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Methods of water management of the Euphrates River in Anbar Governorate and a comparison of traditional and modern methods

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ABSTRACT

The study found that water consumption passes in three key sectors, and can be studied and measured through detailed in the domestic sector adopted the population of the districts in the province, and the proportion of the population increase for each spend, except spend wetlands dependent on groundwater in various fields and determine the per capita cubic meter, And by determining the number of inhabitants in the per capita share, we obtain the water demand of the household sector, and the household demand is expressed through algorithms of the program (WEAP) .The population was estimated up to the year (2040) based on the base year of2019 , as the growth rate for each district in Anbar Governorate was adopted by summing up the population of the districts. Total water demand recorded in 2020 about (2882.33 million m^3) the amount of the deficit to reach (564.18 million m^3)In 2030 increased the demand for water by (3497.64 million m^3) This high demand has increased by (1,470.8 million m^3) ,while demand rose in 2040 to (4139.43 million m^3) and reached the deficit (2403.8 million m^3) and here it is clear that the overall demand for the province. In order to determine the total demand of the industrial sector, which depends on the river, the current water demand of the various sectors constitutes varying percentages in Anbar Governorate, where the agricultural sector represents (%84) of the total demand, and the household sector represents about (%9). The lowest sectors in terms of water demand, reaching (%6) in Anbar Governorate.

The problem

By addressing the issue in terms of available water quantities and the corresponding increase in demand for it, the problem can be formulated as follows:

- Does Anbar province suffer from a shortage of water imports ?Is what is available is sufficient to meet the need in light of the increased demand resulting from the increase in population and the expansion of development projects ?Does the use of modern methods and technologies have a role in preserving this important resource?

Hypothesis

It is evident through the research that the percentage of water resources for Anbar Governorate is %17 of the water of the Euphrates River, which currently covers the demand for it. The number of population and development plans submitted by the government in the agricultural and industrial fields and the consequent increase in demand.

First :The current reality of the Euphrates River in Al-Anbar Governorate due to the use of traditional methods:

To develop a scientific basis for the management of the Euphrates River water should know the current reality end , including the development of scenarios involving a solution to the problems related to water management, as facing the management of the Euphrates River water in the province of Anbar , a range of challenges, the most important decline in the values of water imports from upstream countries have touched over , As Turkey affirms that the Euphrates River is one of the transboundary rivers and is a natural resource of its own, thus confirming its dominance over the river and that all negotiations focus on efficiency of use and not the sharing of water with the countries located on the river basin. A state, and thus it follows a policy that is close to monopoly (3)Turkey focuses on the optimal use of water because it is aware of the weakness of the basin countries' use of modern technologies in irrigation and other uses, and the arid climate of Iraq and climate changes that contributed to high temperatures, high evaporation rates, and low rainfall were one of the challenges in water management, as well as opportunities for development. Sustainable, which needs management of water supply and demand to create a state of balance conducive to the interest of development, and which needs strategic foundations and plans that work to develop available resources, and benefit from the experiences of countries in sustainable management processes .

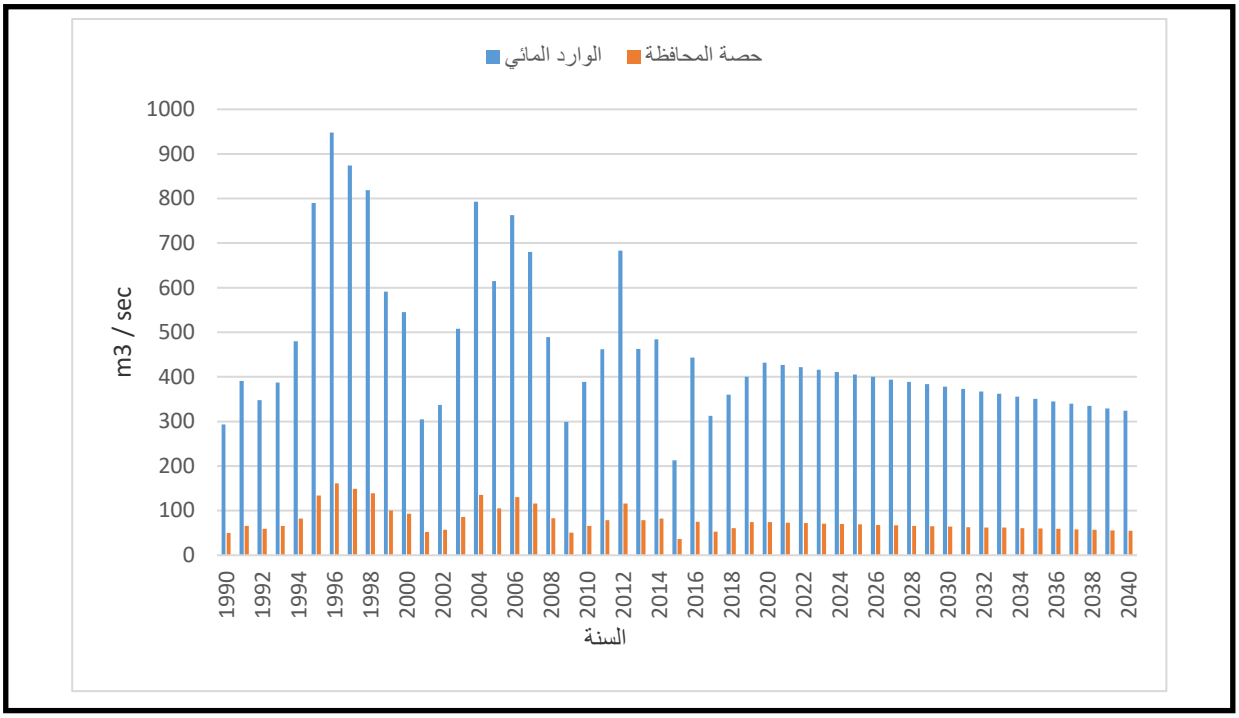
Through the analysis of the data of Figure (1) it becomes clear that there is a decline in the drainage from the Western Hasiba station, and this is a result of the water policies of the upstream countries and the associated expansion of agricultural areas and industrial projects, which requires knowledge of the water reality in light of the use of traditional irrigation methods and the high water demand Home, as well as to the sector, private sector industrial, Related to the distribution of sectors, taking into account the actual share of the governorate of water, which represents (17%) (4) From the water supply from the Hasiba West station, the future demand has been determined through the provision of the (WEAP)With the water supply of the Western Husaybah station for the period from (2019-1990) to estimate the water discharge for the period from(2020-2040) using the linear increase method(Linear Program),

And the water discharge per second was converted to a volume (quantity) through the following equation:

Discharge x Number of seconds per hour x Number of hours of the day x Number of days of the year

$T = 365 \times 24 \times 3600 \times \text{Year} / m^3$ and in this way was determined annual water quantity contained in the Euphrates River and through the quota of Anbar province, amounting to (%17) of the total quantity of the waters of the Euphrates River, and to find out how the future prediction notes Figure (1) through these data , which are provided with the program of the future prediction of the waters of the Euphrates River, the aim of which the program shows the annual knowledge contained the Euphrates River, and to determine the province 's share of water, to create a state of balance between supply and demand.

Figure (1) the water reality and future prediction of the waters of the Euphrates



Source : 1- Republic of Iraq, Ministry of Water Resources, Planning Department , Strategic Studies, National Center for Water Resources Management, unpublished data, for the period.2019-1990

2- Depending on the outputs of a program ,WEAP Version: 2019.2, August 1,2019

The agricultural plans have been adopted in determining the irrigated areas in all the districts approved in the water demand on the Euphrates River, which include crops of wheat, barley, orchards, crops, summer vegetables, crops and winter vegetables, so that the water demand of the agricultural sector is determined through the following equation

Size = total area × requirement per hectare of water m^3 .

The water requirement per hectare is known through the following equation :

$$Dg = \frac{dn}{Ea}$$

Dg= Total water depth , Dn =Net water , Ea= Irrigation efficiency (5)

The water requirement was determined according to the results of the previous equation as in Table (1).

Table (1) hydrological classifications of agricultural crops

Type	Depth (mm)	The water guide for the Christian (M^3 / hectares)	Water dispenser for spraying (M^3/ hectares)	Drip water dispenser (M^3 /hectares)
Wheat - barley	857	8570	6856	-
Winter crops	803	8030	-	5353
Summer crops	1418	14180	-	9453
Orchards	3262	32620	-	21747

Source : Anbar Governorate Agriculture Directorate, Planning Department, unpublished data.2019 .

Through the estimation of the water need for the crops of the agricultural sector in the governorate, the efficiency of irrigation was adopted in order to rationalize the water demand of

the agricultural sector to achieve rationalization opportunities through the best methods as shown in Table (1) where more than one method was adopted, including the traditional method of wind irrigation and modern methods, including the method of spraying For strategic crops, as well as drip irrigation, for crops that are irrigated by the method of meadows, as well as orchards, the purpose of these methods is to know which methods are more efficient in irrigation operations, as shown in Table (2) and through which irrigation methods can be determined to be followed.

Table (2) Irrigation efficiency

T	Irrigation methods	Irrigation efficiency
1	Seepage irrigation	%60
2	Sprinkler irrigation	%75
3	Drip irrigation	%90

Source: Brouwer, C., K. Prins, Heibloem, M. 1989. "Irrigation Water Management: Irrigation Scheduling." Training Manual (4): 66, p3.

As for the domestic sector, the number of the population of the districts in the governorate has been adopted, and the percentage of population increase for each district, except for the Rutba district, which depends on groundwater in various fields and determines the per capita share in cubic meters, and by determining the number of inhabitants in the per capita share, we obtain the water demand for the sector Household, and the household order is expressed by the algorithms of the(WEAP), Where the population increase is calculated by the following equation

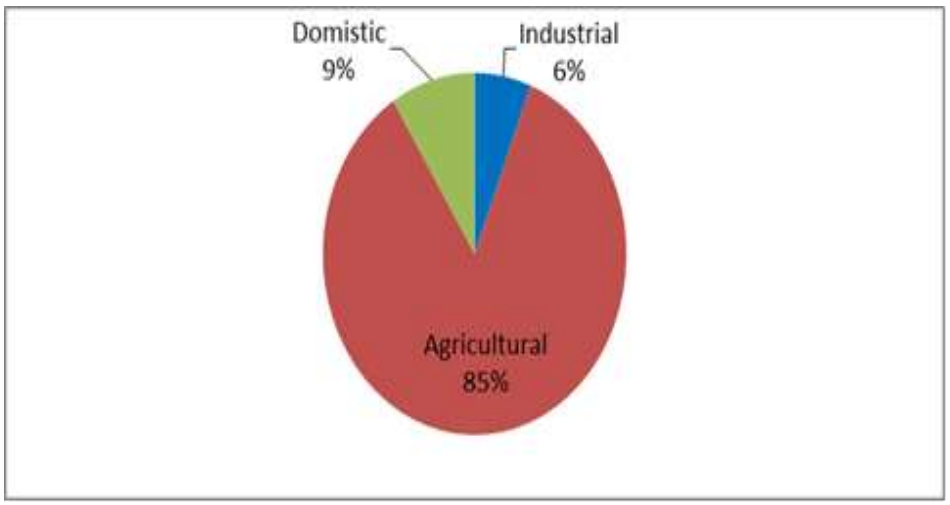
Growth form (The proportion of the population increase to eliminate × year The last census × population in the last census) through this equation is calculated by population increase, and then is converted from liters per capita consumption to m^3.

As for the industrial sector, the number of establishments, the quantity of demand for each factory, and the total water demand of these establishments were determined

Total water demand = number of establishments x water requirement of the facility

In order to determine the total demand of the industrial sector that depends on the river, the current water demand of the various sectors constitutes varying percentages in Anbar Governorate. Figure (2) notes , where the agricultural sector represents (%84) of the total demand, and the household sector represents about (.(%9) the industrial sector is less sectors in terms of water demand to reach (%6) in Anbar province.

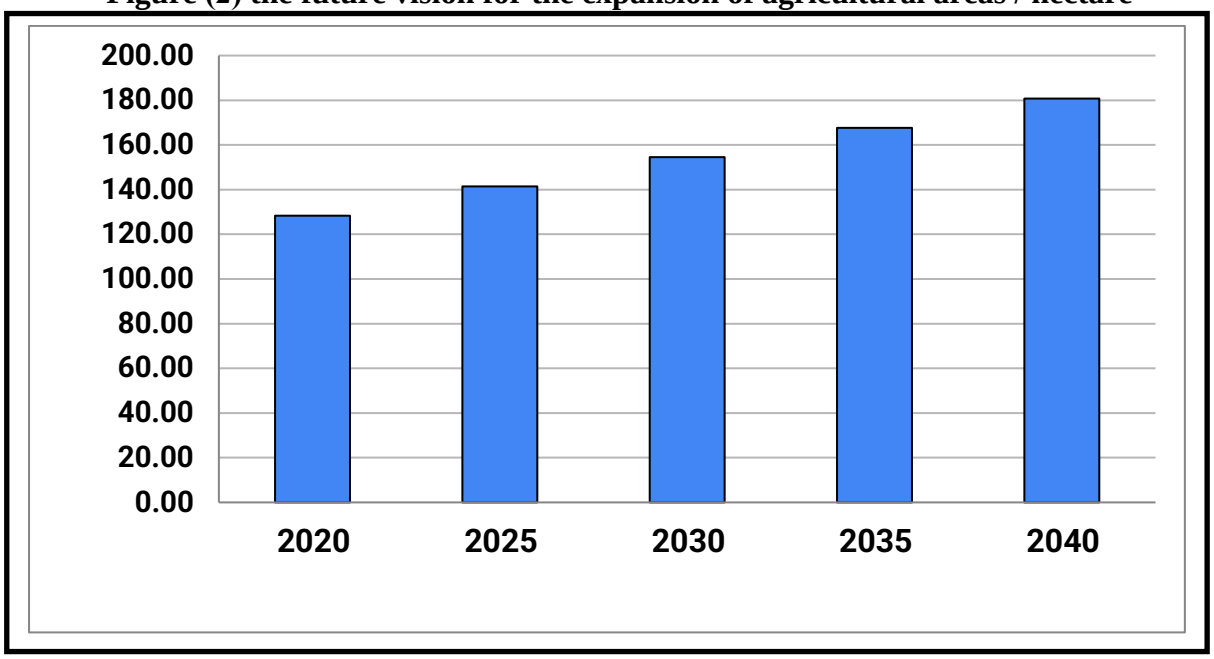
Figure (2) the percentage of current water demand in the governorate



Source : Based on program outputs WEAP Version: 2019.2, August 1, 2019

All the ratios mentioned in the previous table represent the current demand for water, and this is known as the reference scenario or (baseline), that is, it is the basis for all the scenarios that we will address a later, as the various sectors were dealt with in the base year, so we will develop the future vision through several scenarios, but Before entering the stage of scenarios, we should show the agricultural areas in the estimates of the Web program, depending on the agricultural plans Figure (2).This vision is a natural and logical product of the growth and development of the population ,since agriculture is linked to food security for the population as it is an economic resource for the population and the state, as well as providing opportunities Work for the residents of rural areas, the process of expanding agricultural areas continues, as it is noticed that agricultural areas are expanding, as the cultivated areas in the year (2020) amounted to about (128.32) hectares, while the cultivated area, according to the program's estimates for the year ,2030 amounted to (154.54) hectares. In the year (2040) , the agricultural areas reached about (180.75) hectares, which is more than half the area of Al-Anbar Governorate that is suitable for agriculture.

Figure (2) the future vision for the expansion of agricultural areas / hectare

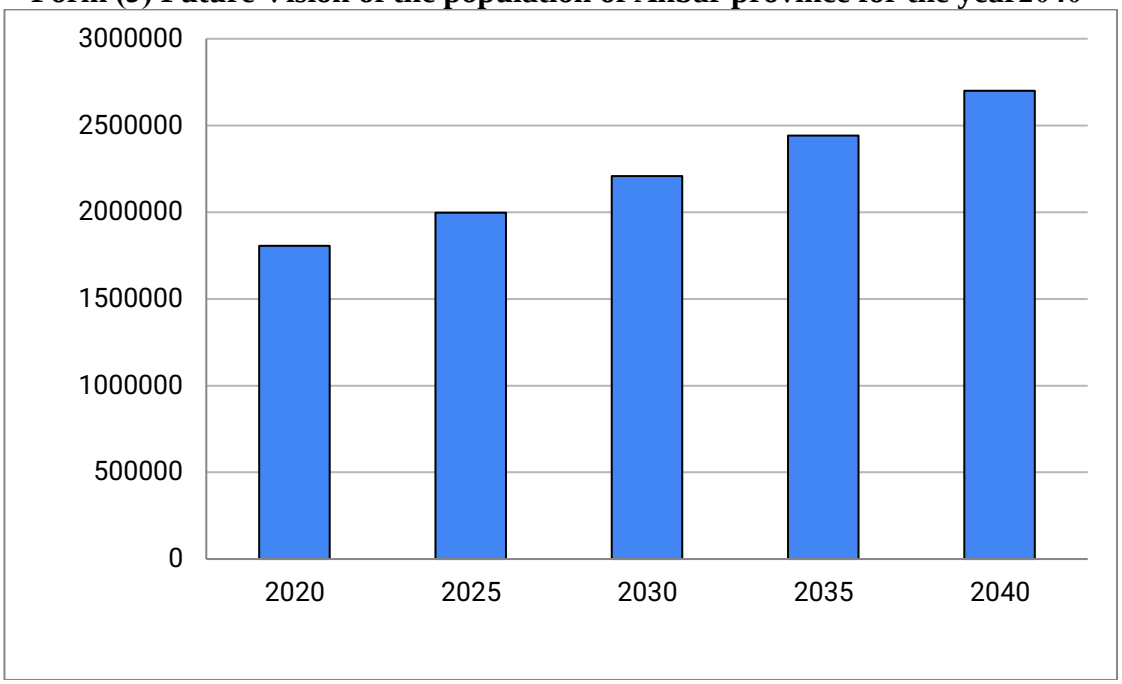


Source : Program Output,WEAP Version: 2019.2, August 1, 2019

The number of the population was estimated up to the year (2040) based on the base year of 2019 , as the growth rate for each district in the Anbar Governorate was adopted as shown in

Figure . (3) Through the collection of the district's population, the governor's future population was determined .And through the analysis of table (3) data ,an increase in population growth rates is evident, as the number of population in the year (2020) reached about (1805977) people, while the population increased in the year (2030) to (2208115) people, that is, after ten years, the difference reached about (402138) people and this increase in the population is offset by an increase in the domestic water demand, while the population in 2040 reached about (2700027) people, and this increases the pressure on the demand for the domestic sector in Anbar Governorate.

Form (3) Future Vision of the population of Anbar province for the year2040



Source : Depending on the output of the program WEAP Version: 2019.2, August 1, 2019

The water demand dependent on the Euphrates River was addressed for the various sectors, and the base year was approved in 2019 and the target year 2040 was approved , as shown in Figure (3). Through these estimates, the sites of weakness in the water efficiency of the sectors and the treatment methods were identified, with the aim of creating a state of balance. Between water demand for different sectors and supply, and controlling pollution of the ecosystem, what is meant is the amount of water available per year for Anbar Governorate measured in cubic meters, while the deficit is the result of the difference between the total demand for different sectors on the available river water to cover the demand

Table (3) Total water demand, amount of available water, and deficit

the year	Home	Industrial	Agricultural	Total order	Available from the river	Impotence

2019	253.26	169.607	2304.7787	2727.64	2333.66	-393.98
2020	258.40	173.847	2450.08373	2882.33	2318.15	-564.18
2025	285.72	196.692	2704.62293	3187.04	2172.52	-1014.5
2030	315.94	222.5 39	2959.16213	3497.64	2026.89	-1470.8
2035	349.36	251.782	3213.70132	3814.84	1881.26	1933.6
2040	386.32	284.869	3468.24052	4139.43	1735.63	-2403.8

Source -1 : Republic of Iraq, Ministry of Planning, Anbar Statistics Directorate, unpublished data.2019 ,

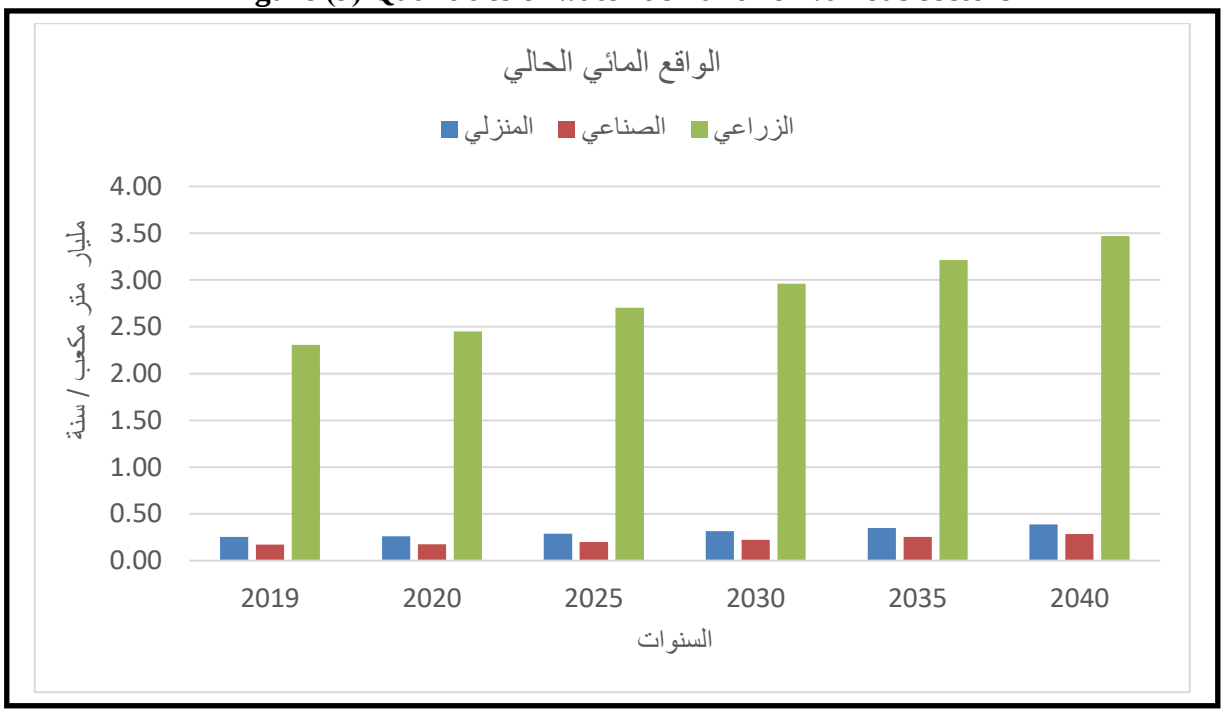
2- Republic of Iraq, Ministry of Industry, Planning Directorate, unpublished data.2019 ,

3- Republic of Iraq, Anbar Agriculture Directorate, Planning Department, unpublished data.2019

4- Program output, WEAP Version: 2019.2, August 1, 2019

Total demand recorded in 2020 about (2882.33 million m^3) according to the table (3) the amount of the deficit to reach (564.18- million m^3)In 2030 increased the demand for water by (3497.64 million m^3)This high demand has increased by (1470.8- million m^3)while demand rose in 2040 to (4139.43 million m^3) and reached the deficit (2,403.8- million m^3) and here it is clear that the overall demand for the province in the height of this is due to population growth and the rate of demand per capita of (392 liters) (6) According to the United Nations, which is higher than the global demand of (200 liters) (7) Share of the individual, the expansion of agricultural plans and the use of traditional methods of irrigation, industrial growth in the governorate, as well as the decrease in the water resources of the Euphrates River from the source countries, and at the same time when comparing the water resources of the governorate with the total demand of the sectors, and this requires solutions Optimal in managing the Euphrates water for various sectors to reduce the burden.

Figure (3) Quantities of water demand for various sectors



Source : Based on program outputs WEAP Version: 2019.2, August 1, 2019

Second : the proposed scenarios for the advancement of water reality:

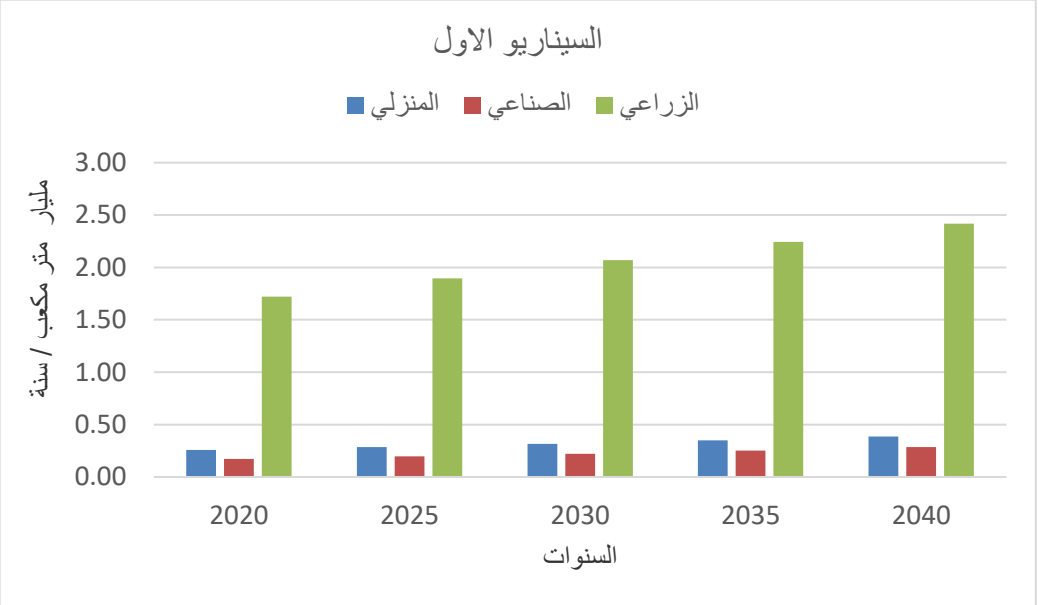
The sustainability of the Euphrates River in Anbar province must improve the current reality

through the adoption of modern techniques in the management of the Euphrates River water should also look for solutions after it was identified the problem of wastage of water resources, and these solutions need to analyze and identify the advantages of and what defects It implies, and the benefit of these solutions, and the aim of them is to build a strategic vision that is an ambitious state for the proper management of water resources. This vision will be the basis for the future planning process, provided that these plans are translated into water policies that take upon themselves to achieve sustainable use of water. Proposing a set of scenarios aimed at finding solutions that would reduce the water deficit, which is accompanied by an increase in water demand by the various sectors. The proposed scenarios included a number of methods to reduce the deficit.

1- First Scenario:

This scenario included the use of sprinkler irrigation method for wheat and barley crops, and the drip irrigation method for winter and summer vegetable crops and trees, in place of the traditional methods of wind irrigation of agricultural fields where two methods are used : the first is basins and the land is divided in a rectangular shape surrounded by the shoulders from all sides and submerged The basin with water so that part of the water evaporates and the rest is deposited in the soil, as for the second method : it is the maroz method and is widely used in vegetable crops, for example, but not limited to onions and potatoes, as well as irrigation of fruit trees (8) , since the adoption of modern methods of irrigation with high efficiency in irrigation, and in this context data were entered for agricultural plans for the years-2010-2005) (2019and included strategic crops (wheat and barley) , the winter plan, the summer plan, and trees, and to determine the future demand. Water for the agricultural sector in the shadow of the population increase and the adoption of the per capita share of (392 liters) with the survival of the industrial sector and through these inputs to the program, with the availability of the current and future quantities of water that were mentioned previously, the results of the first scenario were determined by analyzing Figure (4) notes reduced the deficit by using irrigation methods of sprinkler and drip irrigation, which are more efficient than traditional methods of irrigation, as the year 2020 was the water demand in which about (2152.22 million m^3) and the surplus of demand towards (165.93 million m^3)this is the result of the use of roads modern irrigation the year 2030 has been demand higher (2607.05 million m^3) as it recorded a deficit estimated at (580.16 - million m^3)this deficit is due to the high demand with a decrease in the amount of available water from the river, either in2040 , The water demand of the various sectors has reached about (3088.36 million m^3)bringing the deficit to about (1,352.7- million m^3)So is one of the solutions in this scenario is to reduce the water deficit.

Figure (4) First Scenario Water demand for various sectors



Source : Depending on the output of the program WEAP Version: 2019.2, August 1, 2019.

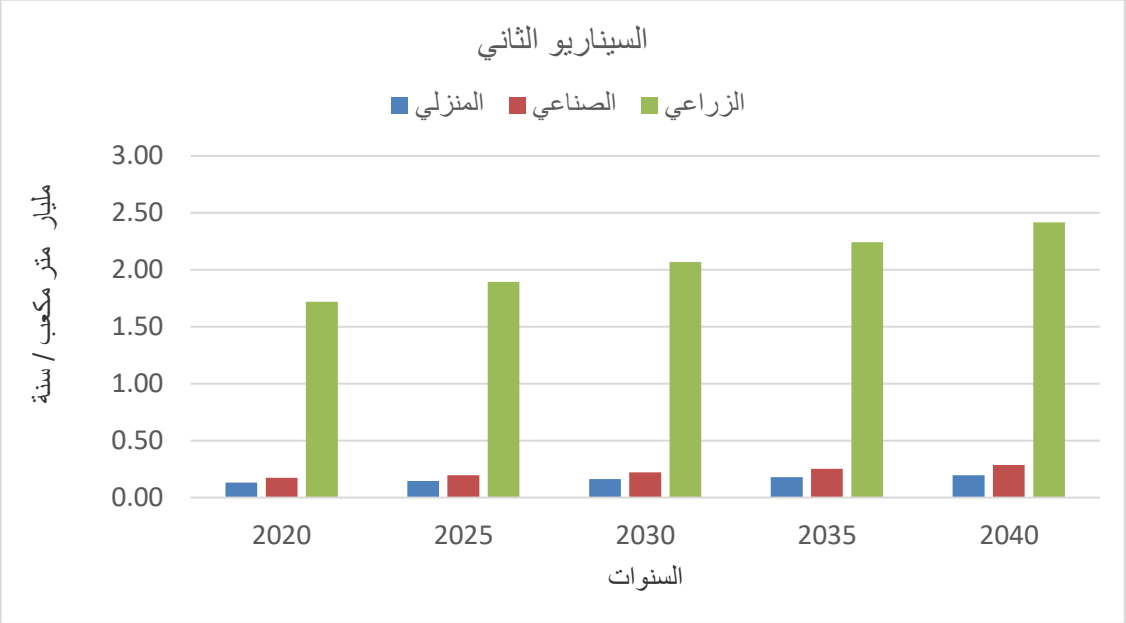
2- The second scenario:

This method includes relying on reducing the per capita quota from (392 liters) per day according to United Nations estimates, as this demand is considered high when compared to the global demand estimated at (200 liters) per day per capita, with the adoption of the method of irrigation by sprinkler and drip and the stability of water demand. For the industrial sector, and the household demand is expressed through the algorithms of the(WEAP), Where the population increase is calculated by the following equation:

Growth form (The proportion of the population increase to eliminate × year The last census × population in the last year) through this equation is calculated by population increase, and then converted the per capita consumption of the liter to m ^{3} in order to keep pace with the program 's mind, with the adoption of water demand per capita amount (200Liters) per day and is converted from liters to cubic meters in the following way :

$\frac{365\times200}{1000}$ =73 thousand m ^{3} per capita in one instead of the previous demand up to (143.08 m ^{3})per year, and by multiplying the number of people in Anbar province per capita we get the water demand quantity in Anbar province ,and through the analysis of data format (5) it is clear that in 2020 available from the river increased more than the first scenario where the water demand (2025.66 million m^3) did not record a deficit , but it was a water surplus is estimated at (292.49 million m^3) and in 2025 reached the water demand is estimated at (2236.74 million m ^{3}) recorded a small deficit is estimated at (64.22- million m ^{3}) this deficit is due to the high demand with the available drop from the Euphrates River, while recorded in 2040 the highest aqueous request by(2899.14 million m ^{3}) bringing the deficit to - (1163.51million m^3) this deficit is due to the high medicine water for various sectors and at the same time low in the water quantity available from the river, but this scenario is less deficit record of the first scenario , where added to the first scenario to reduce the per capita share of water in the province,

Figure (5) Scenario Two: Water demand for various sectors

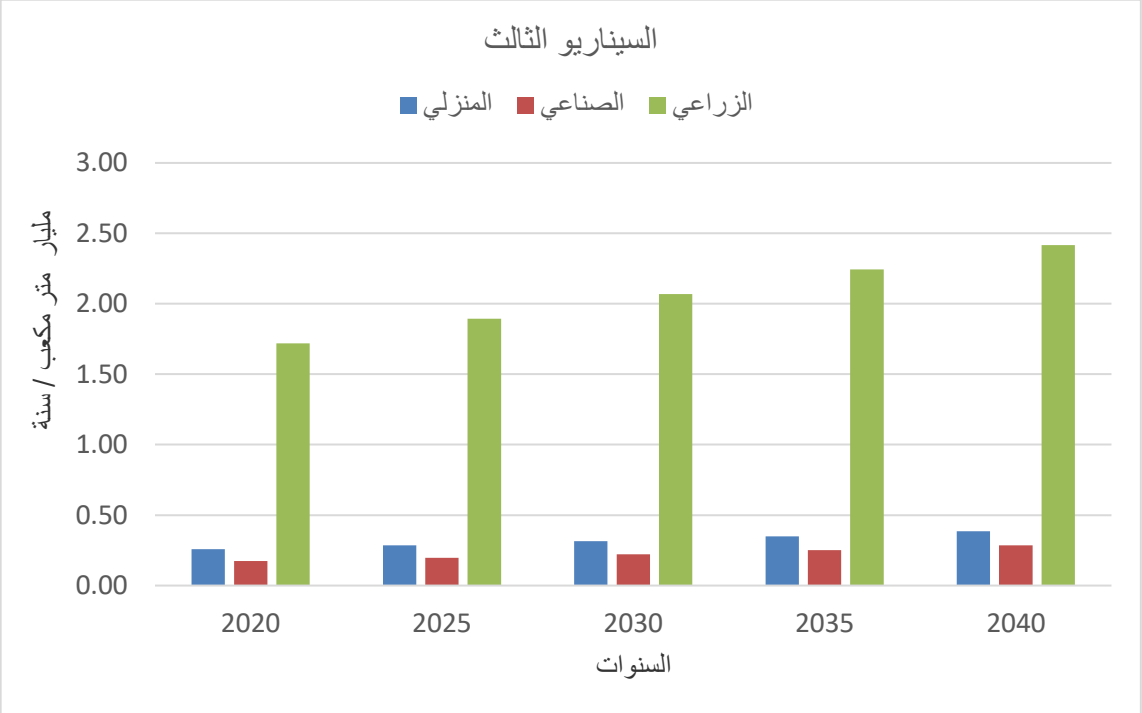


Source : Based on program outputs WEAP Version: 2019.2, August 1, 2019

3-The third scenario:

This method includes using the method of sprinkling and drip with the per capita share of water remaining (392 liters)per day, with the return from domestic use of (%80) of the prepared water. A group of studies showed that the return from home furnishing in developing countries is (9) .(%80) Which emphasized that domestic demand water is consumed in the processes of drinking, washing, cooking and evaporation. Only (%20) of the water is consumed and the rest is returned to the river in the form of untreated wastewater, and these quantities of water will be calculated on the available water from the river, and this scenario works to reduce the water deficit of the Euphrates River in Anbar province ,through the analysis of data format (6) notes that in 2020 the total of the various demand sectors towards the record (2152.22 million m^3)but the yield of water for domestic use reached (206.72 million m^3) and through the process of collecting revenue with available from the river we get the available total, to record this year 's surplus is available and the amount of (372.65 million m^3) in the year 2025 has been the demand for water is estimated at (2376.69 million m^3)and the return of home use about (195.03 million m^3) but notes the deficit by (9.13- million m^3) and the deficit resulting from the available drop of river water, with high demand for other sectors, recorded in 2030 an increase in water demand reached (2607.05 million m^3) and a decrease in return to (184.14 million m^3) this is due to the lack of nutritional decline Water Fold the deficit to reach (396- million m^3) In 2040 the highest record request by (3088.36 million m^3) as well as the decline in the return to the river by (164.95 million m^3) to record the highest deficit by (-1188million m^3) this the rise in the deficit is the result of an increase in water demand with a decrease in the availability of water for the Euphrates River, and this relationship is inverse between water demand and the available water of the Euphrates River, and Figure (6) shows the amount of demand for various sectors under the third scenario.

Figure (6) the third scenario, water demand for various sectors

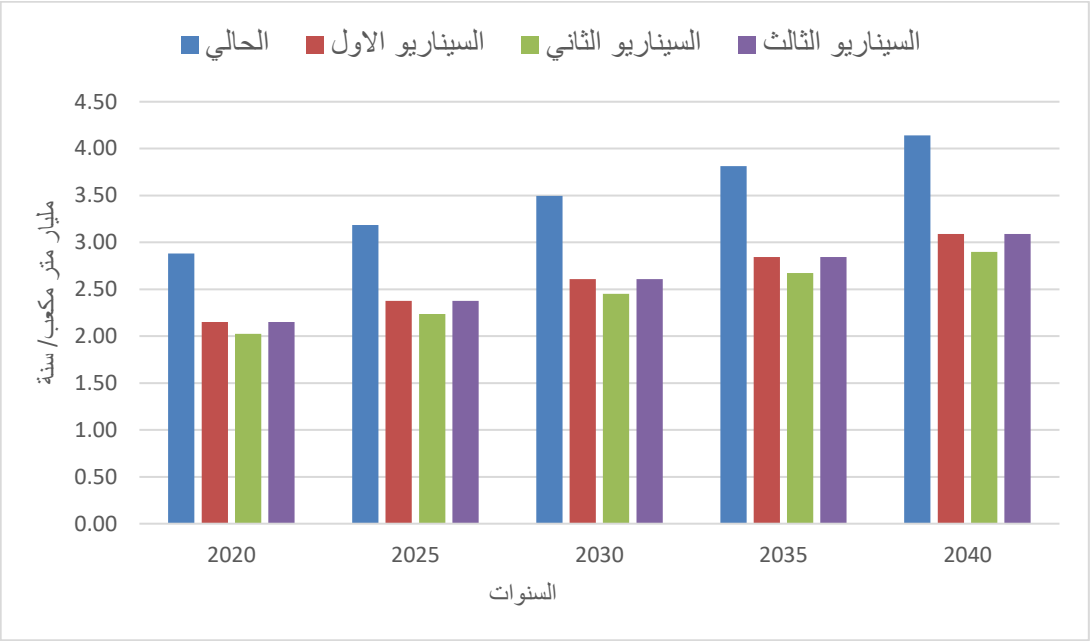


Source : Based on program outputs WEAP Version: 2019.2, August 1, 2019

4- Demand comparison:

Varies water demand in different sectors , depending on the scenarios used, to use more than one method would reduce water demand, was adopted comparison to request water to clarify any methods represent the high water demand ,and through the analysis of data format (7) notes that the current reality of the year (2020) recorded the highest demand by (2882.33) billion m ^{3} ,because all the methods used in management methods are inefficient in the rationalization of demand, while the second strategy for the same period recorded a less watery request by (2025.66) billion m 3 and thus recorded less demand from scenario the first and third , who record in 2020 a water request by (2152.22) billion m^3 ,for each of them , and the reason for this is to reduce per capita to 200 liters per day different from the rest of the scenarios (the first, third) in which the per capita adopted towards (392) liter ones and this case applies to all years by observing scenarios that demand rises over time , and this increase natural product of the expansion of agricultural areas in all districts of Anbar province, and the population growth of the districts of the province works to increase water demand, as well as sector The industrial sector that grows with the rest of the sectors, but there is a difference between the first and third scenarios, which is that the third scenario differs in that the return from domestic wastewater is among the available, and this return will reduce the deficit in river water as shown in the deficit comparison later, so we find demand in reaching high to the target year of (2040) , where record current reality demand by (4139.43) billion m ^{3} ,which demand the highest, while the second scenario scored less than requested by (2899.14) billion m^3, while recorded first and third scenarios the same water demand has sexual (3088.36) billion m^3 .

Figure (7) Comparison of water demand for different scenarios

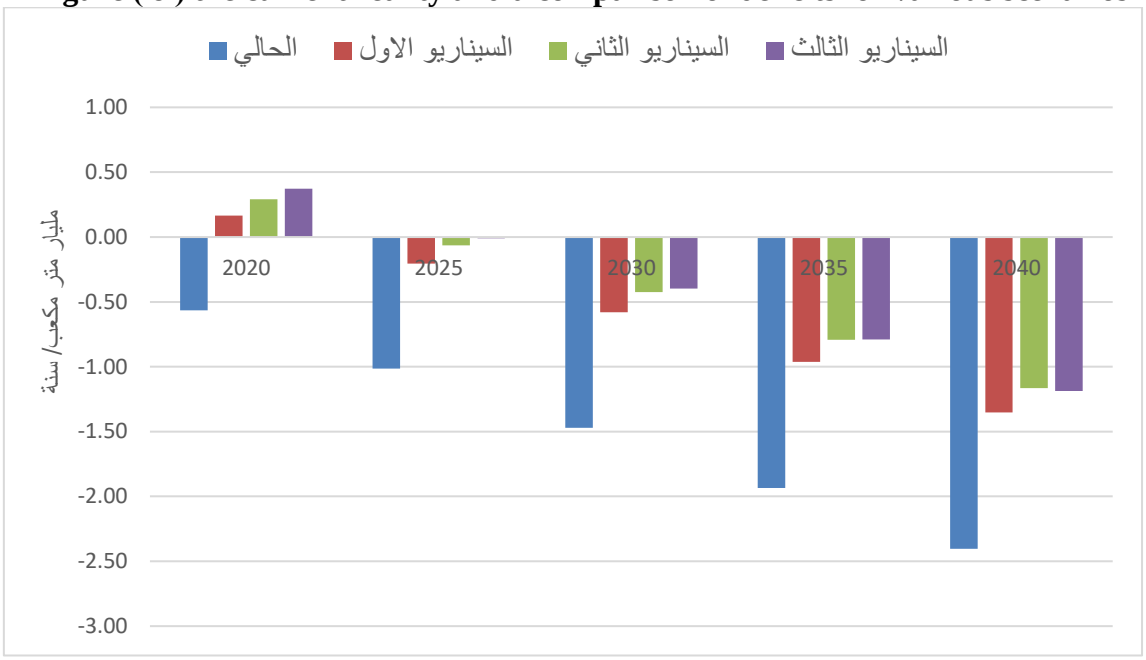


Source : Depending on and outputs of the program WEAP Version: 2019.2, August 1, 2019

5- The current reality and comparison of the water deficit for different scenarios:

The current evaluation of water represents the base year for the rest of the scenarios, which represents the results of managing the water of the Euphrates River in light of the continuation of current policies using traditional methods of irrigation, the rise in domestic demand, as well as the demand of the industrial sector, and through analyzing the data of Figure (8) and by observing the current reality of the river Euphrates shows the deficit continues to rise as the deficit recorded in 2020 by (564.18- million m^3) bringing to almost doubled 2025 ,while up in 2030 to (1470.75- million m^3) in 2040 more than a record of four deficit - fold in 2020 to reach (2403.8- million m^3) which is a very large number and produces the difference from high demand for various sectors with the available drop of water over time, all this requires knowledge of the best solutions through the proposed scenarios, where the third scenario record best a surplus in 2020 by (372.65 million m^3) narrowly for the first and second differential scenario significantly from reality the current, either in 2025 it was the third scenario is the best of the rest where the recorded deficit by scenarios (9.13- million m^3) it is very simple If compared With the rest of the scenarios is possible this treatment using management methods other including the use of underground water, either in 2030 also is the third scenario is the best rate (396.02- million m^3) and narrowly with the second scenario, as is the case for the year 2035 ,the deficit is less from the rest of scenarios by (788.78- million m^3) and the difference was simple with the second, but in 2040 a high deficit record in all scenarios, but the second scenario is the lowest deficit by- (1,163.51million m^3) and the amount of the deficit close with the third scenario, The reason for this is the decrease in the deficit in the second scenario, which is the decrease in the water coverage of the agricultural plans, and on this basis, the third scenario is the best when compared to the deficit years for the various scenarios, as the total deficit from 2020 to 2040 is the lowest among the scenarios.

Figure (8) the current reality and a comparison of deficits for various scenarios



Source : Based on program outputs WEAP Version: 2019.2, August 1, 2019.

Through the analysis of Figure(8) , it becomes clear that all the strategies adopted in the administration for the year (2020) did not record a deficit due to the presence of a state of balance between water demand and supply of water except for the reference scenario (the base year) in which traditional irrigation methods were used and the absence of mechanisms to determine Domestic demand as well as the industrial sector, and despite its small size, the demand is high despite the fact that most of the large industries in which water is recycled, and it is used in the processes of cooling, evaporation or humidification, such as milling plants, but in the year (2025) it is noticed that the water deficit increases And in varying proportions and according to several data, including that there is an increase in population growth for all districts of the governorate, and this means an increase in water demand, as for the agricultural sector, in which water demand represents the most sectors, because the relationship between the increase in the population and the expansion of agricultural areas to provide food safety for the population, Increase the deficit despite the presence of many modern methods that can be relied upon in irrigation operations as well as in the domestic sector, and this deficit will cause future problems in providing water demand It is necessary to refer to the issue of water imports by the source countries, which are in a continuous decline as a result of Turkish water policies that confirm the imposition of their hegemony over the sources of the Euphrates River, and this decrease in imports is a large part of the deficit problem occurring in all years, since the relationship is inverse The water demand received from the river's water, the first recorded an increase over time, and the second recorded a decrease.

Conclusions

1. An increase in the rates of demand for various sectors . This rise is a natural product of population growth and the expansion of agricultural areas as well as the expansion of the industrial sector, in light of the use of traditional methods of water management.
2. All scenarios recorded a deficit, and this deficit is the result of two reasons, the first of which is a decrease in water supply by Turkey over time, and the second reason is the increase in water demand for various sectors, and it is a natural product of the high population.
3. The non-use of water rations for agricultural crops is a result of the lack of guidance to

the farmer on the importance of using rationing.

4. The apparent weakness of the media role in the process of extension and awareness of the importance of water and the assertion that water is a national wealth that should be used efficiently, and the rationalization of water use for various sectors.

Recommendations

1- The search for alternative water sources through the use of groundwater as a reserve of the Euphrates River to reduce the water deficit.

2- The use of modern methods in irrigation of the agricultural sector, through the use of sprinkling and dripping in the irrigation process, and work on lining water channels that carry water, or use pipes to transport water to agricultural fields in order to reduce waste.

3- Pressuring the Turkish side in order for Iraq to obtain its water share, stressing the importance of international cooperation to reduce the water shortage, and finding solutions to divide the river's water that guarantee water quotas for future generations, as well as cultivating crops that can grow on saline water.

4- Work on building earth dams on dry valleys in the governorate in order to harvest the largest amount of water that can be used in the agricultural sector.

5- The audiovisual media must play its role in educating the population about the importance of water, how to conserve it, and the opportunities for achieving sustainable development for future generations..

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