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Hydro-politics of Water Resources in Iraq

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Abstract

Iraq relies in its water resources on the Tigris and Euphrates and their tributaries. It is located at the lower part of the catchment area of these rivers. The long-term average annual flow that enter Iraq is about 30 BCM from the Euphrates, 22.2 BCM from the Tigris, 24.78BCM from tributaries and 7BCM from side valleys between Iraq and Iran. Now, the flow of these rivers is decreasing due to climate change and hydrological projects established in the upper parts of the catchment. Precipitation will decrease 15-25% during this century and the flow of the Tigris and Euphrates Rivers will be reduced by 29-73%. This will cause a grave depletion of ground water resources. Turkey is trying to build 22 dams and 19 hydropower stations. Iran built 12 dams, diverted the flow of some tributaries inside Iran, and blocked all the valleys that contributes water from its land to Iraq. The factors affecting the hydro politics within these basin are: Water scarcity, Climate change and Hydrological projects, population growth rate, Energy issues, Water mismanagement, Economic changes, Expansions of projects and technology, Political issues, International water laws and Public awareness. To solve the problem of water scarcity in Iraq they should do the following:
A.Reach agreements with Riparian Parties
B.Develop Long-term Strategy that should take care of rehabilitating of hydrological projects, Improving the efficiency of diversion and supply, Using of Nonconventional Water Resources, Irrigation modernization using suitable techniques, Developing a Public awareness program and establishing an agenda for training.

Keywords: Tigris River; Euphrates River; Water management; Iraq.

1. INTRODUCTION

Iraq is located in the Middle East (geographic coordinates 33 00 N, 44 00 E) and covers a total area of 437 072 square kilometers (Figure 1). Iraq is bordered by Turkey from the north, 352km, Iran from the east, 1458km, Syria and Syria from the west, 605km and 181km, respectively and Saudi Arabia and Kuwait from the south, 814km and 240km, respectively. The population of Iraq is about 39.33 million.
Topographically, Iraq is divided into 4 main regions (Al-Ansari, 1988, 2005, 2013, 2021a; Al-Ansari et.al., 1981; Al-Ansari and Knutsson, 2011) (Figure 2). The first is mountain region covers 5% of the area and is restricted at the north and northeastern part of the country. The second region is the Plateau and Hills Regions which covers an area of 15% of the total area of Iraq. The third region is the Mesopotamian plain area is restricted between the main two Rivers, Tigris and Euphrates. Ito covers 20 % of the total area of Iraq. The fourth region is the Jazera and Western Plateau and it occupies 60% of the total area of Iraq.
The climate of Iraq is continental, subtropical semi-arid type (Al-Ansari, 1988, 2005, 2013; Al-Ansari et.al., 1981; Al-Ansari and Knutsson, 2011). Rainfall occurs from December to February or November to April in the mountain region. The mountain region is of Mediterranean climate. During summer the average temperature of over 45oC during July and August dropping to 25oC at night. In winter, the average daily temperature is about 16oC dropping at night to 2oC with possibility of frost.
The annual rainfall in Iraq varies where it reaches more than 1000mm within the mountains at the north to about 200mm at the eastern part of the country and it reaches less than 150mm within the western desert.

2. WATER RESOURCES

Iraq relies in its water resources on the Tigris and Euphrates Rivers and their tributaries. The water from these rivers comes from Turkey (71%) followed by Iran (6.9%) and Syria (4%). The remainder, only 8%, is from internal sources (Figure 3 and table 1). Tigris River is 1,718km long and its drainage area is 235,000km2 which shared by 4 countries (Turkey -17%, Syria -2%, Iran -29% and Iraq -52%). This river runs toward the Turkish-Syrian border and forms the border between these countries for about 45 km, then it enters Iraq 4 km north Fieshkhabur near Zakha city. Inside Iraq, 5 main tributaries join the main river. These are Khabur, Greater Zab, Lesser Zab, Adhaim and Diyala (Figure 1). The length of the River Euphrates ia about 2800 km.The catchment River Euphrates is distributed between Turkey (about 125000 km2 28.2%), Syria (7600

km2 -17.1%) -and the remainder 177000 km2 (39.9%) is in Iraq. Part of the catchment of the river lies in Saudi Arabia (66000 km2), but it does not supply any water to the river except when precipitation takes place in that area which is very rare (Table 1). The Tigris and Euphrates Rivers join in the southern part of Iraq forming Shatt Al-Arab (Figure 1). The total length of the river is 192km and its drainage area is 80,800 km2 and it discharges its water in the Gulf. The annual discharge of the river used to be at Fao city about 35.2x109 m3 and there are two main tributaries, Suwaid and Karoon, joining the main course of the river from Iran (Al-Ansari 2021b).

Iraq used to receive an average flow from the River Tigris about 30 km3 for the former and 21.2 km3 for the latter when it enters Iraq and about 30 km3 from the River Euphrates (which might fluctuate from 10 to 40 km3 depending on the climate). The Tigris tributaries contribute 24.78 km3 of water and there are about 7 km3 of water brought by small wadies from Iran, which drains directly towards the marsh area to the south (Al-Ansari and Knutsson, 2011, Al-Ansari, 2013, 2016, Al-Ansari et.al. 2012). According to the World Bank (2006), 100% of the Euphrates water comes from outside the borders of Iraq while 67% of the Tigris water also comes from outside sources. They also stated that groundwater resources are about 1.2 billion cubic meters and form about 2% of the total water resources of Iraq.

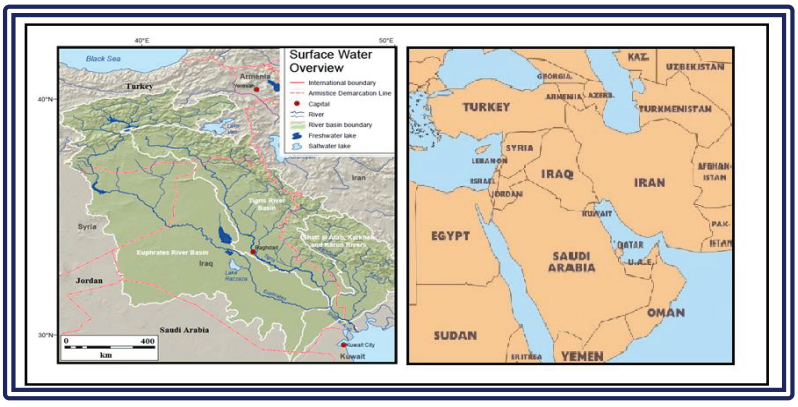

Figure 1. Location map of Iraq.

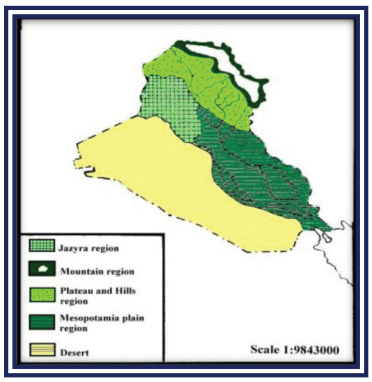

Figure 2. Topographic division of Iraq.

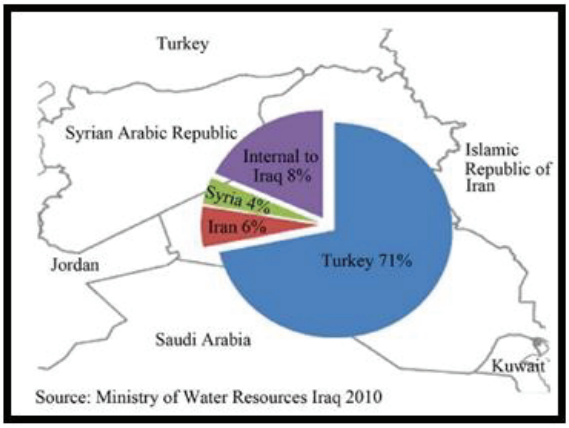

Figure 3. Source of water of the Tigris and Euphrates Rivers and their tributaries.

Table 1. The area of Tigris and Euphrates Basins

Countries	Tigris River		Euphrates River	
	Catchment area		Catchment area	
	(km^2)	(%)	(km^2)	(%)
Turkey	57614	12.2	125000	28.2
Syria	834	0.2	76000	17.1
Iraq	253000	58	177000	39.9
Iran	140180	29.6	-	-
SaudiArabia	-	-	66000	14.9
Total	**473103**	**100**	**444000**	**100**

According to recent estimates, Iraq consumes 42.8 km3 which is mainly used for agricultural purposed (about 85%) and the remainder is for domestic and industrial purposes (Al-Ansari, 1998, Sadik and Barghouti, 1993, World Bank, 2006). Water supplies used to reach 100% of the urban areas and only 54% of rural areas. After the Gulf war, the situation had deteriorated for both water and sanitation sectors. Now, 1/3 of the population of Iraq do not have access to potable water, and the quantity of water production is decreasing to 5469534 m3/day, which represents 53% of the water demand (IMMPW, 2011). The Iraqi government hopes to ensure water supplies reach 91% of the population by 2015 (UN, 2010).

Land suitable for agriculture is 11.5 million ha, which represent 25% of the total area of Iraq (World Bank, 2006). The irrigation potential of Tigris, Euphrates and Shat Alarab rivers is 63%, 35% and 2% respectively. The area used for agriculture is about 8 million hectares, which forms 70% of the total cultivated area. Only 40-50 % of this area is irrigable, while the remainder is rain fed and is located in the northeastern plains and mountain valleys. The irrigated area is supplied by water from the main rivers, and only 7% is of the area is supplied by ground water (World Bank, 2006). The situation changed due to fallow practices and the unstable political situation only 3 to 5 million hectares are now actually cultivated annually and in 1993, it is believed that only 3.73 million hectares were cultivated of which 3.46 and 0.27 million hectares consisted of annual and permanent crops respectively (Al-Ansari and Knutsson, 2011, Al-Ansari, 2013, 2016, 2021b, Al-Ansari et.al., 2012). The contribution of the agricultural sector used to be 5% of Gross Domestic Product (GDP) which is usually dominated by oil (more than 60%) and about 20% of the labour force is engaged in agriculture (Al-Ansari and Knutsson, 2011, Al-Ansari, 2013, 2016,2021; Al-Ansari et.al. 2012).

Iraq is supposed to receive 58% of the Euphrates flow, which crosses the Turkish- Syrian border, while Syria receives 42%. In the past, Turkey was to secure minimum flows of 15.8km3/year at its border which gives Iraq 9 km3/year. Present estimates indicate that Iraq is receiving only about 0.03 km3/year of the Euphrates water (Al-Ansari and Knutsson, 2011; Al-Ansari, 2013, 2016, 2021; Al-Ansari et.al., 2012). There has been no formal agreement between the three countries concerning the Euphrates and Tigris water up to now.

3. HYDRO POLITICS OF THE TIGRIS AND EUPHRATES BASINS

Recently, climate change has highly affected the region (Al-Ansari, 2019; NASA, 2009; Gleick, 2014; Stokes, 2016). In addition, hydrological projects in the upper riparian countries have reduced the flow of the rivers (Table 2) (Al-Ansari, 2019). The flow of the Tigris River at Mosul station (north Iraq) was 21.3 BCM for the period 1931–1973 and it decreased to 19.1 BCM for the period 1985–2005 (Wikipedia, 2017). The flow of the Euphrates River was 30BCMat Jarablus, Syria and after this period, dams were constructed, and the flow started to decrease to 25.1 and 22.8 BCM for the periods 1974–1998 and 1990–2010 respectively (UN-ESCWA, 2013). Long term flow of the rivers is declining in a trend of 0.14 × 109 m3/year for the Tigris and 0.19 × 109 m3/year for the Euphrates (Figs. 3 and 4)(Abdullah 2017).

Table 2. Dam on the Tigris & Euphrates River &Tributaries

Country	Number of dams	Hydropower stations
Turkey	22	19
Iran	12	-
Syria	4	-

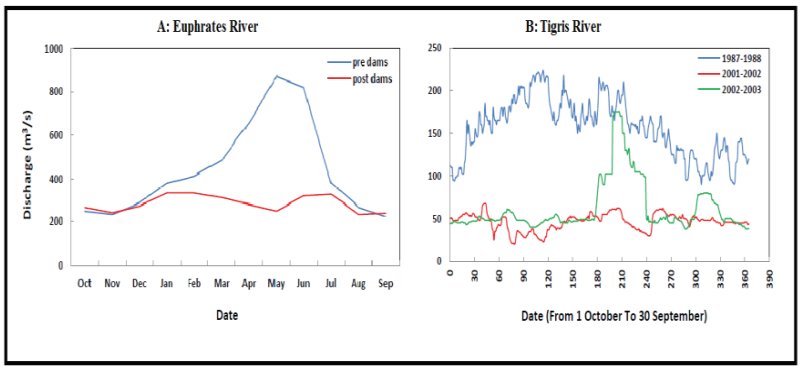

Figure 4. The Euphrates monthly average flow (Thi-Qar station) pre and post-dams. b The average daily flow of the Tigris river near Qurna city before and after the dams construction. Modified after Abdullah, 2017.

Due to the present situation, tension has developed within the Tigris and Euphrates Basins. The most negatively affected country is Iraq because it's the lowest country within the basins. This tension can be attributed to the following factors:

A.Water Availability: Turkey always claim that water allocation is good for Iraq and Syria (Table 3) (Altinbilek, 2004; Bilen, 2000; Turkish Ministry of Foreign Affairs, 2012). Research conducted concerning climate change and effect of hydrological projects within Turkey, Iran and Syria indicates the continuous decrease in the flow of the rivers (Al-Ansari et.al.,2014a, b; Osman et.al., 2017a, b; Al-Ansari, 2013, 2016; IPCC, 2007). Precipitation is expected to decreaseand surface and groundwater will be decreasing with time (Bazzaz, 1993; Chenoweth et.al., 2011; Voss et.al., 2013, Al-Ansari et.al., 2014a, b, c, d; UNDP, 201). More evaporation and drought is to be expected (UNEP, 2011, Hameed et al., 2018) and this will lead to dryness of the Tigris and Euphrates Rivers by 2040 (UN, 2010) and the catchments of the two rivers will be most water stressed (Maddocks et al., 2015).

Table 3. Water allocation per capita per year in Turkey, Syria and Iraq (source of data a- Bilen, 2000; b- Turkish Ministry of Foreign Affairs ,2012).

Country	Water Allocation (m^3/Capita/year)			
	1990	2000	2010	2020
Turkey	3223	2703	2326	2002[a], 980[b]
Syria	1636	117	880	760[a],780[b]
Iraq	2352	1848	1435	1062[a],950[b]

B.Population growth rate: The present population within the Tigris and Euphrates basins is 221.53 (Table 4) (Worldmeter, 2018a, b, c, d and Drake, 2007). This number is expected to increase due to the high population growth rate (Table 3) (Drake, 2007) and as a consequence the allocation per capita will decrease to 887.6 and 709.2 m3/yr/capita in 2025 and 2050 respectively (Table 4) (Abumoghli, 2015).

Table 4. Population Characteristics within Tigris-Euphrates Basins (modified from Worldmeter, 2018a, b, c, d and Drake, 2007).

Country	Population (million)	Rate of Growth (%)	Projected population (million)		Percent Urban
			2025	2050	
Turkey	81.91	1.45	86,12	95.62 95.819**	71
Syria	18.28	3.7	23.41	34.02 34.90**	75
Iraq	39.33	2.78	47.19	81.49 83.65**	66.9
Iran	82.01	1.05	86.72	93.55 92.21**	73.8
Total	221.53		243.44	304.68	
**Wikipedia, The anticipated population growth for several middle eastern countries (United Nations, medium fertility variant) https://en.wikipedia.org/wiki/List_of_countries_by_future_population_(United_Nations,_medium_fertility_variant)					

C.Energy Requirements: All countries within the two basins have oil reserve apart from Turkey. For this reason, Turkey is trying to reduce its import of oil by using hydropower as an energy source. The GAP project is to cover about 40% of the required energy and this will reduce its oil imports by 28 million tons of oil (Akanda et.al., 2007; Turan, 2004; Bagis, 1989).

D.Water Management: Old irrigation techniques (flood irrigation) is dominant in all the countries within the two basins. Water losses are enhanced due to the fact that irrigation canals are unlined and uncovered. In addition, water quality is deteriorating due to the extensive use of fertilizers and pesticide (Figure 5) (CEB, 2011a, b; Abumoghli, 2015). IOM (2020) report indicated that thousands of people left their land in the central and southern parts of Iraq due to water shortages and bad water quality.

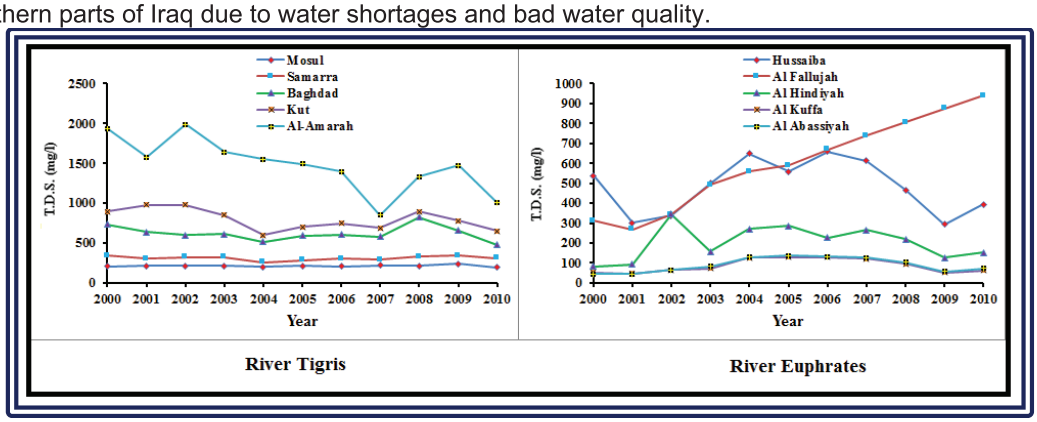

Figure 5. Salinity variation along the Tigris and Euphrates Rivers for the period 2000-2010 (sources of data CEB, 2011a)

E.Economic and Technological Development: The increase of oil prices caused economic development. This caused the movement of about 50% of the population from rural to urban areas and this caused an increase of water consumption of about 10 to 12 times its normal per capita as village dwellers and raised the standard of living (Drake, 2007; Abumoghli, 2015). It should be noted that the economics in Syria and Iraq are hardly affected by corruption and the struggle with ISIS in the past few years (Al-Ansari et.al. 2021).

Building of dams in the countries concerned has increased the rate of evaporation from the surface water of the reservoirs.

F.Public Awareness: All countries within the region are expected to suffer from water shortage problems in future (Al-Ansari et. al., 2021). To overcome this problem, this requires improving the present water supply efficiency, and demands to fulfill the sustainability through secure the required water for future generations and this can be achieved affectionately in case all parties concerned are to be involved. Water planners, managers and marketers; and the politicians who involve in set the external and internal water policies; and the educators about the significance of water conservation in the sector of potable water supply and how it may be approached are to be educated and this contributed in transfer the benefits of the awareness program into society individuals as a whole. Schools are to adopt special syllabus to increase awareness for water significance by developing and finding methods to present this subject, and the media should have a vital role

in identifying the importance of water issues. Since the agricultural sector is the highest consumer of water resource, farmers are to be trained on utilize of modern irrigation systems which they are convenient for arid regions. Finally, the public should understand the importance of proper water management.

4. SOLVING WATER SCARCITY PROBLEM

In case the situation remains as it is, then all countries in the region will suffer from water shortage problems (Maddocks et.al. 2015; Al-Ansari et.al, 2021). Syria and Iraq are the relatively weakest countries due to security situation and wars on terrorism and outcomes of two Gulf wars on Iraq.

Past diplomatic efforts and talks on water rights were not successful to reach an agreement for regional cooperation (Al-Ansari et.al. 2021). Also the experience from the past indicates that discussions should not be restricted to water issue only. Iraq imports billions of dollars of goods from both Turkey and Iran each year. There are number of companies from both countries executing huge projects in Iraq also. These have important effect on the economy of Turkey and Iran. In addition, military and security problems are very important issues for Turkey and Iran. Therefore, discussions and negotiations should consider all these issues including water shortage problem.

It is believed that an external mediator that can highlight and frame the issues in such a way that each country believes that it is gaining by joining the discussion and will lose something by avoiding the discussions should be considered. Such mediator should have very strong political influence on the international level and can give good financial and technical support to the parties concerned. This will enhance all parties to consider solving the problem seriously. Such mediator that fulfils these requirements can be the United States of America or the European Union or the World Bank.

Despite the efforts on regional and international levels, Iraq should adopt a prudent strategic water management plan. This plan should consider the ongoing and future expected problems. The outlines of such strategy should be as follow:

A.Regional and international cooperation and coordination: Technical and institutional requirements are to be determined to build strong cooperation program with international organizations. Establishing a communication network with other bodies which they have a good background in water management to get advices in water issues.

B.Irrigation and Agriculture: New irrigation techniques in order to stop water losses. Adopting efficient methods such as drip irrigation for orchards by using salty water and sprinkler irrigation for grains, and both of them are more conserving than surface irrigation. Conveying system are to be changed from open channels to closed conduits to increase efficiency of the conveying and minimize the losses. Improving the drainage systems of cultivated lands that will provide better soil leaching. Installing new drainage technique to provide an effective solution like use the perforated pipe drainage system in collecting and treating drainage water. Modern treatment methods for drainage and sewage water should be adopted and reuse it in restoring water bodies, for instance, the marshes. Farmers' awareness program is to be implemented concerning using the suitable techniques in irrigation.

C.Water Supply and Sanitation: The efficiency of drinking water distribution networks specially diversion and supply down to the point of use should be improved, which is most cost effective. The sewage network should be expanded to cover the areas that not serviced with sewage collection services, and connect the newly installed sewage networks to the wastewater treatment plants to avoid the pollution of groundwater from the leakage from old septic tanks. The services should be improved using Information communication Technology as an example.

D.Hydrological Projects: Existing Hydrological projects should be continuously maintained.

E.None Conventional Water Resources: Water harvesting techniques and waste water treatment and reuse should be extensively adopted.

F.Research and Development: Data bank is to be established to provide researchers and decision makers with the required information. Enhancing researchers to conduct researches on developing and creating new technologies in water resources and agriculture which more suitable for Iraqi environment.

G.Public awareness and Human Resources Development: Structures and outlines of the public awareness and human resources development programs in terms of water utilization and agricultural activities is to be implemented. Special courses in arid region hydrology are to be given in universities. Prizes are to be awarded for new innovations, pioneer researches and smart ideas in water resources and their management.

5. CONCLUSION

Iraq highly depends on the water of the Tigris and Euphrates Rivers and their tributaries. The flow of these rivers is decreasing due to climate change and construction of dams in the upper parts of the Tigris and Euphrates River basins. Iraq is facing water scarcity problem and in case the situation remains as it is the consequences are very negative. To overcome this problem, Iraq has to urgently act on international and national levels. On the international level, discussion is to be started with Turkey and Iran. Such discussion should include economic, military, security issues as well as water issues so that all parties take the problem seriously. On national level, Iraq is to adopt a new strategy that takes into account the new developments in the water resources situation and expected events and changes due to climate change and projects in riparian countries. In this context, irrigation techniques are to be changed to water saving techniques, nonconventional water resources are to be used, channels and supply canals are to lined and covered to minimize water losses and public awareness and human resources development programs are to be implemented. In addition, regional and international cooperation and coordination with institutions that have a good background in water management should be conducted to get advices in water issues.

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