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Impacts of Extreme Events on Water Availability

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ABSTRACT

One of the significant disputes in the world is battle for access to water supplies. The Middle East district is important in the aspect of geopolitical and strategic situation. Declining water supplies in this district will be because of global climate alteration. Climate change is an occurrence that threatens the future of the world. The Middle East is sited in a dry and semi-arid district with restricted water supplies and climate alteration an decline water supplies in its catchment districts via 14% through 2050.In this chapter, by analyzing the impacts of reliance changes established on the Intergovernmental Panel on Climate Change (IPCC) and World Bank information by 2020, according to scenarios of IPCC, the temperature in this region will risethrough2-3 degrees and precipitation can decreasethrough40 percent. This will have a direct effect on water supplies in this region and will make significant disputes for water supplies.

Keywords: *Climate change, water availability, Middle East, dry and semi-arid region, reduce water*

INTRODUCTION

Water supplies in the word especially in developing areas have become strained because of alterations in climate outlines (Haydar et al. 2016). The water supplies of areas which affected by climate change usually characterize through two seasons, a mild, wet winter and a hot, dry summer (Döll et al. 2015). In recent years, several regions have become at risk to the effects of extreme climate happenings. The effects of the extreme events on water resources has become more distinct (Chen et al. 2015). The effects of climate change on water supplies is not only involved surface water, however, groundwater can affect by climate change (Meixner et al. 2016). Groundwater can be a more reliable water resource than the surface water supply (Kurylyk et al. 2015). Nevertheless, this is only sustainable where, over the long term, extractions keep well below recharge, whereas care should also be taken to prevent extreme decline of groundwater outflow to rivers (Snyder et al. 2015). The shortage or increase in water supplies depends on different parameters include ; 1) changes in rainfall, 2) changes in water demands, 3) changes in sea level, 4) changes in water hygiene (Berardy et al. 2017). Climate change has a scientific difference. Climate change is two-dimensional and fluctuations and deviations outline the climate parameters of the mean and can occur at different times, but climate change is a widespread fluctuation in the climate of an area that is currently experiencing a warming trend Consider the temperature of the planet as part of the climate change (Venkataraman et al. 2016). Climate change is one of the greatest environmental challenges that the world faces today with rising temperatures that change climate patterns (Barreca et al. 2016).

The rise of the sea level and the change in the climate thresholds are the consequences of climate change (Hansen et al. 2016).Climate change and global warming have led to the spread of droughts and their persistence, and this change causes uneven distribution of rainfall and affects water resources (Schlaepfer et al. 2017). In the Middle East, water resources are decreasing and this region will face a shortage of water supplies in the future. More than 5 billion inhabitants of the planet will be affected by dehydration. Despite the scientific growth and raising our awareness of the regional and global consequences of climate change, little attention has been paid to the effects of these changes in the Middle East and Central Asia. In the Middle East, climate change is a major challenge, especially if rising droughts, the

ongoing challenge, as well as the growing demand for water and water scarcity, is a challenge to a large extent. According to the IPCC estimates and rainfall reduction, there will be severe droughts in the area. According to the modeling of more than 80 to 100 million people by the year 2050, there will be a shortage of water in the region, and groundwater will also slow down. These factors indicate that water levels in countries like Qatar, UAE, Kuwait will rise to 5%.

They will come in contact with water and will be destroyed. According to the FAO, more than 80 percent of the climate change estimation models will reduce precipitation in the region by more than 40 mm per year. Reducing the precipitation of the region will also risk water.

The aim of this chapter is to analyze effect of extreme climate events on both water supplies and water quality.

MATERIALS AND METHODS

Due to water constraints in the Middle East, the importance of studying it is clear. This research studies changes and its impact on Middle Eastern water resources. The research method is analytical and documentary and the research data are taken from the FAO, IPCC and modeling and then analyzed. However, some of the characteristics of climate models have been criticized, including the still unknown clouds associated with climate change, the effects of aerosols, and the interaction between the ocean and the atmosphere and the processes between them are not fully identified. Using a general approach to assessing the consequences of climate change on a hydrological regime, using climate information and various models such as RCMs and GCMs, and regional climate analysis and hydrological models, can help us determine climate and future climate conditions in the region(Gu et al. 2016 and Osman et al. 2017) . Inform.

However, if long-term rainfall and runoff data have a significant correlation and there is no water balance in the basin, they should be avoided. Unfortunately, such data are not available or available in most of the countries studied. While data is available for some of the major basins in the region, long-term statistics are not available and most stations are newly established. Therefore, estimating climate change and its impacts is possible by simulated models such as GCM. Several GCM models have been used to predict the future of the Earth in different scenarios (Nuutinen et al. 2016). Recent efforts have focused on standardizing scenarios at different time scales and for maximum confidence in results in various GCM models.

RESULTS

The forecast of climate change in the Middle East has been estimated and compared in various GCM models such as ECHAM4, HadCM2, CGCM1, and GFDL. The IS92a scenario is used to synchronize assumptions. Greenhouse gases and sulfur aerosols are calculated for GCM models, and the outlook for climate is estimated until 2020. Temperature variations are highest during the winter months (January, February and March) and summer months (July, August, and September). Precipitation changes during the wet seasons and from October to April. These models showed small changes in the average rainfall in local areas. While the temperature rises in all seasons. The average temperature has increased in the summer. Mediterranean regions such as Lebanon, Palestine, and the coast of Syria have had the lowest decline (Kelley et al. 2016). Differences between predictions in different models have revealed the maximum increase in Syrian 1.3 degrees in the summer and the process of rising temperatures will continue. This increase in temperature will lead to an increase in the demand for agricultural water due to the large evaporation. Increasing temperature and evapotranspiration and decreasing precipitation will increase the phenomenon of desertification and salinity of the soil.

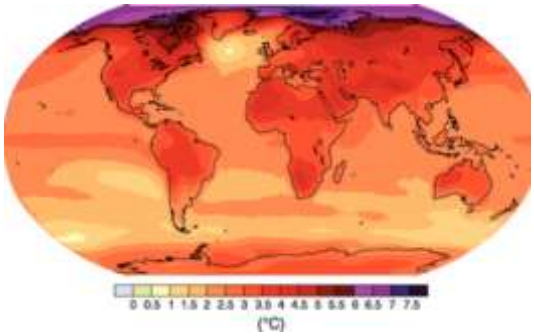

Figure1. *Temperature changes from 1980 to 2040*

The average winter temperature will also increase, and the temperature difference will decrease between winter and summer, which will reduce the injection of groundwater and reduce water resources. However, some models also reduce the temperature to 1 degree if they double the CO2 in the area, which is consistent with the cooling effect of sulfur particles. Figure 2 shows the variation in the temperature of the

world based on the IPCC scenarios. The study area will experience 1 to 2 degrees of temperature increase. A review of the temperature trend over the period 1900-2000 shows a rise in temperature, especially in recent years (this increase has intensified over the past decade).Figure 3: The trend of rainfall in the Middle East shows that during the past decade, rainfall has decreased with rising temperatures. Figure 4 shows the precipitation trend in the region.

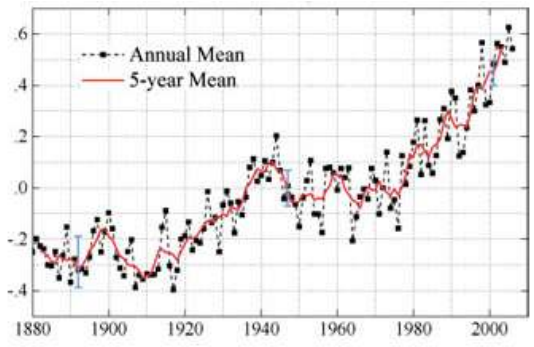

Figure3. *Temperature changes in the Middle East*

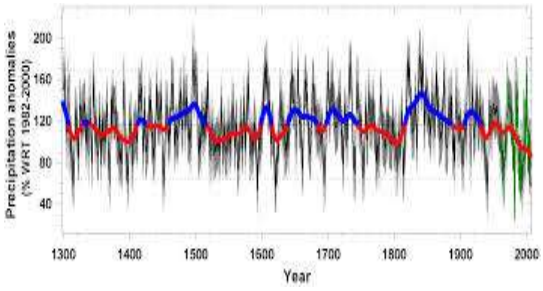

Figure4. *Precipitation changes in the Middle East*

INVESTIGATING THE WATER RESOURCES OF THE REGION

The vulnerability of water resources and their vulnerability to climate change are among the challenges that government officials, scientists have been facing in recent years. Climate change affects the quantity and quality of water resources, and the need for industries to water, agriculture and it affects drinking water. Due to the increase in Earth's average temperature, evaporation will increase and the need for irrigation will increase. It is often assumed that the Middle East has abundant water resources and climates, and that the consequences of climate change in this region are not important or can be neglected. Although, since ancient times, water resources have entered various pressures in the area. And the impressions are too large. Any changes in climatic patterns that make the problem more acute by increasing the temperature and reducing the rainfall.

Table1

In the Middle East, arid and semi-arid areas have the largest extent and water resources are very limited, drought, desertification and the lack of permanent water resources are characteristic of most countries in the region. The rapid growth of the region poses a threat to the pollution and salinisation of water resources, and increasing living standards in the region has increased the demand and demand for water in the region. Water will be one of the scarce resources in the future. Changes in future water resources and runoff

Climate change is one of the most important scenarios. Some countries have plans to develop and store water resources, and even recycle and recycle water for agricultural purposes. Some countries are vulnerable to runoff and water resources.

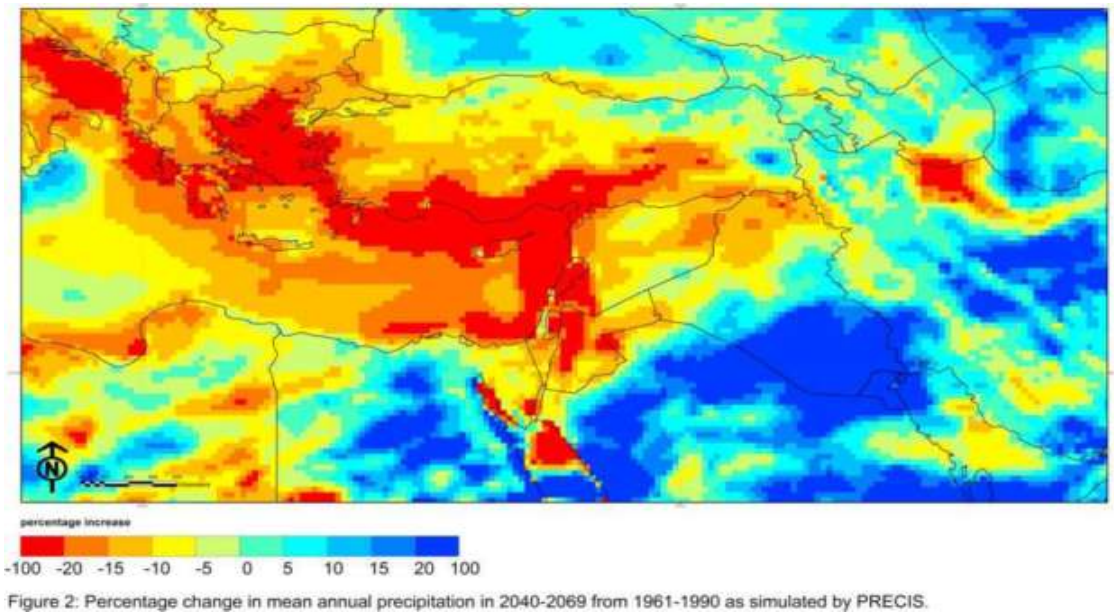

Figure5. *Water availability changes in Middle East*

In arid regions such as the Middle East, which is located in the world's dry belt, rainfall is often scarce and water is inaccessible. So the water in these countries is severely out of reach. Some countries, such as Syria, Lebanon, Jordan and Iraq have good surface water resources, although these countries also have underground water. The rising standard of living and the rapid growth of urbanization have increased the demand for water. In some countries, such as Kuwait, water quality is desalinated and consumed in accordance with the standards of the World Health Organization. The 15 countries of the region use more than 75% of available water for farming purposes. Annual water consumption in the study area is 1710 million cubic meters, which is very high compared to the average world average of 645 million cubic meters per year. In some countries in the region, a large amount of water is used for traditional agricultural uses. The Middle East Water Commission in 1995 suggested that some countries reduce the water used in the agricultural sector by up to 30%. Some countries in the region are heavily dependent on water from outside their political borders. Some of the rivers that are internationally diverse and use different watercourses include Euphrates, Tigris, Jordan, and Indus. The climate modeling scenarios for the region show that 11 to 16 percent of the river runoff, especially the Indus River, is reduced, which will reduce the right of water users in the rivers and will increase international conflicts. These models also show a 20% drop in rainfall in the warm up region to 2 degrees, which will have a direct impact on the water resources of the area. The impact of climate change on the runoff of the region has been studied in some rivers, which in some scenarios predict a 2% reduction in water resources in the region by 2030.

Iran

The impact of climate change on water resources is a vital issue for human life. Even if these people are stopping the greenhouse gas emissions, the rise in temperature and related impacts, including the presence of water and flooding of rivers, will continue for decades to come (Winsemius et al. 2016). In recent decades, the most severe phenomena of rainfall have occurred and parts of the world have experienced the most meteorological phenomena such as severe floods, droughts and heat waves (Marengo et al. 2016). The models of resonant climate change analyze the frequency and severity of these phenomena. Changes in its work along with increasing temperature and reducing snow cover, which affects the quality and quantity of water, force water managers to engage in climate change in their programs. Based on the fifth change assessment report presented in 2016, climate change has led to a change in the hydrological gear and could have severe repercussions in regional water resources. In general, the effects of climate change and global warming on water resources can be summarized as follows:

- Changes in the duration, intensity, form and time of rainfall in different parts of the planet. This could lead to a decline in the years and floods that we have not seen before.
- Change in volume, runoff time and duration. The consequences of this happening in the area of water resources management will bring about many changes and changes. For example, by changing the amount and time of rivers, the problem of water supply will be new problems and a new chapter in the policy of exploitation of reservoirs Dams will dance.
- (C) The rise of the ocean surface due to the melting of polar fridges and the increase in the failure of Levee, which not only caused coastal water logging to cause loss of some coastal land, but also the arrival of the shorter water to the coast and its combination with sweet sources Water on the coast, such as water rejection of rivers and the influx of saltwater into aquifers, will result in the loss of these valuable and limited resources and will create many problems in supplying drinking water.
- Reducing snow reserves in the mountains as water resources in the dry seasons, which will bring about the upswing of the rivers in these days to the current situation and will require revision of the use of dams.
- Changes in the rate of evapotranspiration from the plant surface and its impact on increasing water demand in the agricultural sector and creating many problems in discussing the water supply of this sector due to the problem of water shortages and possibly the necessity of rationing and changing the pattern of cultivation.

The Effect of Climate Change on Runoff and River Flow

Changes in the hydrological cycles of many rivers are mainly determined by seasonal

precipitation and temperature, which establishes a relationship between snow and rain. Studies have seen changes in annual river runoff in a number of watersheds over the past few decades. In some areas, the amount of river runoff has increased, while in other areas its amount has decreased. Predictions show an increase in these changes for annual runoff. Increasing carbon dioxide leads to an increase in the temperature and absolute humidity in the air layers near the surface of the earth. However, increasing CO2 increases rainfall, but rising rainfall is not the same in different locations. In areas with high latitudes, rainfall and runoff are generally increased, but in areas with low latitudes, rainfall increases or decreases depending on the region.

In addition to annual changes, seasonal changes occur in river flows due to climate change. Snow and its melting in mountainous areas are the most important hydrological effects of climate change. For example, high temperatures in mountainous areas reduce the amount of precipitation in snow, resulting in a decrease in snow storm maintenance and an increase in winter runoff. This increase in annual runoff increases with increasing precipitation in the country, and earlier melting of the snow in the spring will lead to changes in peak flow levels. Reducing snow storms will result in milder snow and lower summer precipitation, resulting in longer summer periods few river flows. Changes in the flow regime may also increase the risk of flood and drought.

Chandran et al. (2016)analyzed the rainfall in five stations in united emirate Arab the Man-Kendall test and linear regression method to find that there was no significant trend in annual rainfall series during the period The climate is not studied in the studied stations and none of the tests confirm the presence of the component of annual rainfall climate change in terms of precipitation quantity in the old stations of Iran.

Salman et al. (2018) studied the trend of temperature and precipitation changes in Iraq during the statistical period by using regression and smoothing analysis and showed that the temperature and precipitation of Iraq are increasing trend, and this trend before 1974 with the increasing trend of temperature and seasonal coordination But since 1974, the seasonal and annual trends are in line with each other. Kaskaoutis et al. (2018) also proved the presence of climate change phenomenon in South east Asia.

Caini et al. (2018) using time series methods (difference between mean, moving average, regression equations and Z-SCORE standard to study the changes of major climatic elements of temperature and rainfall in annual and seasonal periods in Kerman synoptic station during a statistical period 29 years old and found that the annual temperature increase of 0.7 ° C on an annual scale and the highest rainfall reduction in the thermal cycles of 1996-2002 was at the annual scale and the precipitation trend was 0.23 mm in the autumn and in other seasons descending.

Dry and semi-arid regions are more sensitive to climate change than wet areas, and runoff is more sensitive to changes in rainfall than temperature rise. Iu and colleagues (2001) used the Man-Kendall test to investigate climate change on southern Taiwan's water resources and found that Which during the wet season increases the amount of runoff and decreases for dry season. The use of long run runoff prediction model for 30 watersheds of the country shows that as the temperature increase causes snow to rain and accelerate the time of snow melting the amount of runoff increases during the winter and decreases in the spring.

Mac and colleagues studied the effects of climate change on the Zayandehrood River and concluded that the amount of precipitation decreased and the temperature increased, so that the precipitation decreased by 10 and 16% and the temperature increased by 3 and 4 degrees ahead It also reduces the flow to 6% and increases the flow coefficient up to 3 times for future periods.

Effect of Climate Change on Flood and its Frequency

Flood is a phenomenon caused by rising water level of rivers and streams and flooding of rivers and plains causing damage to structures and public facilities and human and animal casualties, and flood disasters are one of the most serious disasters in 15 types of disasters Natural that has serious effects on human life in the world. Research shows that floods and droughts have increased in the second half of the 20th century. These floods can not only be attributed to global climate change. Changes in river management and increasing urbanization in flood disasters also affect flood events. The cutting of forest trees in upstream mountainous areas can increase local runoff. At the end of 1358, there were about 12 million hectares of

woody vegetation in Iran, which also increased the risk of flooding in flood areas.

Increasing the surface temperature of the ground causes more water to evaporate, and further evaporation causes the energy to enter the atmosphere in the form of lethal heat. Part of the released energy causes the air to warm and part of it gives the kinetic energy to the air and causes it to move and create wind, both of which cause an increase in evaporation. As annual evaporation increases, salinity increases from sea and ocean levels, and water temperature drops and decreases the density and stability in the sea column. Given the steady flow of rivers and rain If global evapotranspiration increases in a small amount due to the global climate change, based on the principle of the volume survival in the oceans, a large amount of water is needed to bring the water flow to the lower salinity into the oceans and seas therefore, the velocity of the flows in the lagoon and the sea increases.

The rising sea levels and the increasing frequency and severity of the phenomenal meteorological phenomena, such as storms and associated waves, make it difficult for inhabitants of the coastal areas. The effects of climate change and sea level rise include flooding, wetland migration, coastal erosion, salinity and drainage reduction. Increasing the sea level due to thermal expansion due to the increase in temperature and the addition of fresh water due to the melting of ice polar masses According to the latest report from the Intergovernmental Panel on Climate Change, rising sea levels are between 0.20 and 0.60 by 2100. Mac and colleagues examined the effect of climate change on flood abundance in a mountainous basin (Canada) and found that the amount and frequency of flood would increase. Mac and colleagues used the RCM data directly to generate rainfall inputs and potential evapotranspiration for a rainfall-runoff model of British watersheds in order to detect flood variations under climatic conditions, and found that the frequency of flood events was surprisingly large and the waters of the southern and eastern parts of England have been decreasing and have increased in other areas.

The Effect of Climate Change on Drought and Water Scarcity

Drought is the shortage of rainfall in long run periods, which leads to a lack of moisture in the soil and a decrease in the flow of water, and from a climatological point of view, if the precipitation of a location in a given period of time is less than the average rainfall of the same period, we face drought. However, some human components directly affect drought, but the main reason is the lack of rainfall. The models of climate change are more abundant and more predictable for summer droughts due to higher temperature rise.

Groundwater is an important element of the hydrological cycle and is a vital resource for nature, especially wetlands and coastal ecosystems, and for water storage, especially for drinking water. Ground water supply depends on several variables, especially precipitation in the summer. Observations, less nutrition of groundwater due to climate change and extraction. It is also anticipated that groundwater levels will be reduced, as less nutrition is due to shorter feeding periods and less water retention. While rising in winter rainfall, basically, groundwater and soil saturation conditions, which means a faster penetration of surface runoff into groundwater, increases. Studies show that the susceptibility of groundwater resources to a warmer climate in mountainous regions is relatively low and depends on the type of land use. Excessive withdrawal from groundwater table and re-feeding it will cause land plots and irreparable damage, with numerous examples being seen in the world. The continuation of the drop in the water table will gradually expand these gaps at the surface of the earth, which will surely be accompanied by losses. At present, the phenomenon of meeting and creating a gap in the ground level in different parts of Iran has been observed, which is prominent in Kerman, Sirjan, Rafsanjan and recently the Isfahan Mahyar plain.

Amiri (2005) studied the climate change in Rasht city during a 50-year period and found that global climate change over the period considered did not affect the annual precipitation trend in Rasht, but it caused a change in the temperature of Rasht.

Mac and colleagues studied the variation in drought versus the long-term mean of Sistan region, which in drought years, compared with normal conditions, the temperature of air was about 1 degree centigrade warmer, relative humidity of about 5%, and rainfall of about 56%, and evaporation of about 550 mm per year has increased. Mac and colleagues studied the phenomenon of climate change in Semnan city based on monthly and monthly average monthly precipitation parameters and found that rainfall in winter increased somewhat (about 5 percent) and in the summer evaporation increased and

the dry and the warmer is created and the likelihood of drought increases in the summer.

The Effect of Climate Change on Water Quality

Climate change causes significant changes in the variables that affect water quality. These impacts have caused various changes in the hydrology of water bodies, their physicochemical and biological properties, and also changes in anthropogenic pressure. The effects of climate change are not limited to changes in rainfall, but also include other factors. The increase in air temperature causes:

- Reducing the amount of oxygen. Rising water temperature reduces the amount of oxygen and increases the amount of biological respiration, which may result in a decrease in the amount of dissolved oxygen (DO), especially in summer when the flow is less.
- Changing the location and distribution of aquatic organisms: Increased water temperature changes the spatial distribution of aquatic organisms and may lead to the disappearance of some aquatic species.
- Bacteriological conditions and dissemination of these pathogens include severe food poisoning requiring advanced water refinement.
- Reduction of ice organization. For example, studies show that ice decomposition in the rivers is 15 to 20 days earlier, and a change is made to a yearly ice-free period, the 1950s. The lake ice decomposition time is of biological importance because the disappearance of ice cover affects the production and biodiversity of phytoplankton and winter mortality of fish.
- Changes in the nutrient cycle in aquatic systems and the algal blooming: For example, spring blossom of phytoplanktons in the Great Lakes of the United States in the 1990s was one month earlier than in the 1970s.
- With the increase in temperature, the population of bacteria that undergo nitrogen mineralization and nitrification processes in soils are controlled to increase.

With the increase in the number of phytoplanktons due to the rising water temperature, an increase in chlorophyll content can be expected. However, despite the direct correlation between temperature and chlorophyll in the surface water of summer, its effect is not significant. The most important problem with phytoplankton is the smell of mildew produced by green-blue algae. When the green-blue algae increase, the water temperature is relatively high; this increase, coupled with the rise in temperature caused by greenhouse gases, creates better conditions for the activity of green-green algae and increases the odor of mildew. Also, the increase in temperature creates better conditions for the growth of insect and weed species and increases the use of pesticides, resulting in a rise in toxicity caused by soil washing in surface water and underground waters.

Mac and colleagues examined the effects of climate change on the quality of the Mississippi River water, and found that leaching could be increased due to significant reductions in runoff and the increase in the base flow, sediment, and nitrate from streams. So, although water quality may be improved to reduce sediment, nitrate may be increased.

Mac and colleagues evaluated the effects of climate change on the quality parameters (BHD, DO and NH4) of the Pineus River (Greece) for 2050, and found that the biological oxygen content of NH4 increases and the amount of oxygen dissolved decreases due to The loss of the capacity of dilution and low water velocity resulting from river flows has been reduced. Also, the important water quality damage during the summer is expected to be the highest rainfall reduction.

Mac et al. Examined the effects of climate change on nitrate and ammonium parameters in the Kent River (UK), and found that the succession of dry summers leads to the formation of nitrogen in the soil, which when the drought stops from the ground It flows into the currents and increases with increasing nitrate and ammonium values.

Mac et al. Examined the importance of the flow temperature in the effects of climate change on the quality of the San River (France) water. As water temperature increases, the oxygen emission in water decreases and, by affecting nutrients, organic matter and biomass, biological activity increases.

Conclusion

The Middle East in the dry world and the limitation of water resources in the area and the demand for water in the wake of urbanization is one of the issues that will be aggravated by climate change and warming. An increase in the temperature of the region to 2 ° C is confirmed by climate prediction models. This climate

change in the region will have a direct impact on the surface and underground water resources in the region. And according to forecasts, water resources will fall by about 12%. The challenge of the future of the Middle East will be water resources, especially when common water resources will be curtailed, regional disputes will increase.

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