with flooding, and this parish warned him and prayed to him not to be mad at her. The Pharaohs offered offerings to the Nile. Its importance comes as it is used for industrial and agricultural purposes and domestic use. The research problem is the limited water supply in Iraq compared to the growing demand due to improved living standards and rising populations, fluctuating from year to year and high levels of pollution and problems with upstream countries Turkey, Syria, and Iran.

## **1. Literature review**

As most countries strive for continuing economic growth, the increasing water demand may potentially contribute to the higher trend in human withdrawals that have been documented over the previous century. A significant driver of increasing global freshwater withdrawals has been irrigation, the most critical driver thus far. But other industries, particularly in industrialized nations, have also played a substantial role, for example, water for power plant cooling in the United States and Europe (Agency, 2010). A similar trend may emerge in emerging regions as their economic development grows increasingly reliant on energy inputs and other water-intensive commodities. In addition, the increase in population and urbanization rates in these nations would also increase the demand for municipal water by homes, putting further strain on freshwater supplies. As a result, global non-agricultural water consumption is expected to expand fourfold for industry and more than double for thermal cooling and

municipal applications (Marchal et al., 2011). Again, the most significant growth is likely to occur in emerging markets (Wada et al., 2016).

Because there are significant disparities in the distribution of water endowments across different global regions, the expected increase in water demand in water-scarce places would result in more generalized and frequent imbalances between demand and supply than in the other areas. When economic activities are disrupted, the ramifications can be widespread (Wang, Fang, & Hipel, 2008). They are affecting all sectors and households, either directly through a reduction in water availability due to increased competition among users or indirectly by a decrease in the supply of water-intensive commodities. Moreover, as global supply chains grow more connected, the ramifications of this integration might be seen outside of these regions due to international commerce even though water trade is permitted both formally and informally (Breviglieri, do Sol Osório, & Puppim de Oliveira, 2018). In many instances, the exchange of water withdrawal rights remains restricted due to restrictions resulting from government intervention and limited conveyance capacity. Regions currently capping withdrawals to avoid river-basin overexploitation generally do so by prioritizing user groups based on historical patterns that are highly conducive to economic inefficiencies (Nechifor & Winning, 2018). As a result, complete water mobility across broad geographical regions may be hampered because of the expenses associated with conveyance infrastructure, institutions, and use rights transactions. However, water usage efficiency may be enhanced by considering market-based allocation mechanisms.

Several studies (Hejazi, Edmonds, Chaturvedi, Davies, & Eom, 2013; Shen et al., 2014; Shiklomanov & Balonishnikova, 2003; Wada & Bierkens, 2014; Wada et al., 2016) have been conducted in recent years to estimate the extent of future demand in the context of socio-economic growth. Although measuring the economic consequences of water shortages caused by a mismatch between rising demand and limiting freshwater supply is underway, it is still in its early stages. The majority of economic modeling has been devoted to the consideration of water shortage in connection to agricultural production (Co-Operation & Development, 2017; Liu, Hertel, & Taheripour, 2016; Ponce, Parrado, Stehr, & Bosello, 2016; Winchester, Ledvina, Strzepek, & Reilly, 2016) and its implications for crop output. As a result of excluding the direct effects of water shortages on households and sectors other than agriculture from these studies, the economic consequences of water scarcity are understated, and there is no discussion of alternative economy-wide water management options to alleviate these consequences. At the same time, few studies have been conducted on the macroeconomic implications of water scarcity (Berrittella, Hoekstra, Rehdanz, Roson, & Tol, 2007). These studies have either been limited to a single year (comparative statics) or have included only a few elements that consider the relationship between socio-economic development and water demand (Berrittella et al., 2007). Only the most recent attempt, Roson and Damania (2017), attempted to address the relationship between socio-economic growth and economy-wide water deficits and the role of water productivity in resource allocation across sectors in the context of limited water supply, among other things. Despite this, the study employs a highly rigorous water allocation method since water continues to be an implicit element of production. As a result, an endogenous adaptation of economic sectors to water shortage based on the shadow price of water is not achievable.

## **2. Data and Method**

As part of the midstream socioeconomic development route, this article evaluates the real economic consequences of the demand-driven water shortage in Iraq. It does so by considering the trade-offs between macroeconomic consequences and food security. When it comes to water usage through economic activities, the research employs an exploratory

analytical approach with a high degree of detail, which allows for the internal adaptation of a specific sector to water shortages. Aspects of the macroeconomic impact that depend on the relative size of industries with poor water productivity, the amount of water used in these sectors, and the ability of crucial water consumers to replace water inputs in times of shortage are all considered. The scenarios with the most significant negative departures in GDP are those in which consumers have little mobility to reallocate water among themselves. On the other hand, when demand patterns are adjusted in response to disparities in water productivity, substantial alleviation is gained; however, this comes at the expense of severe imposition on food security prospects.

### 3. Results

#### 3.1. Analysis of The Water Shortage In Iraq

The waters of the oceans, seas, lakes, rivers, and other bodies of water cover 75% of the earth's surface area, with an estimated total volume of 1,360 million cubic kilometers (as measured in cubic kilometers). Saline water in the seas and oceans, which account for 97 percent of the world's water, or 1,319.2 million cubic kilometers, accounts for 97 percent of the world's water. While The remaining 40.8 million cubic kilometers of freshwater, or 3% of total freshwater, are represented by ice, rivers, lakes, groundwater, and other bodies of water, with rivers and icebergs accounting for 75% of total freshwater. According to the United Nations, freshwater for rivers and lakes accounts for only 1% of the total amount of water on the planet. As a consequence of yearly rainfall and snowfall estimated at 110,000 cubic kilometers, freshwater resources are replenished continuously. Of this total, around 70,000 cubic kilometers evaporate, and 40,000 cubic kilometers flow into rivers, lakes, and groundwater. The volume of this flowing water is estimated to be 9-14,000 cubic kilometers, and a significant portion of it is disposed of annually in water estuaries. The total flow of water from continents is estimated to be approximately one cubic kilometer per year. It returns to the 41000 seas in the form of 27000 flood flows and 5,000 cubic kilometers of uninhabited space, with about 9000 cubic kilometers of water remaining worldwide for human use for agricultural, industrial, and domestic purposes United Nations Environment Programme. Table 1 depicts an estimate of the total amount of water available on the planet and alternative distributions. In general, there are three significant sources of water resources in the world: rivers, lakes, and groundwater.

1. Rainwater, surface water, and groundwater are examples of conventional water resources.
2. Unconventional water resources include treated water and desalinated water.
3. Miscellaneous water resources comprise species that do not fit into the categories of the preceding species, such as water (overdrafts), water and iceberg transfers, and measures used to avoid evaporation and leakage from the water supply.

Table 1. The world's water sources and various distributions

| Source of water                     | The volume of water in cubic kilometers | The importance of water in cubic miles | Freshwater ratio | The whole percentage of water |
|-------------------------------------|-----------------------------------------|----------------------------------------|------------------|-------------------------------|
| Oceans, seas and bays               | 1,338,000,000                           | 321,000,000                            | --               | 96.5                          |
| Permanent blocks, glaciers and snow | 24,064,000                              | 5,773,000                              | 68.7             | 1.74                          |

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|                  |               |             |       |        |
|------------------|---------------|-------------|-------|--------|
| Groundwater      | 23,400,000    | 5,614,000   | --    | 1.7    |
| torment          | 10,530,000    | 2,526,000   | 30.1  | 0.76   |
| salty            | 12,870,000    | 3,088,000   | --    | 0.94   |
| Soil moisture    | 16,500        | 3,959       | 0.05  | 0.001  |
| Permafrost land  | 300,000       | 71,970      | 0.86  | 0.022  |
| Lakes            | 176,400       | 42,320      | --    | 0.013  |
| torment          | 91,000        | 21,830      | 0.26  | 0.007  |
| salty            | 85,400        | 20,490      | --    | 0.006  |
| Atmosphere       | 12,900        | 3,095       | 0.04  | 0.001  |
| Swamp water      | 11,470        | 2,752       | 0.03  | 0.0008 |
| Rivers           | 2,120         | 509         | 0.006 | 0.0002 |
| Biological water | 1,120         | 269         | 0.003 | 0.0001 |
| Total            | 1,386,000,000 | 332,500,000 | -     | 100    |

Source: S.H. Shinder, *MoaWater Response: Encyclopedia of Climate and Weather, Volume 2*, Oxford University Press, New York, No Date, p. 817-828.

**Table 2. Traditional water resources in Iraq and other Arab countries (1 billion cubic meters)**

| Country      | Available water resources | Country   | Available water resources |
|--------------|---------------------------|-----------|---------------------------|
| Iraq**       | 81.65                     | Tunisia   | 4.99                      |
| Egypt        | 76.25                     | Oman      | 2.467                     |
| Morocco      | 38.33                     | Jordan    | 1.24                      |
| Sudan        | 34.5                      | Libya     | 1.163                     |
| Syria        | 27.41                     | Palestine | 0.63                      |
| Algeria      | 19.17                     | Djibouti  | 0.32                      |
| Somalia      | 14.64                     | Kuwait    | 0.23                      |
| Lebanon      | 11.56                     | U.A.E     | 0.17                      |
| Mauritania   | 9.33                      | Bahrain   | 0.15                      |
| Saudi Arabia | 7.092                     | Qatar     | 0.05                      |

|       |      |                      |     |
|-------|------|----------------------|-----|
| Yemen | 6.45 | Total Arab countries | 338 |
|-------|------|----------------------|-----|

Source: *Table of the researcher's work based on:*

- Arab Monetary Fund, et al., *Unified Arab Economic Report, Abu Dhabi, 2018, p. 301.*
- Arab Monetary Fund, et al., *Unified Arab Economic Report, Abu Dhabi, 2020, p.50.*
- Arab Organization for Agricultural Development, *Agriculture, Livestock and Fisheries sector in the Arab world, 2015.*

Iraq was the leading Arab country in terms of water supply in 2015, supplying 81.65 billion cubic meters per year, making it the most abundant. On the other hand, table 2 shows that Qatar ranks last among Arab countries in terms of water supply, with a total annual water supply of 0.05 billion cubic meters.

### 3.2. The Water Demand in Iraq

In general, the distribution of water consumption across various economic applications in industrialized nations differs from the distribution in underdeveloped ones. In terms of water consumption, agriculture is the first human activity to consume significant amounts of renewable fresh water every year, accounting for around 69 percent of global total water consumption and 91 percent in developing nations. In contrast, this number lowers to 39 percent in industrialized countries, with industry accounting for 23 percent of total consumption. The remaining 8% of the total is utilized for domestic consumption worldwide. For agricultural purposes, water usage in Arab nations is no different from that of undeveloped countries. As seen in Table 3, it utilizes 91 percent of the total, with industry consuming 4 percent and residential usage accounting for the remaining 5 percent.

Table 3. Annual distribution of water uses to different economic sectors

| Country              | Distribution of water to economic sectors |          |          |
|----------------------|-------------------------------------------|----------|----------|
|                      | Agriculture                               | Industry | Domestic |
| World                | 69                                        | 23       | 8        |
| Developed countries  | 39                                        | 47       | 14       |
| Developing countries | 91                                        | 5.0      | 4.0      |
| Arab Countries       | 91                                        | 4.0      | 5.0      |
| Israel               | 68.4                                      | 5.6      | 26       |
| Iraq                 |                                           |          |          |

Source:

- Dr. Mahmoud Al-Ashram, *Water Economics in the Arab World and the World, First Edition, Center for Arab Unity Studies, Beirut, 2020, p. 31.*

The distribution of renewable freshwater yearly is imbalanced on the world's continents. As it varies from one continent to another, the individual's portion fluctuates appropriately. According to the statistics in Table (4), the person in the South American continent is at the forefront of the world's continents regarding access to freshwater, as he gets 28.3 thousand cubic meters yearly. Next follows the individual in North and Central America at a pace of 17.5 thousand cubic meters annually. While the per capita in Asia ranks bottom at an average of 3.3 thousand cubic meters per year. The gap in the per capita share of renewable freshwater yearly is not restricted to the world's continents but extends to the international level. Depending on the population size, current levels, and social and economic development patterns, people in different countries derive different benefits from freshwater. The demand for water in affluent nations differs from that of underdeveloped countries. For example, the average per capita use of water in the United States of America is 96 times greater than per capita consumption in

Ghana. We also discover that the per capita share in Canada is 120 thousand cubic meters yearly. In contrast, this share in India does not surpass 2500 cubic meters, and in Kenya, it reduces to less than 600 cubic meters.

Table 4. Annual per capita freshwater by continent for 2020 and 2020

| continent                 | 2020 | 2020 |
|---------------------------|------|------|
| South America             | 4808 | 28.3 |
| North and Central America | 21.3 | 17.5 |
| Africa                    | 9.4  | 5.1  |
| Europe                    | 4.6  | 4.1  |
| Asia                      | 5.1  | 3.3  |

Source: *Dr. Mahmoud Al-Ashram, Water Economics in the Arab World and the World, First Edition, Center for Arab Unity Studies, Beirut, 2020, p. 29.*

### **3.3. Reasons and of Water Crisis In Iraq**

There are many water-related problems in Iraq, including long-standing issues such as fluctuating rainfall and snow. However, some have emerged clearly in recent decades, such as those with upstream countries Turkey, Iran, and Syria.

#### **1. Desertification**

Desertification is an indirect problem arising from the issue of water shortages in Iraq, as we have already shown that the annual water supply as an average is almost constant. In contrast, water demand continues to increase due to the increase in population size and the development of living standards. The study of desertification is relatively new, as the first scientific text bearing this name appeared more than half a century ago. The first desertification map was planned by United Nations bodies in 1977, coinciding with the United Nations Desertification Conference in Nairobi, Kenya. Desertification is a word derived from the desert. It means that the earth is degraded in arid, semi-arid, and dry semi-humid areas, resulting in the loss of plant life and biodiversity. Desertification is divided into four types: very severe desertification, which is the type of desertification that transforms the earth into a permanently hopeless situation, and the second type is severe desertification, which results in the spread of unwanted plants and a reduction in land productivity by up to 50 percent. It is very limited in vegetation and soil, as with land in The Arabian Peninsula and the Sahara Desert.

The world loses between 50,000 and 691,000 square kilometers of agricultural land each year due to desertification. About one-third of the earth's land is vulnerable to desertification. In more than 100 countries around the world, nearly 1 billion of the world's more than 6.6 billion people are affected by the desertification of their land, forcing them to leave their agricultural land and migrate to cities for employment. According to the WWF World Wide Fund for Nature report, the Earth lost about 30 percent of its natural resources between 1970 and 1995. Iraq has suffered from the problem of desertification because there is a large area of its territory of 166,687 square kilometers has been desertified. Its part constitutes more than 38 percent of the country's total area. More than half of the country's land is at risk of desertification, a problem that threatens 237,365 square kilometers, making it a severe issue. This problem is compounded by the fluctuation of the amount of rainfall falling on the country and that it has fallen significantly below the rate for many seasons. Thus, it reduces the amount of rain falling from its average annual average of 99.9 billion cubic meters per year. Drought has adverse effects. The lack of rainfall leads to desertification due to sand creeping, causing water scarcity, environmental scarcity, decreased agricultural and animal production, people from affected areas to cities, and causing the spread of diseases and epidemics.

## **2. Pollution**

Another problem facing Arab countries is pollution, i.e., pollution of water quantity and quality. The pollution in the language means mixing something with what is outside it, and it is said: polluting the thing with something. In other words, mixed it with it. In terms of pollution, pollution is the existing situation in the environment resulting from the changes introduced in it, which cause human beings to disturb, damage, disease, or death directly or by disrupting environmental regulations. Pollution, therefore, affects all ecological elements, including plants, animals, humans, and the composition of non-living natural components such as air and water. Waterways have not been spared pollution, and in many places, rivers and lakes have become deplorable due to the waste dumped in the industry, and pollution has hit both closed lakes and open seas. In general, water pollution is divided into four types. Biological pollution results from water containment of organisms such as bacteria, viruses, parasites, and algae. These pollutants are primarily produced due to mixing human and animal waste with water. The second is chemical pollution, and this pollution is often caused by increased industrial or agricultural activities near water bodies, resulting in the leakage of various chemicals, such as salts. Mineral acids, fertilizers, and pesticides. The third sort is physic pollution that occurs from modifying the standard water requirements by changing its temperature, salinity ratio or raising the number of substances trapped. whether of organic or non-organic origin and resulting in a rise in the percentage of salinity of water most likely due to an increase in the quantity of Radiation contamination is the latter. The cause of this contamination is mainly by radioactive leaks from nuclear reactors or by disposal of such waste in seas, oceans and rivers, and frequently does not occur. This pollution makes it the most dangerous species in this water, most likely absorbed by organisms in these waters and then transmitted to humans while eating these organisms, causing many serious effects, including defects and mutations in genetic genes.

## **3. Problems With Upstream Countries**

One of Iraq's fundamental challenges is its problems with upstream countries like Turkey, Iran, and Syria and the principle of oil-water exchange (Carkoglu, Eder, & Kirisci, 2005). Turkey is still working on the GAP jungle project, which includes the construction of 21 dams to store 186 billion cubic meters of water. It has begun to build massive dams and water reservoirs without heeding the opposition of Iraq and Syria, such as the Keban Dam. It was completed in 1973 with a storage capacity of 31 billion cubic meters, the Qara-Qaba Dam, which has 11 billion cubic meters, and the Ataturk Dam, the Bergak Dam, the Qara-Qaba Dam, and others. Israel also played a role in these problems despite its geographical location through cooperation with Turkey to supply water in the future at the expense of the share of Iraq and Syria, through an agreement with a Canadian company to make balloons filled with fresh water and withdrawn across the Mediterranean Sea. Considering its financial and technological capacity and relations with the international community, particularly the United States of America and the European Union countries. As for the problems with Iran, they are no less important than previous problems. There are 42 small common rivers and permanent and seasonal tributaries. The largest of which is the Karon River, which flows into the Shatt al-Arab. Most of these rivers and tributaries originate from Iranian territory. Therefore, they may change the course of many of them into Iranian territory, especially concerning the rivers of Karon, Karkha, and Lund. It has dramatically affected the salinity of the Waters of the Shatt al-Arab and the change in the water quality. It involved the agricultural land near the river banks and domestic water consumption.

In general, Iraq's problems with Iran concerning the water issue date back a relatively long time, particularly about the waters of the Shatt al-Arab. Since the days of the Ottoman Empire, the water-sharing mechanism has organized three basic agreements: the 1847 Erzurum

II Convention, which provided for the Ottoman Empire's recognition of Iran's sovereignty over al-Muhammedra and on the territories on the eastern bank of the Shatt al-Arab. In 1913, a protocol on the Iraqi-Iranian border between the Ottoman Empire and Iran was signed under British auspices. However, Iran has acquired new rights due to Iraq's internal problems of the Iraqi government's war with the Kurds, as the agreement was a deal to end Iranian aid to the Kurds. Iraq abolished the Convention in 1980 and returned to recognition after the occupation of Kuwait in 1990.

#### **4. Waste In Water Use**

One of the water problems in Iraq is the waste of water use in various uses (Ewaid, Abed, Chabuk, & Al-Ansari, 2021). For example, water uses in developing countries goes to the agricultural sector, amounting to approximately 90 percent of the total water consumed (Weinthal & Sowers, 2020). In contrast, the industrial sector and domestic use consume up to 10 percent of the water available. The large proportion of water allocated to the agricultural industry raises an important issue related to the irrigation methods used in local agriculture. Most agricultural land depends on traditional methods and does not use modern techniques such as drip spraying or padded canals only on a limited scale. About 90 percent of irrigated agricultural land depends on old roads or surface irrigation methods (Al Ibrahim, 2021). Hence, a waste of water use in this sector is a clear issue and does not require a detailed study. The proportion of water wastes estimated at 70 to 80 percent is caused by evaporation or flow into the Arabian Gulf through the Shatt al-Arab. Some crops in this area also contribute to increased evaporation and leakage rates below the soil due to their continuous flooding, such as rice, which is widely grown in central and southern Iraq.

#### **3.4. The Food Security in Iraq**

Increasing emphasis has been paid to the notion of food security since the 1970s, owing to the economic, social, political, and security elements that it entails (Woertz, 2017). Agriculture and other exports that generate income in foreign currencies must be provided for the state to meet its food security obligations. Food security means that the state produces as much of its food needs as possible in an economically efficient manner that takes into account the relative advantage of that country in delivering the goods it requires and within the limits of its resources and ingredients. It can also be utilized to import other food items in which the state does not have a competitive edge in terms of its manufacturing. Based on each country's comparative advantage in manufacturing food commodities and making them available to residents at prices corresponding with their incomes and material potential, while considering the fair distribution of all citizens, particularly those with low means.

In contrast, keeping a stock that is not less than fully stocked for at least three months and the longer the length of the treasury, the greater the likelihood of increased food security to cope with abnormal situations in the future (Aziz & Muhamad, 2021). Natural disasters, agricultural pests, epidemics, economic crises, wars, social unrest, and other occurrences to which the state may be subject include, but are not limited to, such events. The global food sector witnessed enormous transformations following World War II. Production of strategic food commodities, inventory of strategic food commodities, and surplus strategic food commodities were concentrated in a small number of developed countries. They are dividing the world into two main groups: the Group of Food Exporting Countries (the industrialized countries and some developing countries) and the Group of Food Importing Countries (the vast majority of developing countries). Only a tiny handful of industrialized countries are involved. Agricultural commodities in nine nations account for about 68 percent of world production. The United States, China, France, Canada, Australia, the Commonwealth of Independent States,

India, Turkey, and Argentina are among the countries whose decline rates vary from year to year and from nation to country. Irrigation is necessary to sustain the remaining 15 percent of the land. The United States of America is the world's most significant grain exporter, accounting for over 50% of total global exports and approximately 40% of wheat exports and their limit. Agriculture, or agribusiness as it is known in certain circles, is one of the oldest vocations pursued by human beings in Iraq and all other nations worldwide. Because of its relationship with human strength and living, it is considered one of the most significant professions. Most ancient communities and civilizations were formed in Iraq, Egypt, China, India, Greece, and other human cultures. It is the fundamental building block of all living things. Agriculture continues to be one of the most significant vocations in the country and one of the most vital economic cornerstones of the country. Agriculture has provided the raw ingredients necessary for other sectors to thrive since it is essential to the survival and persistence of human beings and the continuation of life (Dixit & Rzgar, 2019). Because the people of Iraq, like the people of Arabia, have had a vested interest in agriculture from ancient times, it is not necessary to build many dams, which were meant to store water and utilize it to irrigate agricultural land. Some writings governing the relationship of renting land and collecting taxes were written on stones placed in public places for the general knowledge of the community. There are writings written by tribal chiefs explaining the limits of their property and the ways of renting their land, laying out the rules of digging wells to extract irrigation water, and the existence of agricultural terms and names for machines and tools used in agriculture. Agribusiness piqued his interest, and he paid particular attention to it, encouraging land reclamation and the cultivation of various crops and Muslims digging wells and irrigation canals and reclaiming neglected agricultural land. He also transported palm liquids to Europe and coordinated gardens in Spain, which served as a source of crops for Europe.

Agriculture in Iraq has been systematically ignored throughout the country's current history, notably throughout the 1970s and the decade that followed (Jongerden, Wolters, Dijkxhoorn, Gür, & Öztürk, 2019). Following Iraq's invasion of Kuwait, the country was subjected to economic sanctions by the United Nations on August 2, 1990. The government responded by implementing various economic and non-economic policies, including the compulsory marketing of crops, the separation of Kuwait in Agriculture and Irrigation Ministries in 1993, and the reliance on a favorable price policy, particularly for major staple crops such as wheat and rice. Agricultural output has indeed significantly expanded, and the farm sector's contribution to the creation of GDP has increased considerably as well, hitting 34.8 percent in 1991 and rising to 47 percent in 1990 from 16.7 percent the previous year. Because of these policies, the area under cultivation of main grains and industrial agricultural products increased significantly, particularly in the early 1990s, when the area under cultivation of grain grew to 13,241,000 dunums in 1991 from 10,289,000 dunums in 1989. However, the yield rate has declined due to horizontal expansion in production, the cultivation of low-fertility marginal land, and the depletion of fertility. Plantations of winter and summer crops and plantations in semi-guaranteed areas where rainfall rates range from (350-45 mm) per year account for 23% of the country's total land area and are spread throughout 23 percent of the country's total land area. Following the execution of the Memorandum of Understanding between Iraq and the United Nations on the oil-for-food program Food to Oil in April 1996, the Iraqi government established the Food to Oil program. Iraq's agriculture sector continues to suffer from a range of issues due to the conflict's ramifications. The most important concerns were water shortages and pollution, a lack of government assistance for different agricultural production inputs, and power outages. During the day, for lengthy periods, and due to a lack of clear and comprehensive planning targeted at developing this critical sector. Its contribution rate increased from 4.3 percent in 2008 to 5.2 percent in 2009, not as a result of increased agricultural production but rather due to the depreciation of GDP from the previous year (2008).

This decline results from the drop in oil prices following a significant increase in the previous period. Many problems confront Iraq's agriculture. The most critical issues are water supply shortage, water imports from the Tigris and Euphrates rivers, and a high salinity rate in the Shat al-Arab. On the other hand, Turkey failed to meet its water quota due to large projects it has established, and a decrease in rainfall and snowfall from their annual rates. Massive quantities of industrial waste and water are dumped in Syrian water reservoirs, carrying hazardous and poisonous substances that are detrimental to humans and animals, especially during considerably low groundwater levels and watercourses.

## Conclusions

This study utilized the future evolution of unconstrained water demand driven by socio-economic growth as a starting point to assess the implications of water shortfalls on economic activity, welfare, and food security. By comparing the unconstrained demands with regional thresholds for sustainable withdrawals, four regions emerged as water-deficient due to their growth in water demand across five water user archetypes (irrigation, livestock, thermal cooling, industrial water, and municipal water)—Iraq, South Asia, the Middle East, and Northern Africa. The reduction in water demand in these locations was enabled utilizing four different water allocation systems. The paper confirms the absence of an effective international agreement controlling the water shares of the shared rivers between Iraq, Turkey, and Syria to regulate the shared water. The country's high proportion of water losses, as the percentage of failures in agriculture approaches 70 percent, and in-home usage reaches 40 percent. Continuing conflicts between Iraq and the upstream nations, these problems are anticipated to rise due to the increased demand for water, which is not confined to river water. Still, they may encompass the management of shared groundwater in the future.

There is a lack of governmental and general comprehension of the seriousness of the crisis produced by water shortage and its repercussions in the future. The agriculture sector has been neglected in Iraq for many decades. It was only taken care of during the era of the economic embargo before implementing the Memorandum of Understanding between Iraq and the United Nations. The problem is not confined to the scarcity of water in the nation. Still, it is characterized by water that reaches high levels of pollution, and this problem is aggravated by its admission into Iraqi land. Therefore, it is vital to pay attention to the agricultural sector and improve output levels to provide self-sufficiency and export surplus overseas. It is also feasible to benefit from sophisticated technology in water usage in numerous economic aspects, notably in the agricultural field, such as depending on the drip irrigation method and the use of lined canals. Eighty-five percent of the irrigated area employs traditional irrigation technologies, reflecting the high water losses rates. It is vital to develop research institutes specializing in water in universities and government agencies and benefit from Arab and worldwide expertise in this subject. It is also essential to enhance government efforts and civil society groups in educating the public on the requirement of the economy and not wasting water used to decrease waste and waste. It also demands the issuance of legislation that ban the use of riverbeds in the discharge of heavy water or the disposal of industrial and non-industrial trash in them. Finally, it is necessary to coordinate with the international community to put pressure on Turkey to sign agreements and treaties that guarantee a fair sharing of water, as well as on Iran to prevent changing the course of the Karun River, which led to an increase in salinity in the Shatt al-Arab.

## References

- Agency, I. E. (2010). World energy outlook 2013. *Int. Energy Agency*, 3.
- Al Ibrahim, S. N. (2021). The Effect of High-Water Salinity Concentrations on the Agricultural Reality in Samarra District. *Review of International Geographical Education Online*, 11(3), 1068-1088.
- Almagtome, A. H., Al-Yasiri, A. J., Ali, R. S., Kadhim, H. L., & Bekheet, H. N. (2020). Circular Economy Initiatives through Energy Accounting and Sustainable Energy Performance under Integrated Reporting Framework. *International Journal of Mathematical, Engineering and Management Sciences*, 5(6), 1032-1045.
- Aziz, L. D. K. Y., & Muhamad, L. D. B. B. (2021). A Study of The Reality of Food Security in Iraq And Its Potential for The Period 1990-2018. *Tikrit Journal of Administration and Economics Sciences*, 17(54 part 3).
- Berrittella, M., Hoekstra, A. Y., Rehdanz, K., Roson, R., & Tol, R. S. (2007). The economic impact of restricted water supply: A computable general equilibrium analysis. *Water research*, 41(8), 1799-1813.
- Breviglieri, G. V., do Sol Osório, G. I., & Puppim de Oliveira, J. A. (2018). Understanding the emergence of water market institutions: learning from functioning water markets in three countries. *Water Policy*, 20(6), 1075-1091.
- Carkoglu, A., Eder, M., & Kirisci, K. (2005). *The political economy of regional cooperation in the Middle East*: Routledge.
- Co-Operation, O. f. E., & Development. (2017). *The Land-Water-Energy Nexus: Biophysical and Economic Consequences*: IWA Publishing.
- Dixit, P., & Rzgar, R. (2019). Diversification of economy—an insight into economic development with special reference to Kurdistan's oil economy and agriculture economy. *Russian Journal of Agricultural and Socio-Economic Sciences*, 85(1).
- Ewaid, S. H., Abed, S. A., Chabuk, A., & Al-Ansari, N. (2021). *Water Footprint of Rice in Iraq*. Paper presented at the IOP Conference Series: Earth and Environmental Science.
- Ghorbani, M. A., Deo, R. C., Karimi, V., Yaseen, Z. M., & Terzi, O. (2018). Implementation of a hybrid MLP-FFA model for water level prediction of Lake Egirdir, Turkey. *Stochastic Environmental Research and Risk Assessment*, 32(6), 1683-1697.
- Giroto, F., Alibardi, L., & Cossu, R. (2015). Food waste generation and industrial uses: a review. *Waste management*, 45, 32-41.
- Hejazi, M., Edmonds, J., Chaturvedi, V., Davies, E., & Eom, J. (2013). Scenarios of global municipal water-use demand projections over the 21st century. *Hydrological Sciences Journal*, 58(3), 519-538.
- Jongerden, J., Wolters, W., Dijkxhoorn, Y., Gür, F., & Öztürk, M. (2019). The politics of agricultural development in Iraq and the Kurdistan Region in Iraq (KRI). *Sustainability*, 11(21), 5874.
- Liu, J., Hertel, T., & Taheripour, F. (2016). Analyzing future water scarcity in computable general equilibrium models. *Water Economics and Policy*, 2(04), 1650006.
- Marchal, V., Dellink, R., Van Vuuren, D., Clapp, C., Chateau, J., Magné, B., & Van Vliet, J. (2011). OECD environmental outlook to 2050. *Organization for Economic Co-operation and Development*, 8, 397-413.
- Nechifor, V., & Winning, M. (2018). Global economic and food security impacts of demand-driven water scarcity—Alternative water management options for a thirsty world. *Water*, 10(10), 1442.
- Ponce, R., Parrado, R., Stehr, A., & Bosello, F. (2016). Climate change, water scarcity in agriculture and the economy-wide impacts in a CGE framework.

- Roson, R., & Damania, R. (2017). The macroeconomic impact of future water scarcity: An assessment of alternative scenarios. *Journal of Policy modeling*, 39(6), 1141-1162.
- Shen, Y., Oki, T., Kanae, S., Hanasaki, N., Utsumi, N., & Kiguchi, M. (2014). Projection of future world water resources under SRES scenarios: an integrated assessment. *Hydrological Sciences Journal*, 59(10), 1775-1793.
- Shiklomanov, I. A., & Balonishnikova, J. A. (2003). World water use and water availability: trends, scenarios, consequences. *International Association of Hydrological Sciences, Publication*, 281, 358-364.
- Wada, Y., & Bierkens, M. F. (2014). Sustainability of global water use: past reconstruction and future projections. *Environmental Research Letters*, 9(10), 104003.
- Wada, Y., Flörke, M., Hanasaki, N., Eisner, S., Fischer, G., Tramberend, S., . . . Ringler, C. (2016). Modeling global water use for the 21st century: The Water Futures and Solutions (WFaS) initiative and its approaches. *Geoscientific Model Development*, 9(1), 175-222.
- Wang, L., Fang, L., & Hipel, K. W. (2008). Basin-wide cooperative water resources allocation. *European Journal of Operational Research*, 190(3), 798-817.
- Weinthal, E., & Sowers, J. (2020). The water-energy nexus in the Middle East: Infrastructure, development, and conflict. *Wiley Interdisciplinary Reviews: Water*, 7(4), e1437.
- Winchester, N., Ledvina, K., Strzepek, K., & Reilly, J. (2016). The impact of water scarcity on food, deforestation and bioenergy.
- Woertz, E. (2017). Food security in Iraq: results from quantitative and qualitative surveys. *Food Security*, 9(3), 511-522.
- Zhang, H. (2019). Comprehensive evaluation and coordination analysis of water, energy and food nexus in China. *Lanzhou University, Lanzhou*.