



Towards Sustainable Water Resources Management In Iraq

30 August 2018

Publication Number: IEI 300818



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Acknowledgement

The Iraq Energy Institute (IEI) would like to thank all participants, experts and Task Force members of the “Water Resources Management Workshop” for their valuable presentations and contributions to produce this report. IEI also extends its sincere appreciation to Al-Kindi Society of Engineers (as partner) and to Crescent Petroleum (as sponsor) for their support to this initiative, and to the editorial team for compiling this report.

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The Workshop Program

Session-1: Water Resources Management

Session-2: Law, Economy and Planning

Session-3: Working Groups on Technical, Management, Policy and Economy

Session-4: Presenting Initial Recommendations

The Workshop Objectives

The workshop participants have assessed the current situation of the water scarcity crisis in Iraq and proposed policy recommendations to the Iraqi government. This preliminary report represents the follow up work administered by the IEI Task Force of academics and practitioners, with focus on:

- Iraq's National Water Resources Strategy
- Iraq's integrated water resources plan
- Short, mid and long-term policy measures to sustain demand
- Alternative water resources
- Environmental policies and climate change impact
- International law, policies and legal framework
- The Water and Energy Nexus
- The role of technology, engineering and the economy in water resources management.

Background

The Task Force for the Future of Iraq's Water Resources convened at a time of unprecedented environmental crisis in the Tigris-Euphrates River basin. Iraq's water crisis made global headlines in early June 2018, when Turkey began filling the 10.4 billion cubic meter capacity *Ilisu* dam, but the crisis is complex and has been developing over a forty-year period. In 1975 Turkey began the South-eastern Anatolia Project (*Güneydoğu Anadolu Projesi-GAP*) a network of 22 dams for irrigation and hydroelectricity on the Tigris and Euphrates headwaters in Turkey. Decades later, Iran developed its own hydroelectric and irrigation projects, the *Daryan* dam and *Sarkasht* dam which, like the *Ilisu* dam, saw completion in 2017 and 2018 respectively.

This report starkly displays the metrics of the crisis. The Tigris-Euphrates river basin provides up to 98% of Iraq's water. Due to a number of factors discussed here, the Euphrates and Tigris are expected to decline by 50% and 25% respectively by 2025. Indeed, as we outline, the rivers have been in decline for decades. For the Euphrates, the river flow was 927 cumecs (cubic meters per second) for the period 1961-2000, and 522 cumecs after the year 2000. The river had a volume of 30.6 billion cubic meters measured in the period 1938-1973, 22.8 billion cubic meters for the period 1974-1998, while the current volume is estimated at 18 billion cubic metres. Concurrently, Iraq's population and water demand is rising significantly, while existing infrastructure is wholly inadequate to maintain quality of life in Iraq and prevent the spread of water-borne disease.

While this is not a new crisis, the *Ilisu* dam began filling in June 2018, causing the Tigris to briefly empty to the point where residents of Baghdad and Mosul were able to cross the river on foot in some places, causing an outpouring of concern in Iraq and leading to emergency talks between Baghdad and Ankara. On June 7th, Turkish Ambassador for Iraq Fatih Yildiz announced that after talks with the Iraqi Ministry of Water Resources (MWR) Turkey had re-opened the gates of the new dam and that filling would re-commence on July 1st. But the crisis is far from over. Going forward, it will require a renewed focus within Iraq, Turkey and in the region and within the international community to find an amicable resolution to a complex transboundary water dispute.

This report, the work of over two dozen Iraqi hydrologists, policy makers and practitioners in the sector, is an entreaty for all stakeholders to urgently address what could become one of the most serious environmental disasters of the 21st century. The Task Force report is therefore an attempt to delineate the array of issues, whether they be anthropogenic, climatological, legal, political or demographic in nature, and to propose a basis for a sustainable solution to the crisis.

The issue of dam construction on the Tigris and Euphrates and their tributaries, while tied to economic and industrial strategy in Turkey and Iran, cannot be separated from regional politics and political leverage. However, one of the Task Force's propositions is to move negotiations

away from the “resource imperialism” of the past towards regional economic integration, viewing water resources alongside mutually beneficial, regionally linked energy infrastructure and cross border agricultural trade to create a net gain for the MENA region.

This will in turn carry a “peace dividend” for the riparian countries, akin to the beginning of the European economic union that led to the E.U. This is especially important given recent turmoil in the region and the history of crisis over transboundary water. For example, in 1990 when Turkey began filling the Atatürk Dam, the former Iraqi regime threatened Turkey with conflict after the Euphrates flow dropped 70%.¹ Dam construction continued and since the start of major dam construction on the Euphrates in the 1970s, the river flow has fallen by up to 45%.² Furthermore, the risk of conflict over water resources in the Tigris-Euphrates river basin has been assessed in various scenarios produced by international organisations including the UN and NATO,³ although internal instability, as seen in Syria, is more probable due to increased rural-urban migration.⁴

More recently, in May 2009 and June 2018 the Iraqi parliament cautioned that it would review all agreements with Turkey after a dramatic drop in Iraq’s water reserves. From Turkey’s perspective, responsibility lies with Iraq for poor water management including wasteful flood irrigation, although drip irrigation is expensive and difficult to implement in Iraq’s state run agriculture sector. The Task Force report addresses this issue and contains numerous recommendations for the Iraqi side.

Internationally, the World Bank and European Union halted financing for Turkish dams in 2009, but Turkey has nonetheless pushed ahead with construction with funding from other sources, although the diplomatic stance from Ankara softened in 2018 as both countries explored wider regional cooperation. This report outlines the potential legal strategies, in addition to strategies of mutually beneficial economic cooperation, and the wider legal context of transboundary water resource disputes.

From the Iraqi side, the report calls for a revisited and upgraded Strategic Land Water Resources of Iraq (SWLRI) plan to take into account new climate data and damaged infrastructure following the war with ISIS. A principle aim here is to encourage water conservation, improve the quality of available water, combat salinity, create viable opportunities for new investment in the sector, reducing domestic water demand and preparing emergency strategies that address worst case scenarios. Such a plan would be multi-sector and cross ministerial in nature, taking into account Iraq’s 2018 Reconstruction and Development Framework and the changing demand on water resources due to the expansion of the energy sector and Iraq’s industrial base.

Finally, and perhaps most importantly of all, the report frames the issue in a regional and global context, outlining how this is not simply an environmental threat to livelihoods in Iraq (and Syria) but a regional issue. Models of climate change indicate that the Middle East and North Africa (MENA) is among the most vulnerable regions of the world to the potential impact of climate

¹ <https://mepc.org/dams-and-politics-turkey-utilizing-water-developing-conflict>

² https://www.chathamhouse.org/sites/default/files/field/field_document/20150413Euphrates_0.pdf

³ <https://mepc.org/dams-and-politics-turkey-utilizing-water-developing-conflict>

⁴ <https://journals.ametsoc.org/doi/10.1175/WCAS-D-13-00059.1>

change. For this reason, we frame the issue regionally, looking at cooperation, rather than competition over water resources, and consider the importance of successful international case studies regarding sustainable sharing of transboundary water resources. We hope that this report can become the basis of a galvanised Iraqi and international response to a crisis that will directly impact over 60 million people in Iraq and Syria.

Iraq's Water Sources

- Ground Water: 2% - 7%
- Rivers: 93% - 98%

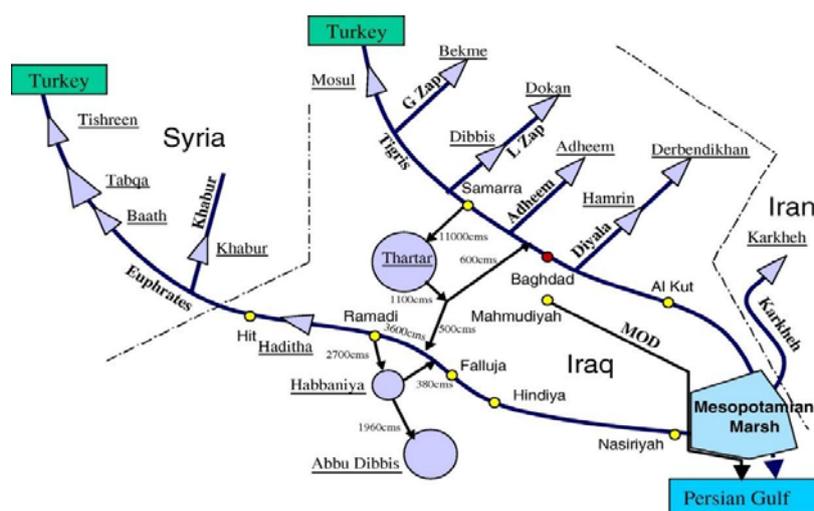


Figure 1-1: Schematic of water management structures in Iraq

Due to dams built in neighbouring countries, and a lack of common management practices, peak flows in Iraq do not coincide with the country's water needs, while the peaks are too late for winter crops and too early for summer crops. This problem will become worse with time as demand increases due to increasing population, the unpredictable effects of climate change and extreme weather events.

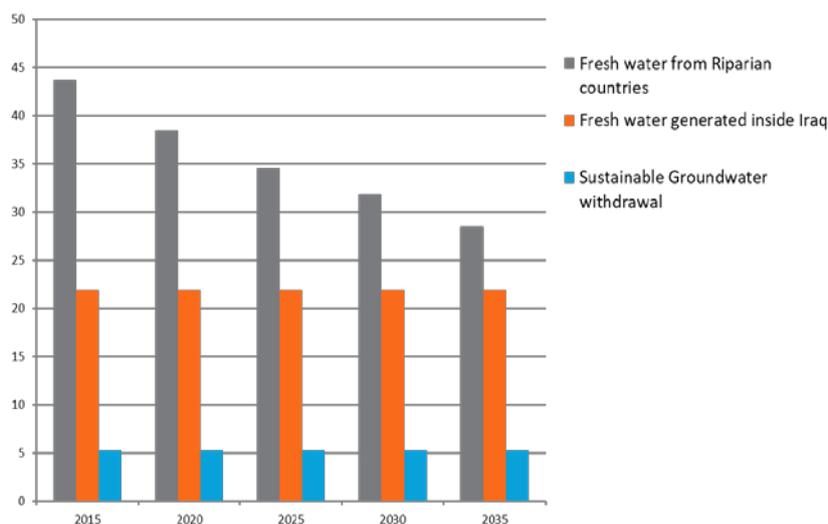


Figure 1-2: Expected water supply sources and quantities in Iraq in the near future

Water Supply by Country

The total water withdrawal in Iraq was estimated at 42.8 km³ in 1990 which was allocated for agricultural use (92%), domestic (3%) and industrial (5%) purposes. According to recent estimates, 85% of water withdrawal is used for agricultural purposes.

The flow of the Tigris River was considered natural until 1973 when dam construction started on the river and its tributaries. The average annual discharge for the period 1931-1973 was 21.3 Billion cubic meters.

For the Tigris River, dams were built on the tributaries in *Dokan* and *Derbendikhan* in the 1960's, however, the river was not controlled until dams began being built in Turkey as part of the South-eastern Anatolia Project (*Güneydoğu Anadolu Projesi-GAP* project) in the middle of the nineties with the latest being *Ilisu* dam, which is currently being filled. In the nineties, Iran also began building dams on the head water, impacting the shared rivers and tributaries to the Tigris and compounding the problem. The annual flow of the Tigris was estimated to be 50 km³ before the dam building era.

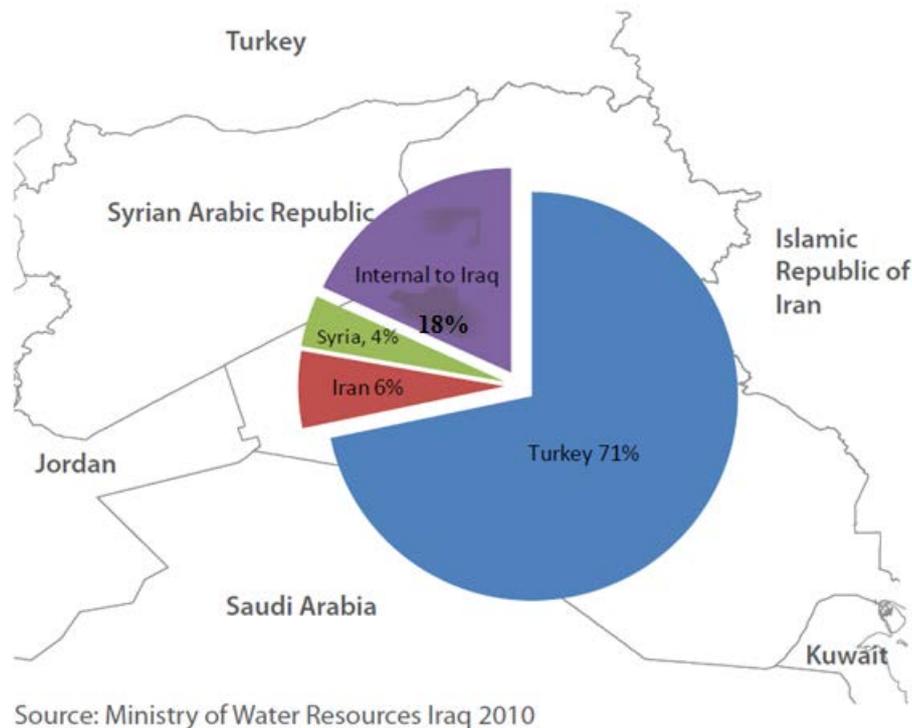


Figure 1-3: Water Sources for Tigris River

For the period 1974 – 2005, it was 19.6 Billion cubic meters.

The discharge of the river at Baghdad was:

- 1207 cumecs for the period 1931-1960.
- 927 cumecs for the period 1961-2000
- 522 cumecs after the year 2000

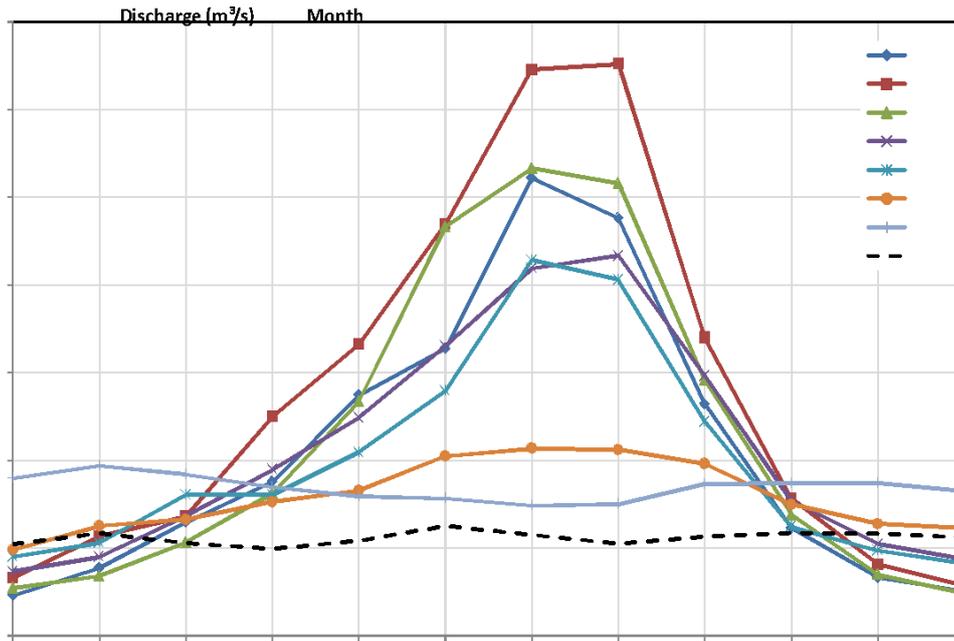


Figure 4: Monthly flow averages by decade for Tigris River

The average annual flow of the Euphrates is estimated at 30 km³ which might fluctuate from 10 to 40 km³.

- About 89% of the water of the river comes from Turkey.
- Its flow at Hit city after it enters Iraq has an annual average of 30.6 billion cubic meters measured in the period 1938 -1973.
- It was 22.8 billion cubic meters for the period 1974 -1998.
- It is at 18 billion cubic meters now.

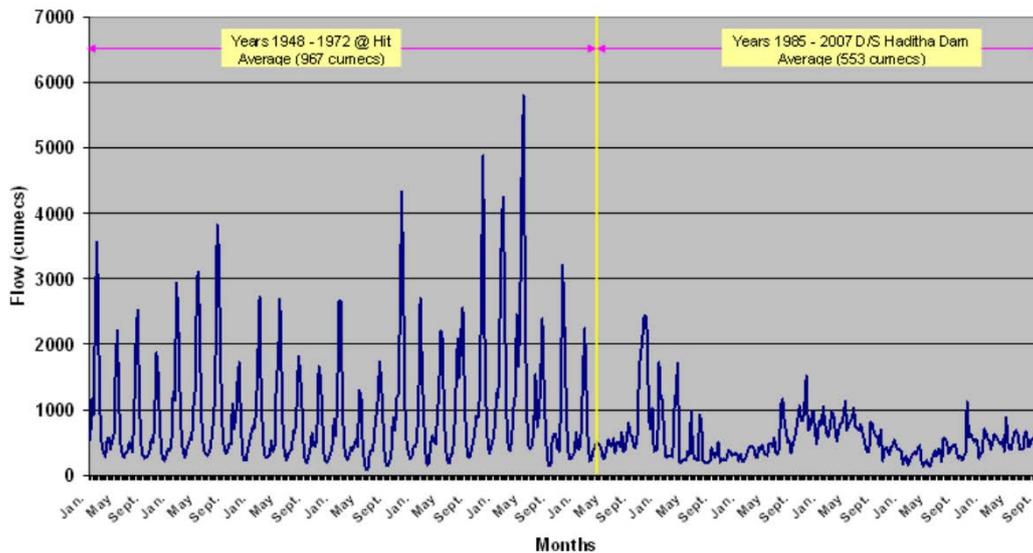


Figure 1-4: Water Discharge of River Euphrates at Hit & Haditha cities for the period 1948-2007

Water Infrastructure

- Dams and Reservoirs: Peak flows in Iraq do not coincide with the country's water needs, the peaks are too late for winter crops and too early for summer crops.

Table 1-1: Storage Capacity for Iraqi Water Control Structures

IRAQ	STORAGE (BILLION M³)
<i>HADITHA DAM</i>	8
<i>DERBENDIKHANDAM</i>	3
<i>MOSUL DAM</i>	11
<i>DOKAN DAM</i>	6
<i>THARTHAR LAKE</i>	86 (45 Dead Storage)
<i>HABBANIA LAKE</i>	43

Table 1-2: Table: Capacity of some of the Mega Dams in Turkey

TURKEY	STORAGE (BILLION M³)
<i>ILISU DAM</i>	44
<i>ATATURK DAM</i>	49

Water Supply/Demand

Current estimates indicate that water supply to urban areas provides 73% coverage. In rural areas, this falls to 40-45%. Water services are limited to a few hours per day, and the water is often of poor quality and in many cases undrinkable.

A low water tariff rate, combined with the lack of awareness about water scarcity, leads to a daily consumption of 392 litres per capita per day that exceeds the international average of 200 litres.

The biggest user of raw water however is agriculture.

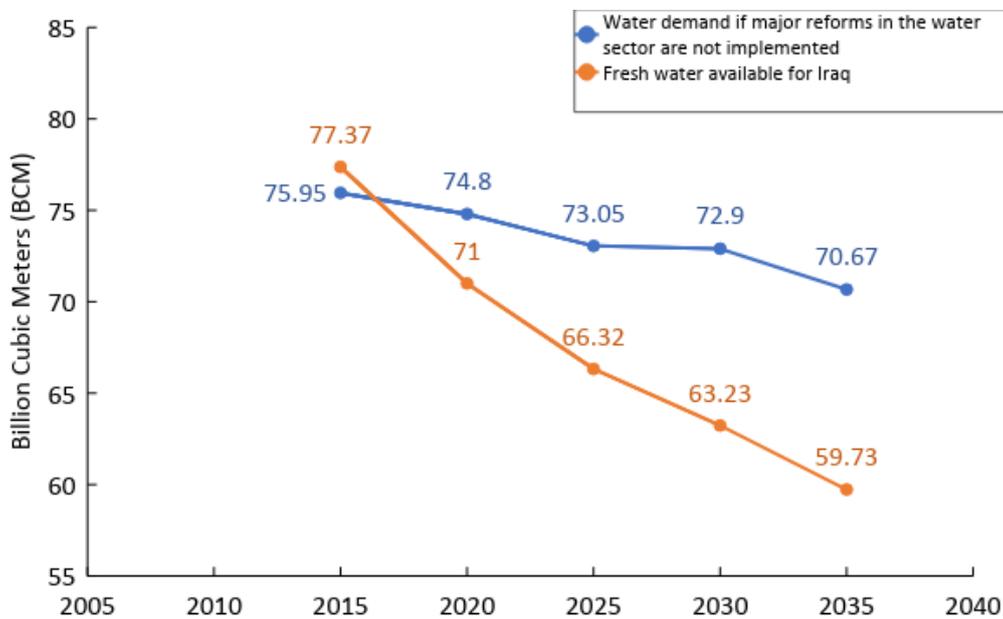


Figure 2-5: Projections Water supply vs demand

- Oil Industry projects a need of 1.773 billion cubic meters/year (By 2035).
- The marshes require a minimum of 5.305 billion cubic meters/Year of fresh water to prevent socio-economic losses countrywide.
- At least 50 m³/s needed to stop salinity intrusion from the sea to the Shat Al Arab.
- 60 million projected population growth by 2035.
- Domestic consumption is forecast to increase from 4.6 billion cubic meters/year to 6.4 billion cubic meters/year by 2035.

Water Production and Losses

Iraq's current treated water production is 6.8 million cubic meters per day (240 l/capita/day), but the amount of water reaching customers is only 2.17 million cubic meters per day, which means the efficiency of the system is 32%, i.e. losses of 68% (World Bank, 2006).

Future Water Demand in 2030

According to the UN, by 2030 the world is projected to face a 40% water deficit⁵⁶. Iraq's water demand is increasing; this will lead to an estimated water deficit of 37% by 2030

Major highlights on future water management:

- Bad sanitation is a major cause of the spread of diseases including cholera.
- Water economy is essential for maintaining quality of life in Iraq.
- This can be achieved through a full assessment of Water Management practices.
- Water conservation
- Education from a young age on the value of water
- Water and wastewater recycling is becoming more popular around the world.
- An assessment of the actions other countries have taking. Lessons to learn.

Table 2-3: Projection of water supplies

	2015	2020	2025	2030	2035
FRESH WATER FROM RIPARIAN COUNTRIES	43.695	38.482	34.592	31.871	28.486
<i>EUPHRATES</i>	18.396	16.683	14.137	12.383	9.999
<i>TIGRIS</i>	15.919	12.905	11.588	10.703	9.822
<i>GREATER ZAB</i>	3.378	3.377	3.375	3.316	3.294
<i>LESSER ZAB</i>	2.292	2.236	2.219	2.203	2.182
<i>DIYALA</i>	3.71	3.281	3.273	3.266	3.189
FRESH WATER GENERATED INSIDE IRAQ	21.92	21.92	21.92	21.92	21.92
<i>EUPHRATES</i>	1.123	1.123	1.123	1.123	1.123
<i>TIGRIS</i>	5.073	5.073	5.073	5.073	5.073
<i>GREATER ZAB</i>	7.462	7.462	7.462	7.462	7.462
<i>LESSER ZAB</i>	4.551	4.551	4.551	4.551	4.551
<i>UDHAIM</i>	0.956	0.956	0.956	0.956	0.956
<i>DIYALA</i>	1.788	1.788	1.788	1.788	1.788
<i>THARTHAR</i>	0.967	0.967	0.967	0.967	0.967
SUSTAINABLE GROUNDWATER WITHDRAWAL	5.243	5.243	5.243	5.243	5.243

⁵ <http://unesdoc.unesco.org/images/0026/002614/261424e.pdf>

⁶ Hydrologists consider a country to be under water stress when its annual water supplies drop below 1,000 cubic meters per person.

Assuming new/modern irrigation methods are used:

Table 2-4: Estimated Water Demands in 2030

(CUBIC KILOMETRES)

DOMESTIC USE	5.0
INDUSTRIAL	3.15
EVAPORATION FROM DAMS	8.4
RESTORING MARSHES	11.0
AGRICULTURE	42.0
TOTAL	69.55
EXPECTED SUPPLY	44.00
DEFICIT	(-37%)

Iraq's Water Challenges

External Reasons

Climate Change

Models of climate change indicate that the Middle East and North Africa (MENA) is among the most vulnerable regions of the world to potential impacts of climate change, and a region where the increase in average temperatures is expected to be relatively high. This implies:

- Less precipitation, which is also more erratic;
- Higher transpiration;
- Sea level rise;
- Drought that will affect agricultural life and water supply throughout the Middle East.

Laura Naranjo (2016) has observed how the Fertile Crescent has been steadily drying since 1931, with a decline in vegetation since 2008 and steep decline in groundwater between 2008 compared to the mean of the previous six years. Rainfall has decreased from 15 to 25%, and river discharge of Tigris and Euphrates is expected to fall between 29-73% (Kitoh et al., 2008). Surface water is projected to decrease by 17.640 BCM (billion cubic meters) or 24.5% over the next 20 years. Consumption of water outside Iraq is thought to be the cause of 15.21 billion cubic meters of that reduction.

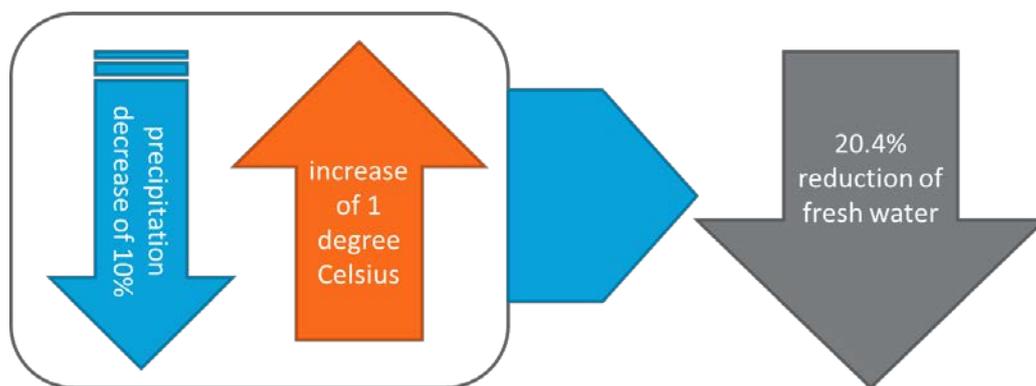


Figure 3-6: Impact of ambient temperature increase on reduction of freshwater

Water Requirements of Riparian Countries

Water needs by the riparian countries of Euphrates River are:

- Turkey - 15.7 km³;
- Syria - 11km³;
- Iraq requires 13 km³.

Table 3-5: Iran Dams (12 Dams)

DAM	RIVER	HEIGHT (M)	PURPOSE	COMPLETION DATE
DEZ	Shatt Al-Arab/Karun	203	I/P	1963
SHAHID ABBASPOUR (KARUN 1)	Shatt Al-Arab/Karun	200	P	1976
MASJED SULAAYMAN (KARUN 2)	Shatt Al-Arab/Karun	164	P	1976
KARUN 3	Shatt Al-Arab/Karun	205	I/P/F	2002
KARUN 4	Shatt Al-Arab/Karun	230	I/P/F	2010
GARAN	Tigris/Diyala/Sirwan	62	I	2005
DARAYAN	Tigris/Diyala/Sirwan	169	I/P	2010
UPPER GOTVAND	Shatt Al-Arab/Karun	180	P	2012
LOWER GOTVAND	Shatt Al-Arab/Karun	22	P	1977
KARKHA	Shatt Al-Arab/Karun	127	I/P	2001
SEIMARE	Shatt Al-Arab/Karun	180	P	2013
KHERSAN 3	Shatt Al-Arab/Karun/Karkha	195	P/F	2015

F: FLOOD CONTROL, I: IRRIGATION, M: MILITARY, P: POWER, W: WATER SUPPLY

Table 3-6: Syrian Dams (4 Dams)

DAM	RIVER	HEIGHT (M)	PURPOSE	COMPLETION DATE
BAATH	Euphrates	14	P/I/F	1988
TABAQA	Euphrates	60	P/I	1975
TISHRINE	Euphrates	40	P	1999
UPPER KHABOUR	Khabour		I	1992

F: FLOOD CONTROL, I: IRRIGATION, M: MILITARY, P: POWER, W: WATER SUPPLY

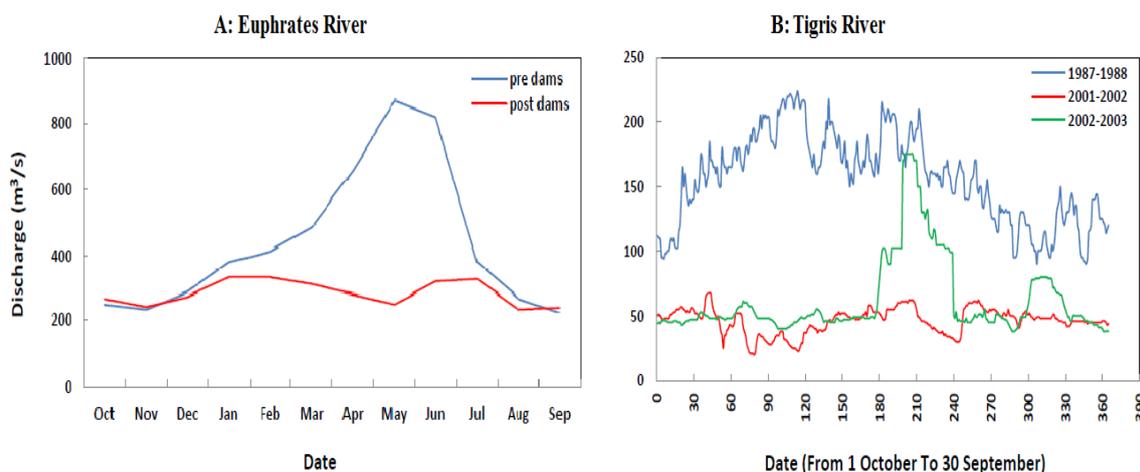


Figure 3-7: The Euphrates average monthly flow at Thi-Qar station during the periods 1950–1980 (pre-dams)

and 1982–1997 (post dams)

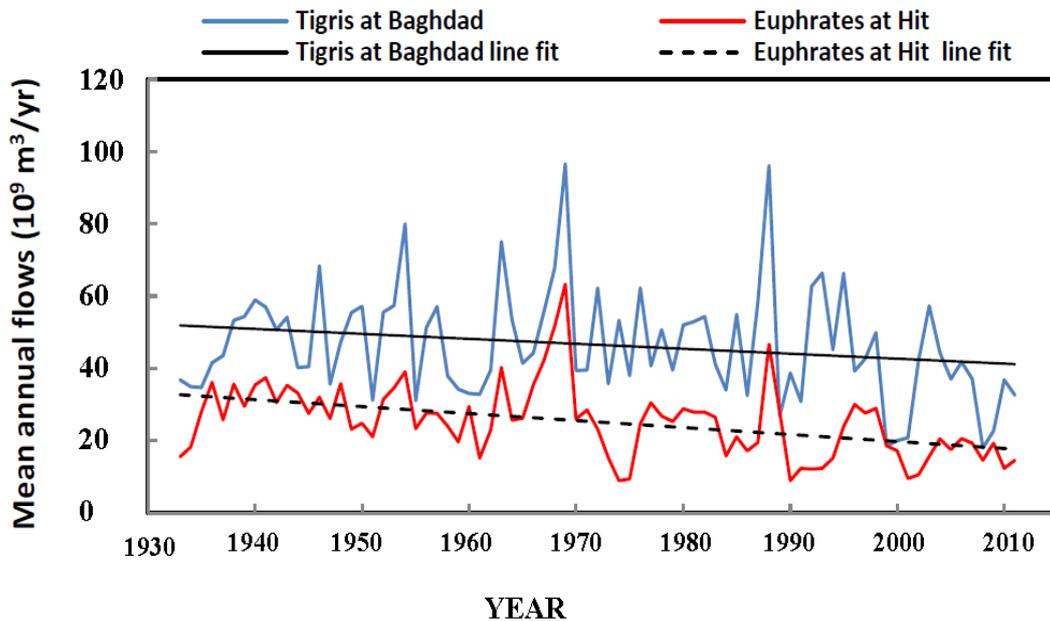


Figure 3-8: Long-term flow of Tigris and Euphrates Rivers (modified Abdullah, 2016)

Internal Reasons

- Lack of long-term strategic planning
- Lack of regional cooperation
- Lack of a human resources development plan
- High water losses through the distribution network
- Water scarcity and growing water demand.
- The need to build large scale new infrastructure with high investment requirements.
- Rapid increase in population (3%) (Ministry of Municipalities and Public Works, 2011)
- Lack of a public awareness program.
- More dust storms are expected.
- Up to 98% of Iraq's water originates from neighbouring countries.
- Euphrates and Tigris expected to decline by 50% and 25% respectively by 2025.
- Population growth.
- Increased water demand for oil production and refining as production and capacity expands.
- Increased demand from industry as Iraq expands its industrial base and diversifies the economy.
- Lack of water allocation agreements with neighbouring countries.
- Weak political bargaining power, or an incoherent bargaining strategy.
- Weak planning and environmental regulations.
- Degraded water infrastructure.
- Lack of capital investment.
- Climate change, rainfall patterns and temperature rise in Iraq.

After rivers, ground water from wells is the second major source of water in Iraq, although to date this resource is not fully utilised for various reasons. The Ministry of Water Resources has divided

Iraq into ten groundwater zones and is carrying out hydrogeological surveys for each of them. In the desert blocks, surveys have been largely completed, concluding that more wells could be sunk in specific aquifers.

Depths of boreholes are usually shallow and water flow is low, presenting a challenge.

Table 3-7: Baghdad Water Treatment Plants Capacities and Capital Costs

IRAQ PLANTS	CAPACITY (M ³ /D)	COST \$
AL-ZAFRANYIA WTP	90,000	58m
AL-KHADHUMYIA WTP	113,000	100m
EAST BAGHDAD WTP	225,000	50m

The total area of Iraq is 438320 km² of which 924 km² of inland water. Population 39.3 million.

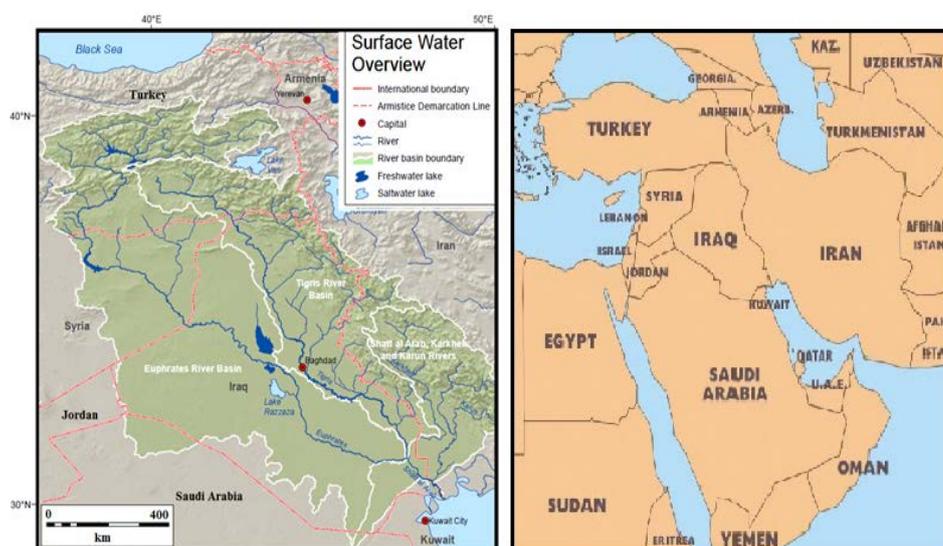


Figure 3-9: Tributary Areas of Tigris and Euphrates

Water Management Challenges

- Low water flow due to the construction of Turkish and Iranian Dams.
- Climate change, drought and reduction of renewable water resources.
- Lack of a coordinated spatial plan for the development of industries, urban and rural settlements and agriculture.
- Lack of an economical view on water and barriers to private investment in the water sector.
- Imbalance of water supply and consumption and increasing water competition among users causing internal conflicts among provinces, tribes and farmers on water quotas.
- Lack of effective project execution to develop water resources and agriculture.
- Deterioration of water quality and pollution of water resources.
- Lack of implementation of an integrated water resources management system.
- Limitations of comprehensive planning for water utilisation within geopolitical boundaries, which considers Iraq's economic plans.

Soil Salinity

Iraq's soil salinity problem dates back 3800 years, however, historically the floods cleared the salts and deposited a new layer of silt and clay and thus natural processes have helped in keeping agriculture from collapse. However, due to the disruption of floods and no changes in irrigation processes, salinity is on the rise. Recent estimates:

Table 3-8: Iraq Soil Salinity

SEVERELY SALINE OF IRRIGATED AREAS	4%
MEDIUM SALINE	50%
SLIGHTLY SALINE	20%
TOTAL EFFECTED AREAS	74%

The salinity of the Euphrates at the Iraqi-Syrian border is 1250 ppm.⁷ The river gets progressively saltier as drainage water is added and as it passes through areas where groundwater leaks to the surface.

⁷ Source of data: The Encyclopaedia of EARTH, Water profile of Iraq (2008)

Water Quality

The quality of drinking water does not meet WHO or national water quality standards. The water treatment plants are barely operational, especially on the Euphrates. To decrease the risk of contamination, residual chlorine is used in very high concentrations (0.5 mg/l). The high groundwater level increases the risk of contamination, with Baghdad and the south particularly vulnerable due to the deteriorated network, which is old and corroded. Furthermore, pumps are added by homeowners creating a negative pressure.

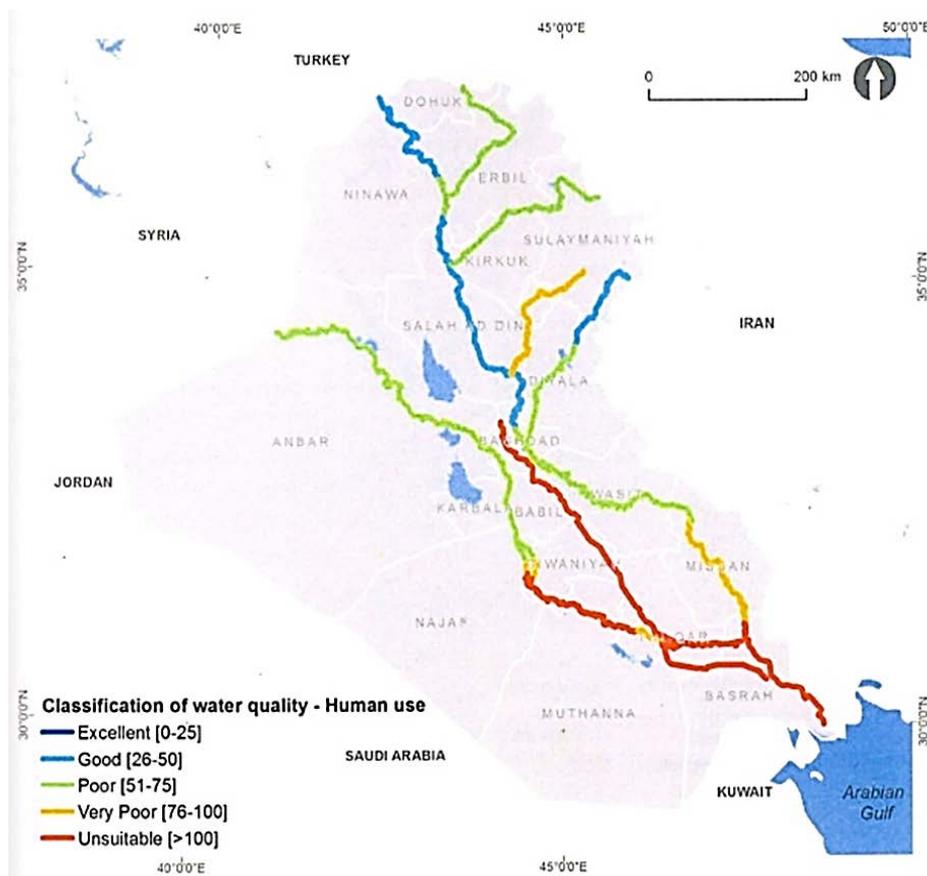


Figure 4-10: Classification of Raw Water Quality

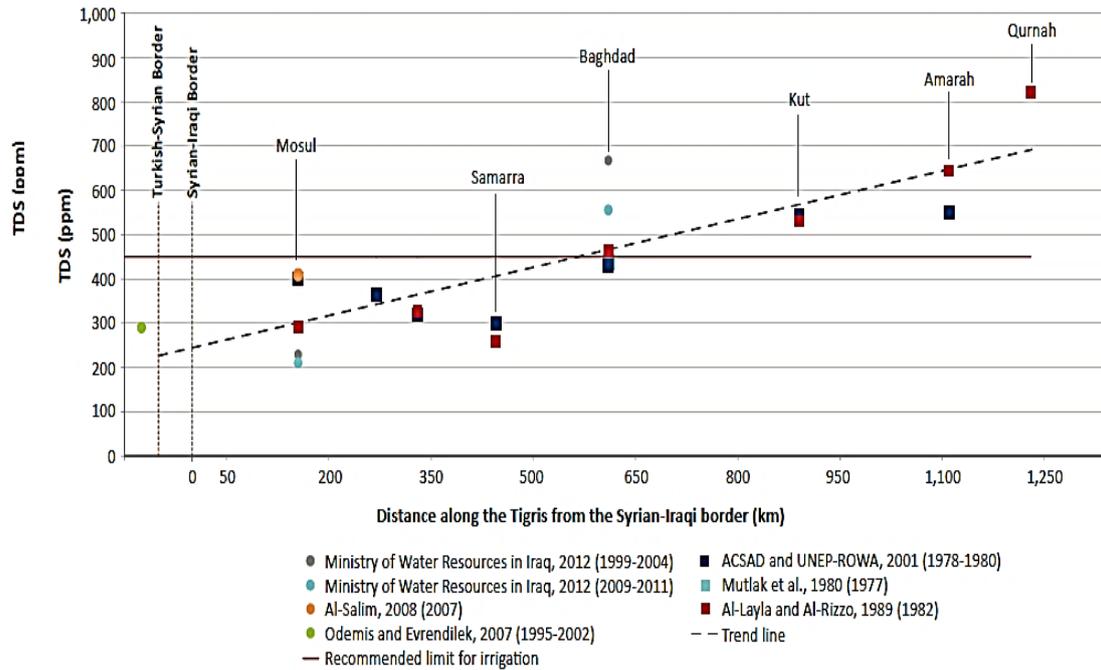


Figure 4-11: Salinity variation along the River Tigris (ESCWA, 2013).

Drought and its Impact on Agriculture

Iraq has been suffering from drought since 1970s. Between 2007 – 2009, 40% of cropland experienced reduced crop coverage and livestock was decimated. During this period, 20,000 rural inhabitants abandoned their land seeking access to drinking water and a better livelihood.

Sewers

Waste Water Infrastructure

- Sewers and Pipes
- Pumping Stations
- Treatment Works

Coverage of the sewer pipe network is about 60% for sanitary requirements. In *Basra*, coverage for storm sewers is 70%. The sewer system and pumping station pipes were installed in the last half of 1970's. The pipe material is concrete including asbestos, ductile cast iron, PVC and GRP pipe with a diameter of 110 ~ 2,250 mm and a total length of approximately 3,500 km. The network suffers from:

- Poor hydraulic modelling of sewer networks.
- Old, undersized, badly maintained or not maintained sewers.

Sewage Treatment Works

- Sewage infrastructure is largely in disrepair.
- There are 331 sewage treatment plants that process 1500 ml/d of wastewater.
- Large flows of sewage are piped directly into waterways.
- Actual WWTW capacity exceeds design capacity.

Proposed Solutions

- An updated water master plan must be created and implemented as a matter of urgency
- Implementation of advanced irrigation methods should be fast tracked.
- Develop an operation and maintenance strategy for water reticulation network to minimize water losses in pipes
- Utilise groundwater resources.
- Build new storage capacity to maximise the use of the available flow from our rivers.
- Explore the Pros and Cons of importing salty water from the Arabian Gulf and building new desalination plants. Examine the UK's experience of using the Beckton desalination plant during drought.

Marshes

The Iraqi marshes cover an area 15,000 -20,000 square kilometres. By the year 2000 less than 10% of the area remained. To restore 70 – 75 % of the marshes, 13 cubic kilometres of water are required. Sixty percent of the fish consumed in Iraq comes from the marshes.

Iraq Water Resources Strategy

An updated, comprehensive water resources strategy for Iraq would consider the following elements:

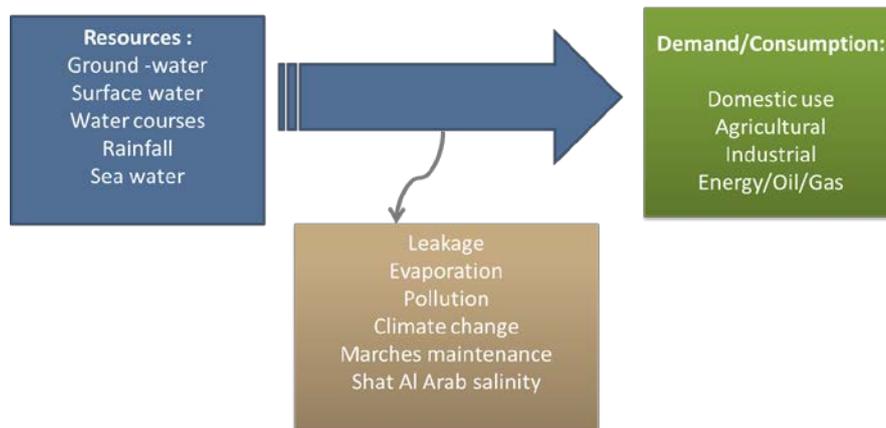


Figure 8-12: An overview of the threat to Iraq’s water resources

- Food security
- Navigation strategy
- Environmental impact
- Energy strategy
- Irrigation/Agriculture strategy
- Policies/laws/regulations

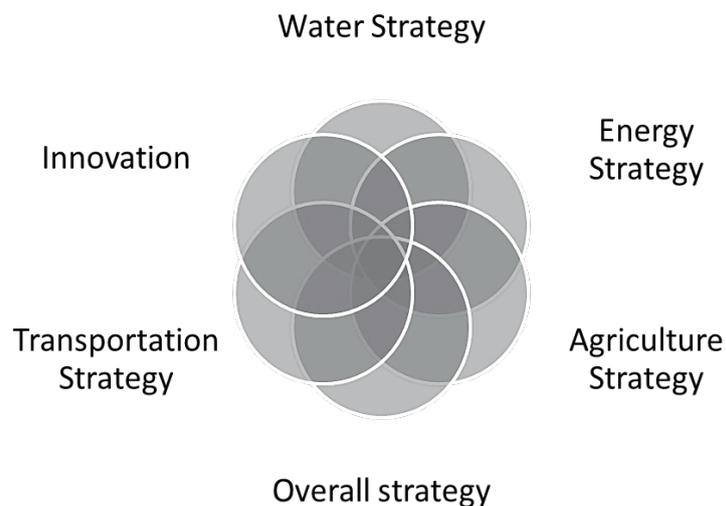


Figure 8-13: Stakeholders in Setting strategic goals

- A national integrated model is required to steer the decision-making process
- Desalinisation plants are required
- A *Shat Al Arab* Barrage is needed
- Innovation, for example, real time weather forecasting can allow for better management of surface water.
- A groundwater recharging plan is needed.
- A leakage reduction strategy must be devised.
- Plans must be made for the worst-case scenarios regarding water scarcity.
- Iraq must assess the feasibility of a strategic drinking water emergency storage.

Iraq's Water Resources Management

Iraq's water resources development and management plans initially evolved between the 1960s and 1980s. USAID assisted the MWR in developing a National Water Plan in 2005. The National Development Strategy (2007 to 2010) included regulations on integrated water management. UNDP developed a strategic framework of assistance towards integrated water management and institutional development. More recently (2015), MoWR completed the Strategic Water and Land Resources for Iraq (SWLRI) that used Iraqi experts along with international experts to develop tools that were then used to compile plans for various scenarios of water supply and development of land in Iraq and the riparian countries. The plan included recommendations for infrastructure developments that have yet to be embarked upon to affect water saving projects. However, the war with ISIL as well as the financial crisis from reduced income due to low oil prices has resulted in no project plans. This makes the situation even more dire for Iraq and the current situation is not sustainable. Iraq has to revise its strategy now in view of changing conditions since the plan was completed.

Failure of Current Water Policies

- Water policies have been dominated by supply only. Demand is usually taken as given.
- Current or projected supply of water are largely funded by the public sector.
- Very limited ambition for cost recovery.
- Inadequate financial resources not only for capital investment but even for normal operations.
- Inability to resolve water allocation problems with riparian countries (mainly Turkey and Iran).

Water Disputes

Iraq believes water conflict is inevitable unless authoritative and binding methods for settling disputes are put in place. Historically, there have been a number of instances when Iraq and Turkey came close to conflict over water:

- *al-Thawra (Tabaqah)* Dam construction (1974): Iraq threatened to bomb the dam in Syria and massed troops along the border, when Syria started filling the reservoir. Iraq asked the Arab League to intervene.
- Turkey's *Ataturk* Dam (1990): The flow of the Euphrates was interrupted for a month as Turkey completed construction of the *Ataturk* Dam.

Iraq faces three specific policy challenges with riparian countries:

- 1) Establishing the rules;
- 2) Monitoring and verifying compliance;
- 3) Providing an authoritative and binding method of settling disputes

International law and rules for transboundary waters

The Helsinki Rules (1966)

- The rules set out the obligation to implement reasonable compensation measures if the interests of states have been violated;
- They establish the necessary consideration of all relevant technical, economic and financial factors while planning and carrying out a project;
- They dry out the requirement of a state to inform all riparian countries of a pending project;
- They stipulate the observation of an appropriate waiting period before the construction of a project is started.
- They advocate the collection and open exchange of data;
- They outline the arbitration procedure arising from objections by means of consultative committees and arbitration commissions.

The Water Convention (1997)

The Convention governs protection, preservation and management of transboundary watercourses.

- Ratified by 35 states only.
- Is a binding law only for the states that ratify it?
- Turkey voted against the convention.
- Iraq did not participate in the voting.

UN General Assembly Resolution 2669 (1970)

- Drafted as a treaty for discussion to define an ‘international water basin’ as a ‘shared natural resource’.
- The International Law Commission (ILC) faced the dilemma that several states, especially those in problem regions, refused to ratify a treaty that contains binding agreements with respect to the utilization of water.

Table 9-9: Countries opposed or voted in Abstention on the International Water Treaty

FOR	42 NATIONS	UPPER AND/OR LOWER RIPARIAN STATES
AGAINST	3 nations	China, France, Turkey
ABSTENTION	18 nations	Mostly upper and few lower riparian states, e.g Egypt, India, Israel, and Pakistan

Other International Laws

The United Nations Environment Programme (UNEP) and the ILC set out a 'reasonable' water management law that can be enforced and accepted internationally.

The United Nations Educational, Scientific and Cultural Organization (UNESCO), the World Bank (IBRD) and the World Health Organization (WHO) are also involved in developing water agreements.

Mutual Watercourse Agreements

Many countries have signed international agreements over the use of water.

Egypt and Sudan agreed on dividing the flow of the Nile between the two riparian countries (1959). India and Pakistan found a formula for dividing the water in the Indus Basin based on the Helsinki Rules (1966). Eight member states of the Southern African Development Community (SADC) share the Zambezi River basin and agreed to form ZAMCOM to promote equitable and sustainable utilisation of water resources (2004).

Turkey and International Laws

Turkey believes the terms of the Water Convention are more stringent than a framework and have overstepped the bounds of the initial General Assembly mandate.

Turkey asserted that it would not accept any customary international legal standards that resulted from the Water Convention.

International Water versus Transboundary water

There exists an ongoing dispute on the definition of the Euphrates and Tigris rivers.

Syria and Iraq consider these waters as "international waters", which need to be shared among all riparian countries. In contrast, Turkey claims these waters are "transboundary waters" as long as the water flows within its boundaries.

Single Basin or Two Basins?

The acceptance of the Euphrates and Tigris rivers as a single basin is also disputed among the riparian countries.

Turkey claims that the basin is a whole in terms of their upper water collection and lower distribution basins. The confluence of the two rivers at the Shatt-al-Arab and the Tharthar Canal are two supporting arguments for this claim.

Iraq states that the hydraulic systems of these two rivers should be considered separate, because the two rivers irrigate different basins.

Sovereign Rights within the Basin(s)

Historically, Turkey and Iraq (upstream and downstream riparian countries) have advocated self-interested policies regarding the ownership rights of transboundary waters.



Figure 9-14: Water Rights

Water Rights of Basin States

The riparian countries rely on different arguments concerning the use of waters from the Euphrates and Tigris rivers.

Iraq believes in "prioritized right of use" over these waters, and requests that the three countries share the water equally amongst them, which means that Turkey should leave 2/3 of the water to Syria and Iraq.

Turkey believes in the 'right of sovereignty' based on accepted principles such as 'righteous and reasonable use' and 'causing no harm'.

Integrated Water Resources Management

The main objective of Integrated Water Resources Management (IWRM) is viewing water both in its natural state and in its periods of high demand. The first priority of IWRM is not an increase of water supply, but rather the economic and efficient utilization of the available water resources.

IWRM General Components

IWRM comprises hydrographic management of water resources and the integrated management of all sources of water (groundwater, rivers, lakes, rainwater, gulf seawater, etc.) It involves efforts to monitor and maintain quantity, availability and quality of water resources.

IWRM also involves the cross-sectoral management of different economic (industrial and agricultural) sectors for upstream and downstream users, hence it requires policy making in consideration of available water resources in the present and in the future. It requires demand-oriented management, including cost recovery mechanisms and water-efficient technologies. Therefore, it requires participative management to ensure the interests of all stakeholders are considered for equitable water access.

There is however, no provision within the Iraqi Constitution⁸ for integrated management principles. Iraqi law includes many provisions related to water dispersed throughout various legal codes. Limited provisions are included in the legislative and planning frameworks but the capacity for implementation is low.

IWRM Obstacles

There are a number of obstacles to IWRM that must be overcome if the countries in the Euphrates-Tigris basin(s) want to govern these resources in accordance with international legal principles, considering scientific data pertaining to climate change. These include:

- Historical conflicts and subsequent political distrust.
- Dissimilarities of legal, economic, ethnic and demographic structures, as well as geological and climatic differences.
- Differing strategic positions on water issues.

⁸ The Iraqi Constitution provides general guidelines for natural resource development and management, including the water sector. The Constitution stipulates that the Central Government will be responsible for dealing with transboundary water issues.

Regional Economic Integration Plan

A Regional Economic Integration Plan (REIP) is a basic precondition for success to resolve the current water dispute. This requires a new regional policy for moving the water resources issue towards a common economic platform.

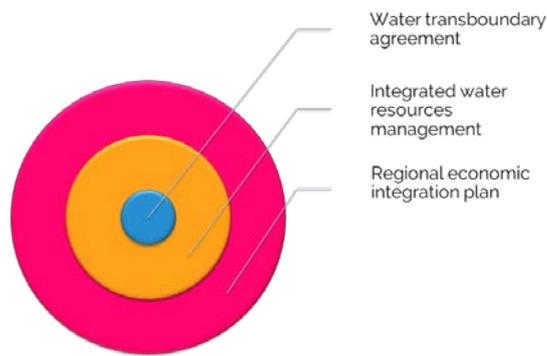


Figure 11-15: The confluence of Economic Integration with Water Sharing

Sustainable economic development of the region will require integration and promotion of effective cooperation in the management and development of the region’s entire natural resources.

Development Nexus for REIP

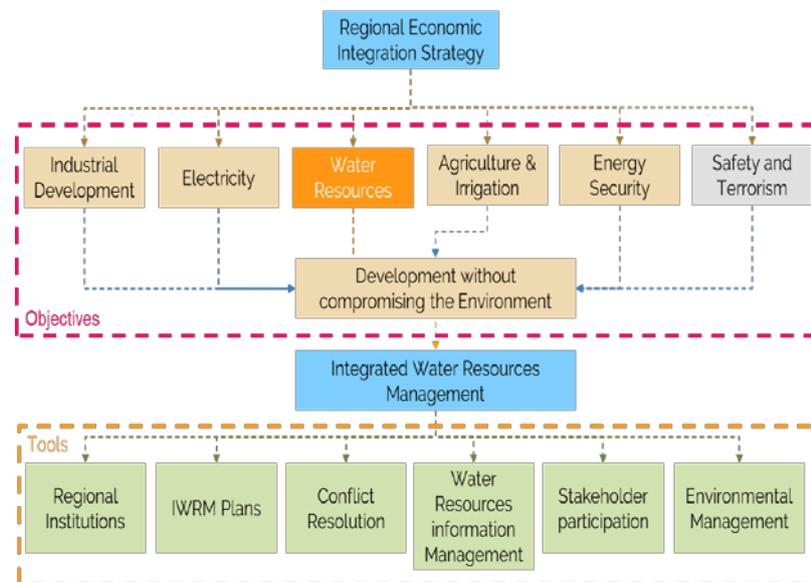


Figure 11-16: Components of a Regional Economic Integration Plan

Key steps for REIP Water Strategy

- Coordination and consultation on major hydraulic works
- Joint investment planning considering consumptive water use
- Coordinated operational management
- Harmonization of water use licensing in the context of the entire river basin
- Promoting the development of energy that allows the sharing of benefits, in particular natural gas transmission and the electricity grid.

Immediate issues for discussion

There are three main areas of discussion that will have a major impact on the development of the Euphrates-Tigris Basin and regional cooperation:

- The extent of hydropower development and whether this will follow the low, medium or high development scenarios of riparian countries.
- The extent of irrigation development, again regarding different scenarios related to the agriculture expansion targets of the riparian countries.
- The nature of any future cooperation platform (e.g. regional development organization).

The Bottom Line

To date, Iraq has been unable to resolve the current water crisis with neighbouring countries either due to rigidity of its policies or the inflexibility of other countries. It remains uncertain whether the government and the local authorities are bold enough to grasp the immediate urgency of using new policies to overcome water shortages. At the same time, the current situation is not sustainable and water shortages will create mounting stresses on the cities and rural communities. As in the past, farmers will continue the abandonment unproductive farms to look for employment in cities, which in turn are hardly able to manage their existing populations. This situation is far more serious now however, due to climate change and population growth in Iraq.

If Iraq fails to initiate emergency measures today that could retain sufficient water in the future, such failure will ultimately be that of the leadership, and of the leadership alone.

Water and economic development are inseparable, and in most cases alterations in one system could cause noticeable effects in the other. Therefore, management of natural resources should be addressed in one context. Lack of cooperation leads to economic disruption in the water sectors where the water-economic development nexus remains very strong. Such eventuality will simply result in a net loss to trade and development across the region.

Discussions

- 1) **Dr Abdul Kareem Faisal:** stated that the Advisory Commission works on different sectors in the economy, including agriculture, higher education and construction. It consists of 12 members; some of whom are in unpaid positions. The head of the Advisory Commission attends ministerial meetings. Abdule Kareem Faisal stated that the outcome of the workshop will be presented in the next ministerial meeting.
- 2) **Prof. Nadhir Ansari:** stated that Iraq's water resources comprise 90% surface water and 71% flow from Turkey. He stated the external issues affecting the water scarcity are climate change, north Atlantic oscillations and dust storms due to climatic changes. Studies of Iraq's long-term records from north to south, east to west have noted how Sinjar and *Sulaymaniyah* (Intergovernmental Panel on Climate Change-IPCC data) indicate that rainfall is declining. Furthermore, in some years, intensive rain for short periods is causing sediment deposits in lakes and reservoirs which will reduce storage capacities. Short period infiltration of ground water and storage volume will reduce flows between 29-73 per cent in the future. Regarding the global sea level rise, the most affected areas will be the south of Iraq and the Nile delta.

Prof. Nadhir stated the water requirements of upper riparian countries are increasing, and they will continue efforts to secure water resources due high population growth. However, he stated that officially stated water requirements in Turkey are three times more than what they actually require. Prof. Nadhir stated the riparian countries are not signatories of international water treaties, have no incentive to negotiate and have the right of cancellation for any past agreement. Mediators in this ongoing dispute could be those with political influence, financial capabilities and technical abilities, such as the USA, EU and World Bank.

Euphrates water is currently divided as follows: Turkey 15.7 km³, Syria 11 km³ and Iraq 13 km³. Turkey has built 22 Dams and the now completed *Ilisu* Dam has been planned since the 1980s.

Prof. Nadhir stated there is lack of regional cooperation, human resource development in addition to water loss through distribution, above 32% according to the World Bank. The distribution of waste water is also polluted, contains a high concentration of chloride and there is a lack of public awareness that pervades discussion of the water crisis. By contrast, Jordan's water program is an example of the realization of water's importance. Prof. Nadhir stressed that Iraq must transition to non-conventional methods of irrigation and water harvesting, which will go some way to reducing soil salinity. Prof. Nadhir noted

how the marshes are not recovering, and are now far below 70% of what they used to be and some areas are now solely used for the oil industry.

- 3) **Mr Aun Dhiab:** Mr Dhiab has more than 50 years of experience in the sector: stated the combined volume of both rivers is currently 30 billion m³. He stated that there is now a real water shortage, according to current data which shows a worsening gap between supply and demand, which is set to increase to 11 billion m³ by 2035. A part of the solution to this problem lies with banning the plantation of rice and corn and other water intensive crops. Reducing the deficit will depend on negotiations between the riparian countries and this is a complex issue. Mr. Dhiab remarked how Iraqi negotiators are generally weak and a new direction for negotiation is required with Turkey. One problem now is that that negotiation with Iran and Turkey will require two committees from the Ministry of Water Resources and Foreign Affairs for negotiation.

Mr. Dhiab noted how the Ministry has complete information on the GAP project, and if Turkey completes 100% of the planned projects the water shortage will worsen. Iraq urgently needs to reach a sustainable agreement to reduce the potential damage. The strategic study by the Ministry until 2035 states that there must be an increase in the efficiency of irrigation methods. Water use, out of available treated water, has increased from 26% to 60% in 20 years. The study covers the implications of this, required engineering work and the necessary revitalisation of old infrastructure. The study was conducted in 2014 by an Italian consultancy, Studio Galli Ingegneria (SGI.)

The study concluded that Iraq must direct a significantly higher percentage of its budget for water resources and engineering infrastructure, which would require \$172 billion for the period until 2035 for rehabilitation and new projects using new irrigation technologies. A sum of \$8 billion per year would be required for waste water treatment to reduce pollution. However, since then, ISIS have destroyed a significant amount of water infrastructure, which is in the process of being rebuilt.

The plan to rehabilitate infrastructure included financing repairs and upgrades to the barrages at *Ramadi* and the *Warwar* regulator. However, due to the decrease in oil prices, there is no budget left for the Ministry, which only has 18 billion Iraqi Dinars for the 2018 annual budget. New closed irrigation and water transfer is necessary. Desalination is important, as is the reuse of waste water and new ground water use.

- 4) **Dr Qusay AlSuhail:** discussed Iraq's ground water reserves and the physiography of Iraq. The ground water total dissolved solids (TDS) is 400 ppm-600ppm (2013 data) in west-central Iraq (refer here to Figure 12: Salinity variation along the River Tigris, ESCWA, 2013). In this area, it can be as high as 1000 – 4000 ppm which is reasonable for irrigation. According to UN data in 2013, "the Total Dissolved Salts (TDS) in the Euphrates' river water increased from 457 parts per million (ppm) in the 1980s to 1200ppm in 2009." This rapid deterioration of water quality has almost certainly worsened in recent years, with Basra particularly affected. Towards *Qurna*, ground water salinity becomes extremely high due to seepage. Data on ground water is generally lacking. Block 5 and 7, Yugoslavian company did the survey and block 4, the 8, 9 and 10

WRM more than 3000 meter and new ground of the mixed of layers on the banks of the Euphrates. "The groundwater of the Mesopotamian plain was studied by a Russian team (1980) contracted with the Ministry of Irrigation in the late 1970s. They established observation boreholes in the Mesopotamian plain near *Shanafiya, Nasiriyah, Baladruz, Diwaniyah, Shatra, Dujaila, Amara, Hawija* and *Dibuni*. Regional hydrological studies in the 1970s and 1980s were carried out for the seven blocks of desert and compiled by Al Rawi et al (1983) for blocks 1-3, Southern Desert-Salman area; Idrotecnico (1977) for block 4, Southern desert-*Nukhaib* area; consortium Yugoslavia (1979 and 1981) for block 7, Western Desert *Ramadi-Anah-K-160* settlement and block 5 *Rutba* area. These studies included groundwater regime observations and drilling of relatively deep wells. The deepest well reached 1,600 metres near *Ga'ara*, Western Iraq.

The sea water canal project, for enhanced oil recovery, encroaches onto the ground water area which carries the potential for significant impact on this resource. This project, which is vital for Iraq's oil production, is often referred to as the Common Seawater Supply Project (CSSP) but may be integrated with another plan known as the Integrated South Project.

There are 3 types of ground water sources,(1) strategic basins. (2) Renewable basins from rains and (3) Extracted basin when required..

Rainfall across Iraq is 150 – 200 mm per year in the southern and western regions, increasing to 1000 mm in the north with *Duhuk* and *Zako* averaging 800 mm per year. Much of this rain will not take the form of seepage into the ground water. Annual evaporation is 3500 mm in Basra and reaches 2000 mm per year in the north.

There are 16 layers of ground water aquifers. *Damam* is the largest. depth is 200 meter with high pressure and productivity, renewable 80 million per year in *Aqra*. *Damam* is in average 240 mm per year depending on the rain level.

The soil in Iraq has quick draining rate, water harvesting varies and not in one rate, *Dibdiba* is one of them of largest. Depth is varying as well.

The distribution of water resources outside of reservoirs is highly unequal. There are an estimated 88,000 wells across the country, but the figure is likely to be far higher due to illegally drilled wells (Hannah Moosah, Routledge Handbook of Environmental Conflict and Peacebuilding, pg. 188). The total reservoir capacity is 1,000 billion m³. 3,8 billion m³ over the last 30 years. 4,8 billion m³ per year renewable. investment is 2,5 – 3 billion per year the rest is renewable

TDS is low in the north and in the western deserts, at approximately 500 ppm, which is adequate for irrigation. 50% of the water for crops in these areas comes from rainfall, the rest is supplementary irrigation from the river. Optimisation models suggest that some areas are highly over exploited, such as Najaf.

Ground water should be used in conjunction with surface water and the use of this

resource should carefully be considered. It is important to note that groundwater is not recharged completely and it is high in salinity. As such its use in irrigation is questionable. Dr AlSuhail: stated the *Sawa* lake backfilling might help to increase the pressure on the ground water in the area.

- 5) **Dr Azzam Alwash:** indicated that regardless of what Iraq does internally there is going to be a shortage of water as the water management regime has changed. This is partly due to dam building, but the culture of irrigation that has developed since the Sumarian times has not changed. Flood irrigation methods are sustainable as long as there are annual floods that would heal the farm lands by washing away salts and depositing new layers of silt and clay. This has not been happening since 1968 and as such Iraq will continue to lose arable land.

The solution to the current water crisis cannot come into fruition without an agreement with Turkey. However, the language used in dealing with Turkey should change, since the position of Iraq in regards to its historic rights has not resulted in a policy change over the last 40 years. Iraq loses over 8 billion cubic meters through evaporation from artificial lakes that were created as flood control structures, built at a time when Iraq's problem was flood control.

Dr Azzam stated that this evaporation is like burning gas in the south, wasting an estimated \$2 billion per year. Water evaporation in Iraq is currently 3 meters a year.

The water crisis is an opportunity that can be taken advantage of by cooperating with Turkey to manage the waters of the Tigris and Euphrates. Through leasing dams in Turkey Iraq can drain the artificial lakes that Iraq created to manage floods. This will make 8 billion cubic meters available to help close the gap between supply and demand. Leasing rights can be paid for through preferred prices for oil and gas supplied to Turkey and through connecting the electric grid of Iraq to Turkey. Further, Iraq can allow Kuwait to link its electricity grid to that of Turkey to allow for the selling of electricity all the way to Europe. This can re-open the old transit routes for a new Silk road between Basrah and Istanbul. This cooperation will undoubtedly cost Iraq money but will actually solve its electrical supply problem, cutting out vast opportunity cost lost to power outages. Through such an energy partnership, Iraq can find new markets for oil and gas through a land connection to Europe. Reaching an agreement between Turkey, Iraq, Kuwait and Iran on the management of the Tigris and Euphrates, at the nexus of water and energy can form the nucleus of cooperation similar to how the EU was started, through an agreement between France and Germany in May 1950 on steel and coal production.

The extent of economic integration this calls for requires bold vision and political will. It may be hard to envision with all the tensions currently, but there is no other realistic alternative to reach stability in the region, in order to avoid greater conflict.

- 6) **Prof Rafid Alkhaddar:** focused on lessons from the UK's experience regarding the domestic use of water. He noted that sanitation comprised 30% of domestic water use, while personal washing comprised 12%. He remarked how even a country like the UK,

which rarely experiences water stress, still occasionally implements a hose pipe ban and advocates the saving of water, for example, through shorter shower times.

Prof Alkhaddar then turned to climate change and average water use per person, noting how a water transformation program is necessary to reduce per capita usage to 160 l/d. In the UAE for example, this is very high at 653 l/capita per day.

This issue is not debated in Iraq, furthermore, the low water tariff affects the high rate of daily consumption, which is 392 litres per capita per day.

Harvesting of water is another issue that Iraq needs to work on. Rainfall is 230 mm/year, but a great deal is lost to evaporation. Other solutions include better management of water for irrigation, the banning of certain crops such as rice and improved treatment of waste water, but cost is an issue.

Prof Alkhaddar then discussed the vital input of UK academic institutions in water sector management, including the role of academia in United Utilities (UK) to develop innovative systems. As an example of an area that benefits from more coordination in the sector, the incorrect modelling of water chlorination was given as a frequent area of miscommunication.

There must be an effort to have a better understanding of the current environmental baseline, modelling the hazards, evaluating trends and risks, in addition to systematic thinking about the hazards, resilience hazards, etc.

The Iraqi government must focus on an asset management plan, the k factor, an increase in the water charge, with the resulting funds to be invested in the rehabilitation of infrastructure, devising new company strategy, improving customers service, improving affordability, resilience and innovation.

One of the big challenges is that water demand is increasing, there is inadequate (or very poor) sanitation, a lack of water economy and water management and no culture of conservation. This needs to be instilled from very young age, in addition to education on water recycling.

- 7) **Dr Mudher al Mufti:** explained the role of engineering and finance in water management. Globally there has been a decline in fresh water storage, a dramatic decrease in available cubic meters per day. Iraq ranked 13 globally (1961) to 3 (2014). Subsequently, the efficient use and management of dams is needed to offset some of the damage resulting in a 50% to 25% decline in the rivers' volume.

Oil production and refining capacity have also increased, and are increasing. The lack of water allocation agreements with neighbouring countries will therefore increase tension within Iraq not only between provinces but between economic sectors.

Iraq urgently needs improved planning and environmental regulations regarding water

infrastructure including dams and artificial lakes. Outside of Iraq, there is a focus on the storage of the *Illisu* and *Ataturk* dams, with 49 billion m³ capacity in the latter, while the *Illisu* dam holds a maximum 10.5 billion m³.

Water treatment will only be sustainable if the cost of the water distribution network is recovered. For example, in *Nasriyah*, the wastewater system is old, undersized and not maintained well. Sewage treatment is expensive, for treating 1500 million Litres/d of waste water.

An ambitious plan to build an alternative river of 550km will cost \$20 – \$40 billion dollars and is therefore unfeasible.

There needs to be a focus on the water finance structure, which is currently not considered in Iraq, for example taxes and tariffs.

A proposed solution is an updated water master plan, to be drawn out and implemented by a mix of foreign and local companies.

- 8) **Dr Riyadh al-Zehairi:** explained international river legislation and how this can help Iraq concerning transboundary water disputes.

Dr Riyadh stated Turkey's claims regarding the definition of international waters, noting, explaining that the position of Ankara is that regulations governing transboundary waters do not apply to international rivers. Sovereignty, in the view of Ankara, was the lens through which Turkey views the optimal use of water and the reasonable use of water. In this view, there is no international law over the matter, and subsequently there exists the right to build dams without informing others. Turkey considers water as a commodity and sees no legal obligation to act in a way that would be amicable to neighbours.

General principles for water sharing, the benefits of sharing, *majara ma' duwali* are not the same as international water governance. This alternative perspective asserts that water use should not cause major harm to the downstream riparian countries.

The right of sharing does not harm other countries, it is flexible and applicable to various cases, with equal sovereignty and the same rights to mutual use of water.

The International Law Commission (ILC) lists the basic principles of this shared governance: geographic area, the needs of the population, the obligation to prevent use of waterways in a way that will endanger life and the environment. Regarding compensation: Iraq might claim damages before the international courts according to non-navigational law, the change of term on international, and monitoring compliance. Also, within Iraq itself, there must be clear regulations governing water use in local provinces to prevent conflict.

- 9) **Dr. Abdul Hasan al Sa'di:** stated that resolution of the issues should be according to international laws. Also, stated that mounting water stress is due to increasing population, while the Turkish claims are illegal and political in nature. The argument over

national rivers, international rivers or transboundary waterways has already been clarified by the ILC, which has resolved the issue by standardizing the terms. There are a number of relatively successful river basin disputes that have been managed by agreements on water use.

A good case study is the Danube river which has become a textbook case in terms of transboundary water agreements. According to the International Commission for the Protection of the Danube River, a master plan for sharing these resources was drawn up by multiple national and international stakeholders. The task force comprised, “the Danube countries of Austria, Bulgaria, Croatia, the Czech Republic, Germany, Hungary, Moldova, Romania, Slovakia, Slovenia and Ukraine; the European Commission, European Bank for Reconstruction and Development, European Investment Bank, Nordic Investment Bank, United Nations Development Programme, United Nations Environment Programme, World Bank as well as NGOs such as the World Conservation Union, World Wide Fund for Nature, Regional Environmental Centre and Barbara Guntlett Foundation. The Task Force’s work was supported by a Programme Coordination Unit based in Vienna, Austria.”⁹

Dr Sa’di stated Iraq should take into consideration “security” and “war against PKK” as a highest priority for Turkey for any future negotiation and economic Integration.

- 10) **Dr Mustafa AlShawi:** stated that there must be two phases to approaching the issue, cooperation first followed by negotiation second, with external support coming from world powers who have a vested interest in Iraq’s stability. Mismanagement of the trade agreements in the past between Iraq and Turkey and interlinking with water portfolio for benefiting Iraq. In the past, Iraq has not used any effective leverage over Turkey regarding trade. Other Negotiation aspects include economic integration, particularly in the energy sector, increasing bilateral trade and electricity exports. In addition to turning to international law, Iraq must also assess its own tools of leverage for negotiation to strengthen Iraq’s position. Prof. Al-Shawi stated that in the past there has been a chronic lack of investment in water projects. He noted how Iraq could have involved Turkey in implementing water projects.
- 11) **Dr Hameed AlKifai’e:** stated that Iraq’s sovereign rights should be documented and in the past, negotiations with Turkey have not taken into account the impact of water on multiple sectors. For example, economists were not involved in the negotiations with Turkey, currently only the MWR and Foreign Affairs have had any input.
- 12) **Mr. Montadhar Tariq Najem:** Provided an overview of the “Strategy for Water & Land Resources in Iraq” (SWLRI) with notes. Highlighted the main components of the supply (Ground –water, Surface water, Water courses, Rainfall and Sea water), and major elements of the demand across Iraq (Domestic use, Agricultural, Industrial and Energy/Oil/Gas). Also, stressed on the importance of the losses across the supply and

⁹ <https://www.icpdr.org/main/publications/flow-danube-cooperation-history-shared-responsibility>

demand balance such as (Leakage, Evaporation, Pollution, Climate change, Marches maintenance, Shat Al Arab salinity)

Whilst the SWLRI focused on long-term planning, the difficulty of forecasting demand and varying data in Iraq and neighbouring countries remain a fundamental data issues. There is currently no consensus on water demand. Of vital importance is to introduce the concept of smart city management in Baghdad and other major cities such as Basra for greater efficiency. Recently, development of the sector in Baghdad has been afflicted by conflict among departments within the municipality regarding wastewater and water supply, quality, quantity and navigation of water channels and the deficit in supply and demand.

One forecast is that demand in 2020 will be 3.79 billion cubic meters and will increase in 2035 to 10.94 billion cubic meters. In the worst-case scenario, demand in 2020 could reach 5.3 billion m³/year of fresh water, which will be needed to prevent socioeconomic losses country wide.

As a minimum, a flow of 50 m/s is required to stop salinity intrusion from the sea to the Shatt-al-Arab. Iraq needs to maximise the efficient use of different sources of water. Population growth, climate change and a 1.0oC rise in the average temperature will lead to an anticipated precipitation decrease of 10%. The condition of the water quality along the water courses and in the reservoirs is a major part of any strategy, it is noticeable that the WQ index scores low along majority of the water courses, and goes to unusable levels. There remains a very high level of leakage of clean water, with no study on the losses of this resource. Furthermore, there have been no studies on the cultural impact on water consumption, for example, Wudhu water consumption.

A strategy is needed in the form of a national integrated model to steer the decision-making process. Desalination plants are required, as in GCC countries. As the strategic positioning of the clean water treatment intakes and the wastewater flow outfalls along the country must be studied and reviewed to reduce the severity of pollution.

Building a *Shatt-al-Arab* barrage would be a major step in the battle against rising salinity, with real time forecasts to allow for better management of surface water. Early warning of rainfall from neighbouring countries is important and in developed countries the concept of advanced customers warning system via text messages is active to warn users when precipitation is expected. A groundwater recharging plan is also needed in addition to a leakage reduction and the building of large scale wastewater treatment facilities in Basra.

Better environmental awareness and management is needed at the local level. In central Iraq, the level of the *Shatt-al-Hella* is reduced due to pollution and waste from a nearby hospital.

Iraq should also consider a strategic drinking water emergency storage facility, as in the GCC states.

- 13) **Dr. Luay al-Khatteeb:** stated that petroleum, water and electricity must not be discussed as separate challenges. The management of water can be looked at in the context of energy, from hydropower to the co-location of power plants and water treatment plants, while solar is increasingly seen as a game changer in terms of freeing up oil for export, and also has numerous applications in agriculture and even water treatment. Moreover, Revenue diversification, like water stress, is another shared challenge, one that MENA countries are increasingly facing up to, but they are often facing this challenge alone.

Recommendations

Short, medium and long term negotiation strategies with Turkey must be developed. Three committees must be established for negotiation with Turkey (technical, legal and economic) to consider the following recommendations.

Technical

- Iraq should approach the World Bank for guidance on the next steps.
- Iraq must consult think tanks and academic institutions to enhance the quality of advice it receives while taking the next steps.
- Not following existing strategic plans is one of the major causes of the crisis.
- There has been an acute lack of plan implementation.
- There must be a utilisation of data from surveying Iraq's rivers and lands (GIS) for better water management.
- Desertification, and resolving this threat will remain a big challenge.
- Detailed technical and financial models to facilitate effective negotiations with Turkey must be developed.
- Iraq must consider utilising the Turkish dams' potential extra storage to increase water flow to the Tigris.
- For the purposes of developing an Iraq water resources strategy, Iraq must assume Turkey will fully implement all of their dams' construction projects.
- Iraq must launch an education campaign to reduce water consumption from 450 litres/day/capita to 120 litres/day/capita.
- Iraq must develop a budget for the installation of water meters in Iraq. This should be phased over approximately 10 years and would enable the government to apply tariffs based on consumption (for example, free for xm^3 , nominal increase up to 120 litres/day/capita and a high tariff for any additional consumption.)
- Iraq must work out a suitable tariff structure for industrial and agricultural needs.
- Iraq must adopt lessons learned from neighbouring countries regarding water storage policies.
- Iraq must develop water allocation per province to ensure upstream provinces do not deprive downstream provinces.
- National integrated model is required to steer the decision-making process
- Desalination plants are required.
- Shat Al Arab Barrage is needed.
- Innovation / Real Time weather forecast to allow better management of the surface water.
- Groundwater recharging plan is needed.

- Leakage reduction strategy is a must. Aiming to run full assets planning and maintenance programme.
- Plan for worst case scenarios (with full neighbouring countries planned projects constructed).

Legal

- Iraq's legal water rights must be pursued tactfully with international organisations, courts and mediators.
- Iraq should seek mutual agreement before going into arbitration or taking its case to the International Court of Justice.
- Legal and historical rights should be documented with respect to Iraq's sovereign rights.
- International arbitration is one option for resolving the issue, involving the USA, EU and the World Bank.
- There must be measurable outcomes arising from the negotiations with riparian countries.

Economic

- Economic integration and mutual cooperation is the preferred route.
- Iraq must prepare an investment plan for water resources through a revision to the SWRLI, using Iraqi experts with help from international experts.
- Iraq must consider the mutual benefits for Turkey and Iraq when negotiating.
- Iraq lacks the skills in construction including harbours, heavy industry and agricultural technologies including pipelines. ITP is an example losses US\$5-6 billion annual losses. Turkey might rehabilitate the pipe in less than 10 months.
- There must be a targeted increase in the Trade Exchange with Turkey.
- Irrigation, housing and energy are some aspects of cooperation with Turkey that can take place in the context of water negotiations.
- There must be an urgent review of agriculture subsidies to ensure water resources are not depleted.



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