WATER IS LIFE

Perspectives on Water in the Land of Two Streams
from Mesopotamian water laws
to international cooperation

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CLEAN TIGRIS

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More information can be found on www.elbarlament.org and on the project’s website www.cleantigris.com

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CLEAN TIGRIS

Introduction

As early as 1985, the future UN Secretary-General Boutros Boutros-Ghali stated that the next wars would be fought over water. In this statement, two factors come together: the imminent threat of climate change and the competition for the precious resource: WATER.

Moreover, climate change is only one risk multiplier; when water scarcity, population growth, economic shocks, urbanization, environmental degradation and rising inequality come together, they trigger political instability, protests, outbreaks of violence and may even lead to civil wars and inter-state conflict.

Iraq is massively affected by climate change. In particular, water scarcity and desertification threaten to accelerate political and cultural conflicts. Rising temperatures are shifting fertile and habitable zones. Deserts are advancing, water is either becoming scarcer in certain regions or causing floods in other areas. Environmental degradation and violence are causing refugee movements that are expected to increase tenfold by 2050. In the coming years, competition for transboundary water resources might increase dramatically. It becomes particularly dangerous when states unilaterally decide to alter the flow of water, for instance, by building large dams. Though the situation is dramatic, environmental awareness is still comparably low and there is a significant lack of environmental research. Furthermore, laws and institutions dedicated to protecting the environment exist, but are unfamiliar to lawmakers or are poorly implemented.

In 2018, people in Basra took to the streets after hundreds of children had to be treated in hospitals because of the contaminated drinking water. One major demand of the protesters was access to clean drinking water as well as clean rivers which guarantee the livelihood of many fishers and farmers in the marshlands.

Our approach to meet these challenges was seeking dialogue: since 2020, women and men from different regions, social and ethnic backgrounds, living and working along the Tigris and Euphrates rivers unite as part of the project “Clean Tigris - dialogue for sustainable peace in Mesopotamia”. City mayors, civil society actors, politicians and decision-makers, academia and experts from up and downstream are researching and working together to find sustainable solutions.

This book presents some of the results of the extensive research; its goal is to promote environmental awareness in Iraq. It is also a response to the meager research landscape regarding the water situation in Iraq and the Euphrates and Tigris basin.

In total, five contributions shed light on the rivers in the land of the two streams from different perspectives. We look through a gender lens, discover the field of international conflict resolution, as well as good practices from the Rhine basin, learn about the very first laws on water management in Mesopotamia and travel to Basra to develop a sustainable vision of the southern city.

In the first contribution, Sameh Al-Muqdadi analyzes possibilities for cooperation and travels with us to the future. He imagines how the region of the Euphrates-Tigris basin would look like in 20 years under two different scenarios. In the first scenario, the riparian countries have reached a strategic agreement, while in the second they have not.

In the second contribution, Egyptian gender expert Salma Kadry takes a closer look at the different gender dynamics in Iraq. While water-related threats are pronounced across Iraqi society, their impacts are far from universal: water scarcity and its associated threats have important gender dimensions that shape how women and men experience and cope with these problems. Socially constructed norms and behaviors shape and consolidate structural and institutional discrimination and inequalities against women. Salma Kadry formulates recommendations on how to integrate women in water-related policies and responses and how to transform water-related threats into opportunities for advancing gender equality and female empowerment.

Just like the Tigris and the Euphrates, the Rhine river crosses several European countries before it flows into the North Sea. Sudeh Dehnavi, Muhammad Khalifa, Zryab Babker and Lars Ribbe discuss possible solutions to the issue of river cleaning. The international research team from Enroot and the University of Applied Sciences of Cologne present how knowledge transfer from the Rhine basin could facilitate tailor-made solutions for the case of the Euphrates and Tigris basin.

Archaeologist Lanah Haddad takes us back to the history of Mesopotamia and its very first laws on water. From mediating water conflicts around 2600 BCE to the first written law on water resources in the Codex of Hammurabi in 1750 BCE. Lanah Haddad gives us a fascinating insight into our own history, as well as opens our eyes to hydraulic innovations from Mesopotamia that served as inspiration for modern engineering solutions that still address water problems today.

Last but not least, a team of local and international experts develops a green and sustainable vision for Basra. Between the 1950s and 1970s, Basra was known as the Venice of the Middle East. Today, one can only visualize the beauty that once characterized this city with great imagination.

Broder Merkel, Sameh W. Al-Muqdadi, Nawrast S. Abdalwahab, and Zina Riadh Abdulla look at Basra as it is today, identify the challenges the city is facing, and together develop visions for a green and sustainable water management for Iraq's downstream city.

Before you dive into the chapters, we would like to express our gratitude to all researchers and authors of this book. Our eternal gratitude goes to Fatima Sharafeddine for her commitment in editing the book in Arabic and English. We also thank Abraham Zeitoun for the creative art work for the cover and the collages at the beginning of each chapter; we would also like to thank Julnar Khabbaz for the graphic design and layout of the book.

This book would not exist without the support of the IfA, and their funding program 'zivik', and the funds of the German Federal Foreign Office, who supported the idea for this book in a year of worldwide lockdowns due to the Covid-19 pandemic.

Mesopotamia – literally the land between the two rivers - was one of the world's first civilizations, in part due to its unique location between two rivers. We hope that this book will contribute to raising awareness and develop new ways to protect these rivers. We hope that by reading this book, you will learn many new aspects and get inspiration for future projects to protect the rivers and marshlands in the land of Mesopotamia.

Dr Birgit Laubach, managing director of elbarlament and Alisha Molter, project manager of "Clean Tigris"

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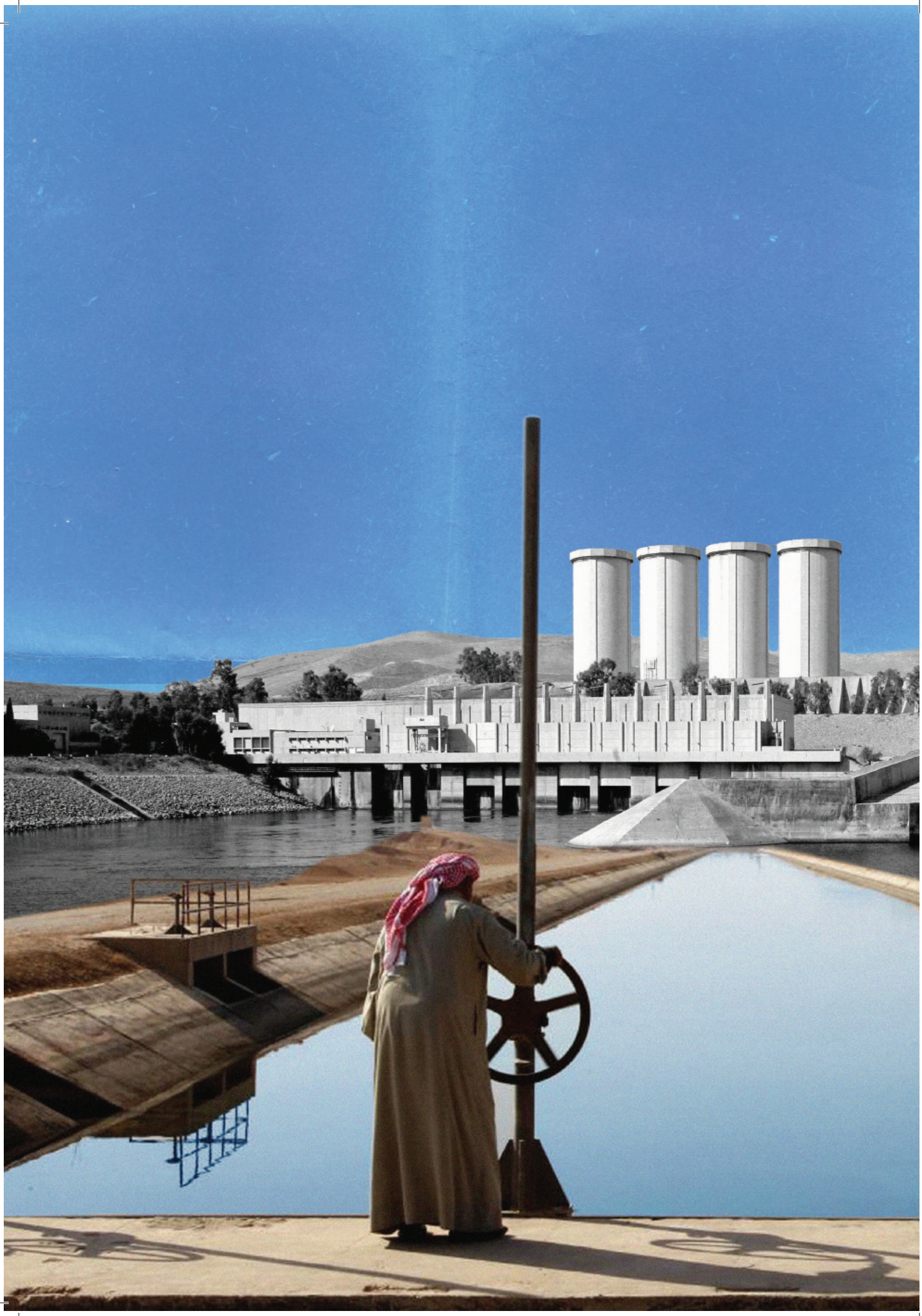


I

Water and International Relations in The Euphrates-Tigris Basin:

How Can We Avoid an Inevitable Conflict?

Dr. Sameh W. Al-Muqdadi

Dr. Sameh W. Al-Muqdadi

Sameh is an expert on Water management, Water conflict and resolution, holding a PhD from TU Bergakademie Freiberg. He is the founder of Green Charter GC in Germany for Water and Environmental consultancy. Sameh has led several international projects in Europe and the Middle East. He firmly believes that water could be a source of cooperation and peace rather than a reason for conflict.

1. Introduction

As the most extensive river system in Western Asia, Euphrates and Tigris rivers run 2,800 km and 1,850 km respectively, from Turkey through Iraq and Syria, finally meeting at the Al Qurnah (Southern Iraq), forming the Shatt Al-Arab River, and eventually discharging to the Gulf. Thousands of years of the rivers' journey have shaped the Mesopotamian as a cradle of civilization. This civilization enriched the world with innovations, science, culture, and art. In 1986, at ten years of age, I witnessed the Tigris river flood in Baghdad, the river that split the ancient city and Iraq's capital into two parts, the Karkh and Rusafa districts. My home was a few meters away from the riverbank. The civil protection authority called for an emergency campaign; childish curiosity pushed me and my neighbours to ask the working team onsite to let us volunteer. The chief in command asked us to help the professional staff move sandbags close to the riverbank to prevent water flooding to the main road. This simple yet effective technique drew my attention - bags acting as a barrier to divert water flow. Even though the bags were not perfectly sealed, they worked well in maintaining the situation. Eventually, the flood had been controlled. This event shaped my very early relationship with the Tigris River. From then, I would observe the water level and its unfortunate decline with time. I learned many lessons from this experience. I discovered the river's indescribable rage, the power of nature that riverbanks have to face, and the resources that are required to confront that power. I also realized how important collaboration and organization are in helping to minimize and manage imminent risk. Not least, I understood how essential leadership is by observing the chief in command working hard on the ground, shoulder to shoulder with his staff and colleagues.

Water has a tremendous impact on our lives on many different levels; it is a fundamental source for life. The average human's ability to survive without water is a mere 3 days, and all civilizations have arisen / developed / evolved and faded / waned based on water availability. Water also gains spiritual power through different rituals. It is an extraordinary element with polymorphic states; available predominantly in liquid form, it turns to gas form when it has boiled, and solidifies when frozen. In its solid form, water becomes less dense, which implies two things. The first is that freezing strains the living cells' membrane, which naturally contains a lot of water. Secondly, because ice is less dense than water, it floats. This means that freezing in rivers and lakes occurs from top to bottom, which enables fish and other species to survive during the wintertime [1].

One of the primary sources of water's power is its use in daily life, as a multi-functional element that influences various sectors. Water is a major concern for the management and development of urbanization, where 90% of all natural disasters world wide are water-related [4 -> 2]. About 50% of the wetland have been lost in the last century, and the demand for global food production will continue to increase dramatically to reach approximately 50% [5 -> 3]. UNESCO (The United Nations Educational, Scientific and Cultural Organization) has announced that by 2025, about 2/3rds of the world's population will have limited access to fresh water [2 -> 4], and it has also been estimated that by 2030, 24–700 million people will be displaced due to water scarcity and climate change [3 -> 5]. Conversely, 50 children are dying daily due to poor sanitation and unsafe drinking water [6].

Tigris River by Tiba Saud, Baghdad 2015

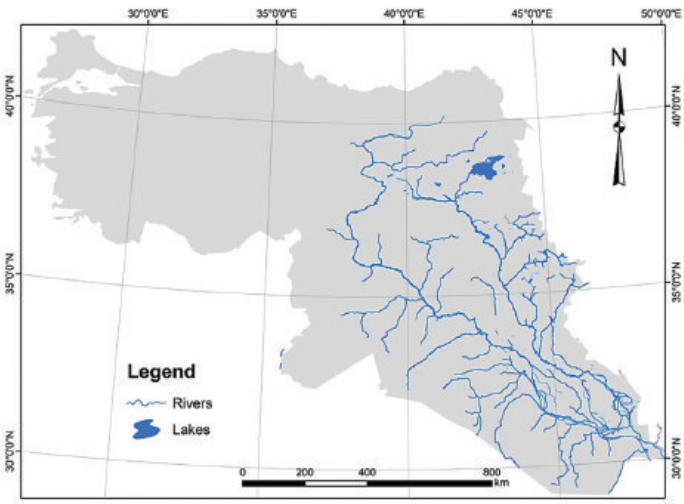
"I greeted you from a distance, so greet me. Oh, Tigris of the goodness and the mother of the gardens
I greeted you with thirst and seeking your shelter as a Dove between water and mud."

By: Muhammad Mahdi Al-Jawahiri - Iraqi poet

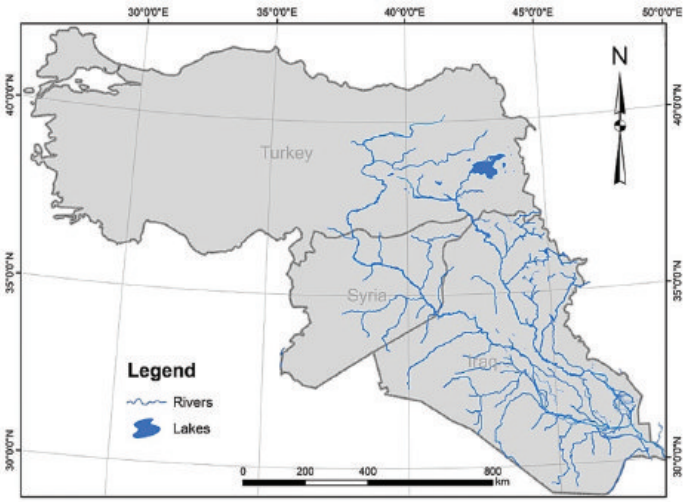
2. Factsheet of Water Resources of Iraq

As an outcome of World War I, with changed geopolitical positions and new political orders and borders, Iraq was considered a downstream for Tigris, and the ultimate downstream for the Euphrates. Turkey has been recognized as an upstream for both rivers in the region. This profound event has changed the shape of the region and the fate of water allocation, as well as international relations. New perspectives have emerged for each riparian country, where each of the three partners has its own national development plans that might conflict with others.

About 98% of surface water resources in Iraq is found in rivers, lakes, and marshlands. Over 70% of Iraq's water is consumed by the agricultural sector, and at least 15% is lost by evaporation from lakes, reservoirs, rivers and marshlands. Iraq needs about 13% of its water



a) During the Ottoman Empire.



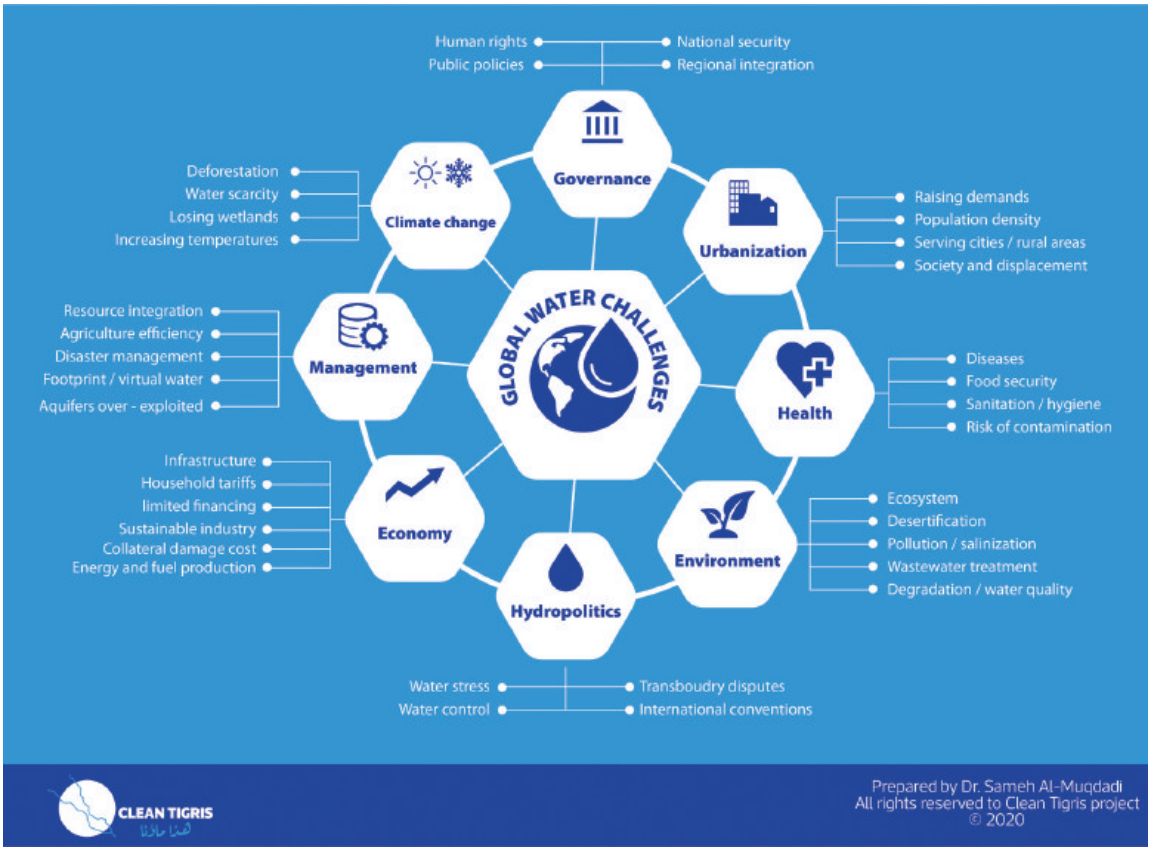
b) Political borders after WWI.

Maps conducted by Dr. Arsalan Ahmed Othman

resources for environmental sustainability, such as empowering the Shatt Al Arab River with sufficient water shares to push back the seawater, and providing the marshlands with sufficient water shares to be sustained. Only 8% is used in the sectors of municipalities and industry [7]. However, the relatively high population growth in Iraq (2.3%) is another challenge to compete with; more than 65% of the population is young [8], which will significantly increase water demands in the future. This raises a fundamental question and an explicit trade-off: although most of Iraq's surface water resources go to the agricultural sector, Iraq still imports most necessary crops. Another challenge is that the estimation of the groundwater reservoirs is still unclear, since many studies have been conducted using mostly old techniques and technologies.

3. Challenges

Water resource-related challenges in Iraq are manifold. These challenges can be summarized in three main parts: 1) internal challenges represented by management capacity, 2) external challenges that reflect the influence of climate change, and 3) hydropolitics. The top five challenges for each of these have been tackled as follows:



Global Water challenges

3.1. Internal Challenges: management capacity

"A goal without a plan is just a wish" - Antoine de Saint Exupéry.

Although Iraq has tried hard to develop the management capacity of water resources during the last couple of years, the country is still in urgent need of enhancing the integrated management system. The top five challenges in this context are:

1. **Agriculture:** There are losses due to inadequate distribution systems and water leakage: about 60% of agricultural water is wasted due to the traditional irrigation methods used by local farmers [9]. Old agriculture technologies lead to low efficiency. Developing irrigation methods by investing in modern technologies is urgently needed. In the 1970s, the agricultural labour force represented 31% of the economically active population; this percentage was significantly reduced to 8% in 2004 due to the presence of agricultural mechanization, development of education, health services in urban areas, and increased job opportunities encouraging rural-urban migration [10].
2. **Water supply and demand:** Iraq is struggling with an outdated water supply network infrastructure, where most water pipes suffer from leakages and cause at least 40% of water loss [11]; the gap between supply and demand will be increasing by more than 50% in 2030 [12]. Climate change, population growth, and the reduction of surface water shares are considered significant burdens.
3. **Governance and public policies:** Although Iraq already has informative national legal policies to regulate the country's water resources, the

Tigris River, Baghdad - Al-Jadriya near University of Baghdad

By: Ayman Qadoori Oct. 18, 2020

government sector is still bogged down from poor implementation and practices. Too many stakeholders and authorities are involved in the decisions regarding water resources; about 59 federal and non-governmental authorities share the decision on water matters, which is probably one of the challenges hindering any sort of development.

4. **Awareness:** The future of water resources relies significantly on public awareness. Water is a matter of solidarity; it is not only a responsibility of the local or federal governments, but rather, all sectors should be consolidated to solve the shortages. Despite the few water awareness campaigns that have been conducted by the Ministry of Water Resources, the Ministry of Agriculture, and a few NGOs, the country still did not manage to draw sufficient attention to raise a comprehensive public program that helps people, particularly farmers, to understand the importance of water as an element they deal with on a daily basis. The media also needs to be encouraged to play a vital role in this context.

5. **Water degradation:** Due to the substantial drop in the water shares of both Euphrates and Tigris rivers, the concentration of pollutants has increased dramatically, where salinity has increased ~3 times during the last decade, from 457 ppm to 1200 ppm [13].

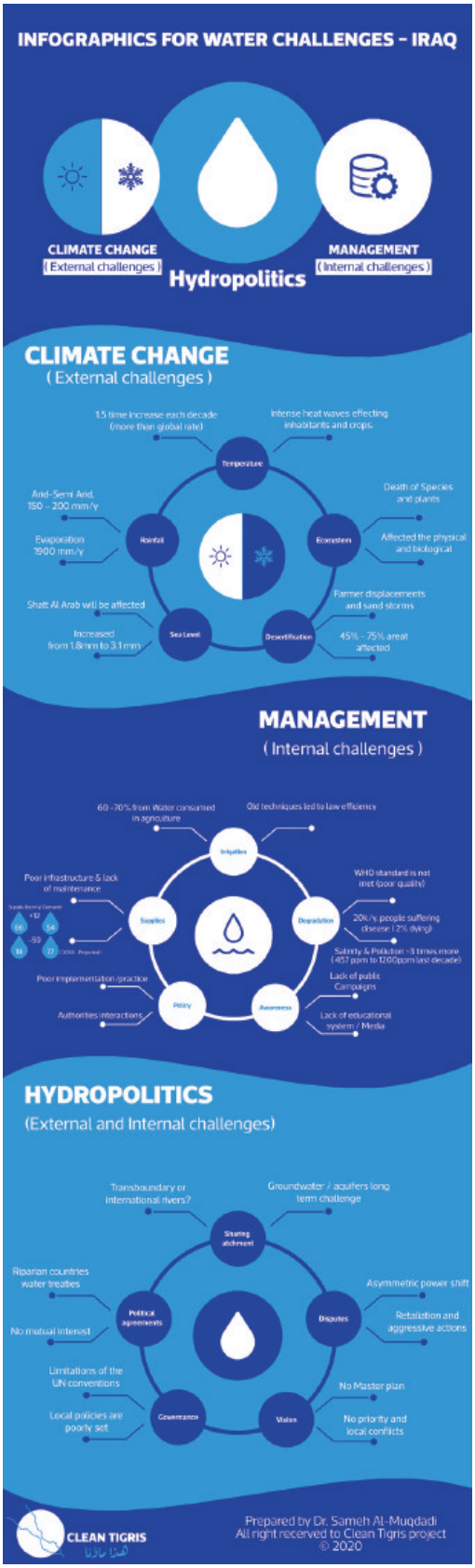
3.2. External Challenges: climate change

In terms of the external challenges, climate change is considered one of the main factors that threaten the country's water security. Globally, Iraq is among the top five countries vulnerable to climate change, which is attributed to decreased water and food availability [14]. As the French writer and philosopher Voltaire said, «Men argue. Nature acts». It is rather hard to manage the climate change impact due to the numerous factors and the various interlinks within the process of climate change. However, with proper risk assessment, we could be well prepared for the potential threats. The top five challenges in this context are:

1. **Temperature:** The temperature rates are increasing ~1.5 times each decade, which is more than the global rate [13]; the intensity of the heat waves affects the inhabitants and the crops negatively.

2. **Rainfall:** The climate is subtropical semi-arid with rainfall usually in winter, from December to February, with an average precipitation of ~200 mm/year. However, the average rainfall varies between 1200 mm/year in the north to less than 100 mm/year in the south. The summer temperatures are extremely hot, with daily peaks reaching over 43°C during July and August.

3. **Sea level:** The sea level has increased from 1.8 mm to 3.1 mm [15], impacting Shatt Al Arab River, which already has



a minimum flow insufficient to prevent the seawater intrusion.

4. **Desertification:** Climate change and the significant drop in the levels of both Euphrates and Tigris rivers have caused a demographic change due to the desertification that affects between 39% – 54% of Iraqi territories [16]. Regular sandstorms have forced farmers to be displaced from the village to the cities, deserting their farms.

5. **Ecosystem:** Biodiversity has been severely affected due to the direct threat to species and the planet. Practices such as illegal hunting and harvesting are destroying the ecosystem [17]. Other clear examples are the drying of the marshlands during the 1990s and the intensive oil exploration [18].

3.3. Hydropolitics

Generally, 'Hydropolitics' or 'Water Politics' as a term reflects on how politics is affected by water resources. It also reflects water as a tool that can enforce a certain foreign or a local political agenda. Hydropolitics is considered as a sword with two edges, with internal and external challenges. Since 1920, the Euphrates – Tigris basin has been struggling from hydropolitical influence. The top five challenges in this context are:

1. **Sharing catchment:** Globally, about 400 transboundary river basins are potential for disputes [19], and the Euphrates-Tigris basin is indeed one hotspot for potential conflict [20].

After the United Nations Resolution for Watercourses [21], whether the river would be identified as an international river (that would be treated under the UN resolution), or instead as a watercourse, became a critical and sensitive issue. However, most of these challenges focus on the water surface, where the groundwater is considered a struggle that might face the region in the long run.

2. **Political agreements:** Most of the water conventions and treaties within the Euphrates-Tigris riparian countries were often subject to rapid change due to the political instability and the lack of mutual agreements.

3. **Governance:** There are some limitations within the UN convention on watercourses; in addition, the local policies are poorly implemented. The country lacks a comprehensive plan to enhance the outdated systems and enforce implementations to guarantee systematic governance.

4. **Potential disputes:** The lack of strategic agreements maintains tension over water levels. With the fragile political system, asymmetric power is often changing and some riparian countries remain with less political clout. This leads to retaliation and occasionally aggressive actions. Collectively, this always raises the risk of conflict.

5. **Lack of vision:** The region has no strategic vision regarding an in-depth assessment of challenges and opportunities. Each country only focuses on a national scale, with less attention to the bigger picture. Also, locally, Iraq needs to build a rigid master plan to secure the water resources and give this valuable element a priority.

4. Background of Hydropolitics at The Euphrates-Tigris Basin

Water may be used as a weapon in three forms: too much of it causes floods, too little leads to water scarcity, and its low quality creates pollution. The ancient Mesopotamian witnessed the first water conflict and its resolution, where thousands of years ago the Sumerian city-states fought over water resources as a vital element in the emergence of the cradle of civilization. The ancient scripts prove that both water conflicts and resolutions have deep roots that are linked to many issues, such as human nature, conflict of interest, and foreign policies. Likewise, within the current political borders created after World War I, which have shaped international relations, water conflict and hydropolitical events could be considered collateral damage for the new order in the region. Naturally, rivers do not follow political borders; rather they follow simple rules: the rule of gravity and the pressure differences. Several events prove that water has been used as a political tool to enforce local or regional agendas in the Euphrates-Tigris basin.

The first agreement between Iraq and Turkey dates back to 1926, followed by

a friendship treaty in 1946. However, three decades later (1962–1993), about 45 negotiation rounds were conducted between the three countries (Iraq, Syria, and Turkey), which ended with no concrete agreement between them. During that time, a only two significant conflict events happened: in 1974 between Syria and Iraq, and in 1990 between Syria and Turkey. After the GAP project was completed, the negotiation approaches and bargaining power for both downstream and upstream countries had changed; thus, a new strategy needed to be developed to ensure peace and reach mutual agreements.

For four decades, the Kurdistan Workers Party (PKK) was in conflict with the Turkish government to obtain Kurdish independence and autonomy. The unstable region was convenient for the Turkish government to establish the strategic and multidimensional GAP, covering 10% of Turkish territories. The Turkish administration was recognized as being of national importance in the region both in terms of economic development (the lowest gross domestic product and the high demand for development), as well as the political aspect (more than 95% of the registered voters voted for one party or for an independent candidate) [22]. The ultimate goals are to manage national security risks, aligned with comprehensive development for the unstable region. As a consequence of the GAP, water shares in both the Euphrates and Tigris rivers were significantly reduced, and the tension between the riparian countries was unleashed. Hence, Syria braced the PKK, providing them with logistical support to force Turkey to sign the 1987 protocol. Turkey then agreed to provide Syria with sufficient water shares, followed by the signing of a security protocol in 1992. The two decades of water and security conflicts ended with the signing of the Adana agreement in 1998. This agreement established strategic cooperation between the two countries on different levels, the water shares being amongst the top of them. The period between 1998–2011 reflects ideal relations between the two countries; it was a promising and historical period for the international relations between them. The water resources proved to be an incentive for building such a mutual interest. In March 2011, the relations between both countries were led to a new page of dispute, where Turkey supported the uprising and played a fundamental role in establishing the Free Syrian Army (FSA), and Syria once again tried to use the PKK card against Turkey. This eventually led to the collapse of the Adana agreement, and thus the return to a zero-sum game.

For a couple of reasons, the relationship between Iraq and Turkey was a bit less tense, since they share both rivers, unlike the Turkey-Syria model, where Syria relies solely on the Euphrates River. Also, relations between Iraq and Turkey have been tightly linked through an excellent economic exchange. However, the two gulf wars kept Iraq from addressing future water resources challenges as it remained focused on local scale conflicts, the marshlands being one of the bad examples of how water is used as a tool in national

security and political decisions. The dry out of the marshlands during the 1990s led to significant degradation. Only 3% remains from the central marsh, 14.5% of Al-Hammar [23], and the marshlands have been restored after 2003 to maintain the degradation. However, the marshlands still face some challenges, especially after water shares have declined in both the Euphrates and Tigris rivers. Despite the well-done efforts of registering the marshes as international heritage in 2016, Iraq has not significantly improved the water resource sector due to several reasons: endless political instability, fragile security, corruption, and lack of a clear national plan. The dark time of ISIS added insult to injury, where Iraq and the entire region were under a significant threat by an extremist group. ISIS was establishing a new era on using water as a weapon and a source of threat, and the occupation of the dam empowered them to threaten the cities by causing floods through exploding the dam; at the same time, they could use the dam as a secure shelter that security forces would avoid striking. Between 2014-2015, ISIS had seized the Mosul and Ramadi dams in Iraq and the Tishrin dam in Syria; here, they used dams as both a safe shelter and a potential weapon that could be used against any possible attack.

Euphrates River, Al-Jazeera regulator

By: Mohammed Saab April 26, 2020

5. Why Is The Region Not Reaching an Agreement?

The water conflict in the Euphrates-Tigris basin has a long history. For a century, the riparian countries (Iraq, Turkey, and Syria) have failed to reach a strategic agreement in water shares. There are several reasons for that, some of which are listed below:

- The limitations of international laws, where the UN Convention for Natural Resources and the International Watercourses of 1997 gives the same weight to the past as to the present [24].
- The lack of agreement about whether to define the Euphrates and Tigris rivers as international rivers (as Iraq and Syria claim) or as transboundary watercourses (as Turkey claims).
- The question of whether the rivers should be treated as one basin (as Turkey and Syria want) or as two separate basins (as Iraq requires)
- The adoption of different water allocation formulas, where Iraq and Syria believe in 1:1 water allocation, while Turkey proposed a three stages project that allocates water based on the country's needs.
- The different perspectives found in negotiations on the issue, where Turkey emphasizes sovereignty, Iraq highlights the Mesopotamian heritage, and Syria expresses food security concerns.
- The region's fragile political environment, particularly in Iraq and Syria, resulting in the three riparian countries rarely gathering around one round table, as well as a lack of mediation.
- The lack of consideration for a strategic partnership of sustainability when making agreements, where most are conducted merely on the basis of acute political requests.

It is for these reasons that the downstream countries followed different approaches to water negotiations; the task of obtaining a mutual agreement was somehow challenging. The distrust dominating the region forms a significant obstacle. Thucydides, the well-known ancient Greek philosopher and the general of war, considered fear as the main driving force of conflict; distrust generates fears that encourage an inevitable conflict. This concept has led Syria to use the PKK as a political card for more than a decade against Turkey, employing it as bargaining power during negotiations on water allocation. Such an issue-linkage strategy aimed to change the asymmetric power dynamic through an external political tool. However, while this pragmatic tactic might be approved and quickly result in earning more water allocation, it would never establish a strategic partnership. Once the asymmetric power shifts, the agreement will collapse. The region witnessed a similar case in 2011 during the uprising in Syria, when Syrian-Turkish political relations were entirely ruined after ten years of excellent agreement.

Iraq and Turkey use another approach in

their water relations, which is represented by the benefit-linkage model. The two countries' political relations have always relied on economic exchange, which has recently reached 16 billion USD per year, and is expected to increase to 20 billion USD per year [25]. One of the major oil export pipelines of Iraq passes through Turkey to Europe (Kirkuk–Ceyhan Oil Pipeline). Iraq also opens its construction market to Turkish companies for national projects in Iraq. This economic cooperation has been reflected in water resources cooperation, leading to less tension than the Turkey - Syria model. An excellent example occurred in 2019, during the flood of the Tigris river basin. The cooperation between both countries helped in surpassing the crises that threatened the Iraqi oil fields – one of the only national revenues that Iraq has, due to the good communication between the Iraqi Ministry of Water Resources and the Turkish authorities. The benefit-linkage approach is a better option than the issue-linkage one, and provides a good basis for the countries to negotiate water in a positive environment. Still, it does not provide a sustainable solution, particularly in the long run; decisions rooted in economic exchange are linked to a margin of interest, which is subject to change. Therefore, the region needs to adopt and implement a strategy to alleviate the risk of failure during any agreement process.

At the state level, Turkey faces three classic challenges: 1) joining the European Union, 2) energy shortage, and 3) political instability in the southern region. Conducting the GAP would solve at least two of these challenges; by developing the southern region to manage the political instability, jobs for 3.5 million citizens - 40% of the GAP region population - can be created [22]. The GAP project will also generate clean power, where the expected annual capacity will be 27 billion kWh; this is 45% of the potential water energy in Turkey. The anticipated plan for 2020 involves increasing the hydropower capacity to 34,092 MW [26]. Through this, the energy and security challenges will be mitigated, since joining the European Union is not currently a priority for Turkey [27]. However, developing the energy sector through clean sources like hydropower, and developing the southern region and increasing the GDP, would push them a step forward to fulfil EU membership requirements in the future.

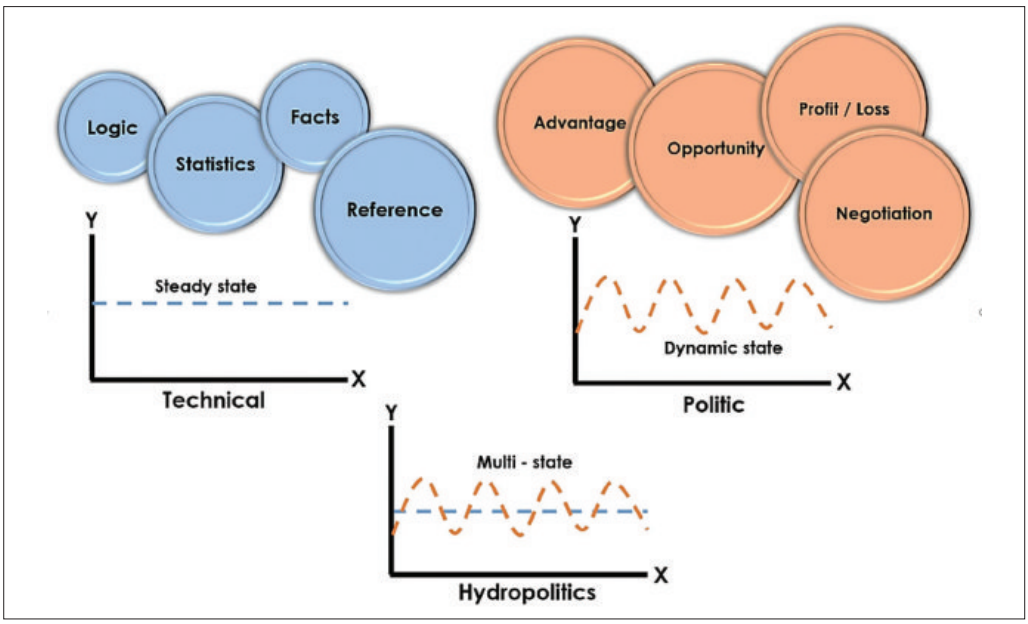
For more than 40 years - the lifetime of the GAP's accomplishment - Turkey worked hard and manoeuvred intelligently in order to gain time and secure the resources to conduct its national project. Perhaps, the proposal for a three-staged plan was one of the tools used to gain time. However, the proposal does sound like a practical approach that includes: 1) establishing a joint, independent technical committee to collect hydrogeological data for the riparian countries; 2) analysing the data in order to understand the demands and requirements per country; and 3) developing a shared formula to allocate the resources appropriately to each of the riparian countries [27]. Regardless of the actual intention behind this proposal, the

three-staged project was indeed the best technical suggestion that would bring the riparian countries together to a round table to communicate. Besides encouraging direct discussion and negotiation, the project would also generate a joint technical committee that includes experts from the three countries. This was the first attempt to shift the conflict from the political level to a technical level, which would be a great move if sustained. Such a direct dialogue would enhance the regional policies regarding water, energy, and food security, and would therefore encourage peace.

6. Negotiation Over The Water

Water negotiation is a challenging task; it carries two different levels of discussion. One is a technical level, where the discussion usually relies on facts, logic, statistics, and references. This type is assumed to have a steady-state environment. Conversely, politicians engage in more dynamic discussions, since they come from entirely different perspectives. In this context, the debate emphasizes profit and loss, opportunities, advantages, and bargaining skills. Managing a hydropolitical negotiation is a hard task because it is a multi-state topic.

Quite a few skills are required for water negotiations, such as knowing the authority level of the opposition negotiator, mastering the negotiation style that will be adopted, and being able to categorize the issues. One needs to avoid discussing broad matters, but rather focus on specific ones. Also, one needs to study in-depth the alternatives the opposition has in order to



Discussion Principles of Water Negotiation and Hydropolitics

define the zone of a potential agreement. These skills will facilitate negotiation rounds and make the discussions fruitful, positive and adoptable, which in turn creates a better opportunity for reaching an agreement.

Further knowledge is needed for the delegations that will address water negotiation. The system's thinking approach is a useful and effective tool for recognizing the areas of conflict, designing a conceptual model for the issue of water shortages, and highlighting the mismatches and gaps that might exacerbate water conflict on both local and regional levels. One of the fundamental concepts of system thinking is the mental models that we have adopted. Mental models are the ideas, beliefs, concepts, and facts that help us visualize the real world. A good example is how downstream countries consider the national development of upstream countries to be a threat. In contrast, upstream countries perceive the downstream countries' objections to water control as a threat to their sovereignty. These different perceptions lead to building preconceived models, which might be incorrect, and more crucially, might lead to creating biases and metaphors that would influence the water negotiations. The mental models might evolve negatively if we encourage these metaphors and adopt them. However, two questions are worth asking: 1) why are these mental models essential for water negotiations, and 2) how relatable are these mental models that we adopted - as individuals or as entities - to the real world?

The mental models are important because they shape our behaviour, form our beliefs, and direct our actions. The metaphors and biases are deep mental models that can often steer our thinking in the wrong direction. The systems' rationale is all about paying attention to these metaphors and updating our mental models to reflect reality better. Most of the mental models that we have without reliable field investigation have gaps; therefore, we should work to evolve them to keep them aligned with the behaviour and actions to ensure better outcomes. This evolution should occur through direct dialogue between the riparian countries in order to mitigate the distrust, bring mental models closer to reality, and ensure better decision making to minimize the risk of the actions taken.

Whenever we discuss water conflict and resolution, we need to go back to the icon of water conflict, which is the massive dams. Dams are a common technique used for water resource management. While few dams are useful, plenty of massive dams might be a threat to peace. The massive dams' negative impact is tremendous, from unleashing the distrust between the riparian countries to causing severe environmental degradation, threatening food security, and leading to socio-economic difficulties. Massive dams, misunderstanding, mistrust, and irresponsible political decisions, are a perfect toxic cocktail that could exacerbate hatred and encourage disputes. Without extreme control in the building of massive dams, water control would be harmful whenever chance and power are with

Euphrates River, Hit city – Water Wheels

By: Hamza Ahmed Sep. 26, 2019

upstream countries. Such behaviour may have been accepted thousands of years ago. Thucydides reflected the school of realism in international relations when he said, «Right, moral and justice, can exist only between equal powers». In other words, only equal powers can negotiate. One of the outcomes of World War II was the establishment of the United Nation and its Charter, whose 3rd principle states that «no one can be stronger than others». This principle has represented one of the essential tenets of European politics for several centuries, after considering the balance of powers as the fundamental principle of international politics. The modern code that emerged shifted the power and gave a better chance to the less powerful countries to negotiate. An excellent example of this matter is comparing the water conflict and resolutions of the Euphrates-Tigris basin to those of the Nile basin. Despite the differences and similarities, and although the downstream country for the Nile basin (Egypt) has a more powerful military source than the upstream (Ethiopia), this would not lead Egypt to win the fight, since modern wars turned to the courts; hence, negotiations emerged as a critical tool.

7. From Conflict to Cooperation, Is It Possible?

Despite the global negative image that potential water conflicts have, statistics show promising records since 1948, with only 37 water conflict incidents versus ~295 agreements that were negotiated/signed [28]. Developing the capacity of negotiation skills and system thinking are needed tools for achieving the ultimate goal and obtaining a strategic agreement to secure sustainable cooperation. However, the possibility of collaboration is infeasible without raising two fundamental questions: 1) is it sufficient to bring in a good experience of tools, like negotiation skills and system thinking, to reach cooperation, and 2) are there intermediate phases between water conflict and cooperation? The following section will answer these questions.

Negotiation skills and system thinking as tools are used to find a water resolution that might alleviate the risk of conflict, but they do not guarantee cooperation. Of course, there is no magic trick that turns conflict into collaboration; instead, it is a process that needs a sufficient understanding of the influence of water hegemony and the potential profits and losses for the riparian countries. This corridor of transformation management needs to be well-equipped in order to pass through it. Hence, water conflict and transformation management require outstanding leadership to turn any water challenge into an opportunity; Zeitoun et al [29] emphasize leadership capacity, where the future of transforming hydropolitical hegemony from asymmetrical to equitable water sharing relies on potential leadership. Knowing the gaps and mismatches through the system thinking approach doesn't only show us where we are; rather, it allows us to know where and when an opportunity might be created from a challenge. Transformation management needs a straightforward discussion and dialogue process to confront and attack the challenges with enthusiasm and confidence, put aside the psychological and cultural barriers, and look at the bigger picture of the Euphrates-Tigris basin. The management needs to pull back the deep old metaphors' tendency for the natural and replace it with innovative approaches that work for the region, while not limiting itself to national plans. Last but not least, it needs to build on the regional strengths of the riparian countries, and avoid the weaknesses.

Albert Einstein said, "We cannot solve our problems with the same thinking we used when we created them". In their book "Managing and Transforming Water Conflicts", D.J. Priscoli and T.A. Wolf [24], extensively describe transformation management approaches in four interaction phases. The four phases were highlighted in four sectors: negotiation level, water claiming, collaboration type, and geographic scope. These phases show the transformation from conflict to cooperation; ten years later, a fifth phase was developed to guarantee sustainability for the entire transformation system[30].

stage	Negotiation stage	Common water claims	Collaborative skills	Geographic scope
1	Adversarial	Rights	Trust building	Nations
2	Reflexive	Needs	Skill building	Watersheds
3	Integrative	Benefits	Consensus building	Benefit-sheds
4	Action	Equlty	Capacity building	Region
5	Sustain	Sharing	Joint projects	Union

Transformation stages for water conflict

The transformation management system showed that real partnership needs significant time, capacity, efforts, resources, and a very strong understanding of the water conflict environment. However, even if the riparian countries reach cooperation, there is no guarantee to keep it sustained, especially under fragile political stability. Excellent examples are the fall of the Adana agreement between Syria and Turkey, and the joint technical committee between Iraq and Turkey that reached a mature stage of cooperation but ended with no strategic agreement. Therefore, sustainable tools such as sharing water resources concerns, conducting joint projects, and proposing a union, would ensure the success of cooperation in the long run, secure the transformation system, and, most notably, reduce the risk of collapse in the worst-case scenario.

Yes, it is possible to walk through the transformation stages, reach the cooperation, and eventually sustain it. This way, peace for the region of the ancient rivers will be secure. In his book "Water, the epic struggle for wealth, power, and civilization" [31], Steven Solomon says, «Who manages the water, manages the civilization».

8. The Future of The Region With or Without Strategic Agreement

Albert Einstein said, «Imagination is more important than knowledge». Let us travel to the future and imagine how the region of the Euphrates-Tigris basin would be 20 years from now under two different scenarios. In the first scenario the riparian countries have reached a strategic agreement, while in the second they have not. Four aspects will be highlighted to visualize the differences; landscape, environment, economy, and people and newspaper headlines.

8.1. Scenario 1: countries achieve a strategic agreement (conceptual model for 2040)

a) **The landscape:** The 3.8% increase in annual population growth has resulted in more urbanized areas. However,

these demographic changes have not affected the health of the ecosystem. The landscapes' exposure to natural elements have been well protected by the law: the vegetation cover, the natural parks, the forest access and the proximity to water. These factors have been sustained not only quantitatively but also qualitatively with regards to the experience itself. The natural lakes, wetlands, farmland and forest have been very well protected and developed. The marshlands in Iraq have been entirely restored and designed to become natural parks. The natural conservation area Hasankeyf in Turkey has been well secured, and the archaeological sites are well protected from any possible flood that might threaten the area. The natural conservation lake Al-Jabbul in Syria has been well protected from any potential pollution caused by the sewage and the pesticides of the surrounding agricultural fields.

b) **The environment:** The environment looks rather promising, water quality has improved, and water quantities are better organized and equitably shared. The agriculture sector has been developed such that fewer pesticides and fertilizers are used, and an effective recycling system for sewage water has been implemented so that 40% to 50% of it is recycled. Evaporation has been reduced by over 60%. Laws on extracting the groundwater have been adopted and the countries have agreed to embrace the strategy of water harvesting and reservoir protection. In addition, many wetlands have been registered as protected environmental zones, and some of the lakes have been registered under the UNESCO's World Heritage Programme. Biodiversity in the region is well protected and regularly monitored. Freshwater fish can move freely in the rivers, and their populations are harvested within biological limits. Ecosystems are healthy and functioning, providing valuable ecosystem services to all communities, thanks to the mutual agreements between the riparian countries. Several environmental laws and policies have been established, along with high-value fines if any party breaks them. The quality of the Euphrates and Tigris rivers' water has improved following collective efforts to ensure that treated wastewater discharged to the river meets international water quality standards. The countries sharing the rivers' basins have started an expert working group to evaluate the economic and environmental impacts of tourism in the region, proposing regional standards for water and energy use in hotels, developing low-impact transportation, identifying tourism sectors that can be expanded without damaging the environment, and laying the basis for a design of awareness campaigns for tourists on the region's unique natural and cultural heritage.

c) **The economy:** The mutual interest and collaboration of the riparian countries have led to a trustworthy system of

commerce. The distrust has been replaced by complex links of economic and security strategic agreements. Statistically, the countries' annual revenue varies between 20 Billion USD to 27 Billion USD, where the GDP has been increased over 2.7% per annum, and free zones have been established to ensure better commercial and economic systems. The new taxation, customs, navigation, general procedures, and policies have been well organized and coordinated between the riparian countries. The market is stable and is rather attractive for investors and international companies. The military manufacturing/importing has been reduced from 210 billion USD/year to 20 billion USD/year, which means diminished over 90% where most of the investment now goes to research and development to empower the innovation industry and to improve the educational system. These economic achievements have attracted global investors to the region, where the countries' investment indicator rate has been increased to be in the top ten global healthy environments for investment, thus leading to the creation of more than 7 million jobs. The vision for 2050 is the cornerstone, where the establishment of Euphrates-Tigris Union (ETU) will be announced and be considered an ideal partner of the European Union to form the biggest united global coalition worldwide.

d) **People and newspaper headlines:** The people are filled with hope and are proud to pass on a healthy system to the next generations, the violence and crime activities have been reduced significantly, and the agreement between the countries has led to establishing peace in the region and building the future for each country. The citizens recognize the agreement's day as a national day to celebrate the right future path. The experience of the Euphrates-Tigris riparian countries will be a model for the next generations. The experience of the Joint Technical Committee for the Euphrates-Tigris riparian countries is announcing an additional package this week to facilitate the work for the wave of international investors. The United Nations recognizes this experience as a successful case study for the global community and establishes in Iraq an International Institute of Water for Peace (IIWFP). The ETU countries initially fund the institute. During the World Water Summit – Turkey in October 2040, the Iraqi Minister of Water Resources states: "The nation that has the water and the will, will inevitably develop".

8.2. Scenario 2: countries fail to achieve a strategic agreement (conceptual model for 2040)

a) **The landscape:** The region has changed over the past twenty years to respond to the growing population's needs and the country's drive to keep the economy expanding. There has been a conversion

of forested areas to farmlands. Smaller farms have been bought out and consolidated to create industrial-scale agricultural operations. An increasing portion of the landscape is devoted to extractive industries, including mining and quarries. Natural areas adjacent to cities have also been replaced by new suburban developments, as the growing human populations increasingly seek economic opportunities in and near cities.

b) **The environment:** Water quality issues have increased in the absence of a cooperation framework for the Euphrates - Tigris basin. The river water has not been managed in a coordinated manner, with each country taking the amount it deems appropriate to fulfil its needs. The rivers' levels have declined by at least two meters. Iraq's human settlement as the most downstream country on the Euphrates-Tigris basin has increasingly encountered difficulties in meeting its water needs. The tensions have increased between Iraq and the upstream country (Turkey). Tensions between Iraq and Syria have also increased as Syria has intensified its use of the Euphrates River to increase its water supplies. In general, water quality in the region has decreased due to intensive agriculture, conversion of forested land to farmlands, and poorly managed industrial waste runoff. More particularly, Iraq has not altered its land-use policy to consider the water footprint and avoid cultivating certain crops such as wheat and barley that consume water. As a result of the intensive logging that was allowed, Turkey's lower catchment has been clear-cut with no long-term plan to replace the forests that once stood there. Therefore, erosion on the clear-cut lands has accelerated, and sedimentation of the Tigris River has become a significant water quality problem for the downstream river users. The forests in the border between Turkey and Iraq that once facilitated the infiltration of 80% of precipitation are now gone, leading to dramatically increased surface runoff and consequently increased flash flooding. Iraq and Syria are increasingly angry at Turkey, blaming it for the sedimentation problems in the Euphrates and Tigris rivers, which have impacted the irrigation systems and caused extensive damage by the flooding, as well as affected fisheries, decreasing fish abundance and diversity. Another result of the lack of a regional plan for the Euphrates-Tigris basin is the absence of a cooperation framework for the riparian countries in aquifer sharing. In the past twenty years, the aquifer's riparian countries have intensified their exploitation of the aquifer due to rising populations and the declining availability of surface water from the Euphrates and Tigris rivers. To complicate matters, the sustainable yield of the aquifer has also decreased significantly over 20 years. The aquifer has experienced reduced recharge due to a decrease in the mean precipitation

(because of climate change), and the region has a recharge reduction from the Euphrates and Tigris rivers due to siltation of the riverbed (resulting in reduced hydraulic connectivity between the aquifer and the riverbed). Because of these conditions, as well as pressure, the countries have been forced to drill deeper wells to access the groundwater, and pumping costs have increased accordingly. Since there is no exchange of monitoring data between the aquifer's riparian countries, no country knows how much the others are extracting, and each one blames its neighbours for the declining groundwater levels, and for the resulting increased cost to access groundwater that is further and further away from the surface. The pollutant loads from the Euphrates and Tigris rivers have reduced the fisheries' productivity. Many fishers now spend more boat days at the river to meet their catch targets, catching fish outside of biologically sustainable limits, which shall lead to collapse in the coming years, and therefore to alarming concerns about food security for Iraq and Syria.

c) **The economy:** In the past twenty years, the regional economy has remained productive; however, signs indicate stagnation. Intensive agriculture and confined livestock production have increased in order to meet the region's growing population's food needs and drive economic development. However, that has been done by placing intense pressure on the region's ecosystems, with substantial impacts on the Euphrates and Tigris rivers (elevated nutrient and pesticide levels, decreased productivity of river fisheries, and contamination from animal wastes). The extraction of minerals and metal ore has also intensified. In the absence of strong environmental protection enforcement in the region, many waterways have become impacted by toxic runoff from poorly managed mining waste. Also, logging has increased across the region, with contracts awarded to one or two important foreign firms that tend to bring in their workers to extract the timber. In the absence of a regional plan for the Euphrates-Tigris basin, which could have included economic cooperation provisions, interstate commerce remains difficult and expensive. Complicated procedures hamper shipments of commodities from one country to another at the borders, and governments are increasingly assessing high import fees on goods originating outside their borders to protect national interests. The result is that while GDP across the region has increased (due to increased logging and agriculture), the annual per capita income has stagnated, with the purchasing power of the average citizen continuously decreasing over the past twenty years. People have become increasingly worried about their financial security and do not have an optimistic outlook on the future.

d) **People and newspaper headlines:** The newspapers tend to focus on the increasing tensions among the countries in the region, highlighting how one country often blames its neighbours for their economic or environmental woes. The Euphrates-Tigris basin is a connected ensemble of ecosystems and communities. Each country sharing the bay has instead decided to manage their territories as an isolated, unconnected part of the broader system. This has led to a lack of cooperation and unsustainable use of the basin's natural resources, leading to severe environmental degradation that will be the legacy for the next generation. The tensions have caused a dispute between the three countries (Turkey, Syria, and Iraq), with the downstream hosting the Turkish oppositions that supports them to create more pressure on the Turkish government. Military bases have been built close to the borders of each country, reflecting the adopted escalation policy. The issue-linkage strategy has led Turkey to implement more water projects without consultation with the downstream, which eventually causes severe drought and environmental degradation. As a result of the geopolitical disputes and the desertification, the downstream people have been displaced. Intensive and successive waves of immigrants' flow to Europe from the Middle East causes global security concerns, demographic and cultural challenges, and increased tension between Europe and Turkey where the former blames the latter for lack of border control.

9. Conclusion and Recommendations

Water conflict and resolution are complex systems with multidimensional challenges; they require deep consideration and knowledge within different sectors. The Euphrates-Tigris basin and the riparian countries are critical for deciding where the region is headed. The decision would shape the region for upcoming generations. A sustainable resolution would never emerge under tensions; instead, it needs extraordinary leadership to negotiate the water and turn the challenges into an opportunity that could reflect the entire region's prosperity. The negotiation itself in this context is not the goal; rather, understanding the journey's dynamics to reach sustainable cooperation is the ultimate goal. The Chinese philosopher Lao Tzu, in 500 BC., described the Philosophy of Water «Wild and Well»:

> *Be humble: flowing from high to the low.*
>
> *Be flexible: whenever you find an obstacle or rock, it will turn around.*
>
> *Be polymorphic: different states (liquid, gas, concrete).*
>
> *Be adaptive: take the shape of the place.*

When we negotiate water, we should follow the philosophy of water flow, the

rule of the element that we are negotiating for, and the reason that gathers us on a round table. We should always keep the negotiation's momentum to support a healthy environment and better understand our partners.

The time factor is a crucial element to obtain agreement; understanding the power of time is essential since each passing moment brings challenge or reveals an opportunity. Heraclitus, the Greek philosopher, said, «You cannot step into the same river twice, for other waters are continually flowing on». This profound statement shows the power of time; it means that the world continually changes and that no two situations are the same. As water flows in a river, one cannot touch the same water twice when one steps into a river.

The following recommendations are fundamental for the Euphrates – Tigris basin to reach a sustainable water resolution:

- Reactivating the three-stages project proposed by Turkey, encouraging the riparian countries to join and empower the joint technical committee's proposal. The committee will work on a technical level to pull back the regional water resources management from the political realm to a technical one. The three-stages project will encourage the development – linkage approach that would link the quantity of water shares for each country to the development plans. More development leads to more water shares.
- Establishing a comprehensive leadership program including Dialogue and Mediation aspects by gathering experts from different disciplines and backgrounds (experts, politicians, and civil society), the idea being to gather them on a round-table to ensure a broad spectrum of participants in order to tackle the challenges and come up with practical solutions.
- Modelling the transformation management tool and customizing it for the regional scale to illustrate the status from water conflict to cooperation, in particular for the decision-makers. This would help recognize the potential sectors for cooperation, and reveal the gaps.
- Encouraging the role of incentive policy through joint strategic projects to foster the riparian countries' economy and security. This includes establishing a joint research centre to conduct research and develop the capacity building for water diplomacy, sustainable development goals, and most importantly, leadership and public policy. One of the objectives of this centre would be to establish an integrated database to be used by the riparian countries for future projects, and to monitor the progress of the water management system.
- Conducting a regional evaluation for the commissioning of dams and for a feasibility study of the currently existing dams. Although Iraq is more in need of regulators than dams, two

strategic dams need to be completed (Makhoul and Bekhme dams). Cooperation with Turkey to use the Ilisu dam as an additional hydropower source is also a possibility that would result in increasing the water allocation for Iraqi marshlands on one side, and in securing the Hasankeyf ancient town and the nature conservation area on the other side.

- Governing and centralizing water resources such that there are fewer possible stakeholders, in order to avoid potential conflicts of interest and unnecessary bureaucracy.
- Developing regional awareness campaigns to highlight the factsheets of the water challenges and climate change influencing the region. Water education should be considered fundamental, and should start in primary school.
- Requiring the riparian countries to develop a mathematical model for possible floods and droughts, using the metrological records' patterns, and taking into consideration that climate change is a fundamental factor for the region.
- Employing modern technology as a legal requirement in the riparian countries, particularly Iraq and Syria. The current irrigation system is outdated and needs to be replaced with a sophisticated one that has a closed drainage system and a modern piping network to reduce water losses due to evaporation. Smart irrigation techniques are highly needed to increase agriculture efficiency.
- Developing a regional map for the riparian countries that shows the key strategic crops (i.e., wheat, barley, rice, corn and dates), in order to encourage production according to a lower water footprint and establish financial support initiated by the agricultural sector.
- Leading a comprehensive and integrative investigation of groundwater reservoirs, in order to estimate the groundwater quantity and quality on a regional scale.

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II

Gender and Water Dynamics in Iraq:

Towards Inclusive and Sustainable Water Responses

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1. Introduction

Across Iraqi society, clean and affordable water access underpins critical services that sustain people's lives and livelihoods. While water scarcity and pollution bring about a cascade of challenges and threats, and aggravate existing problems, these issues do not affect all demographic groups in the same way. Women are often disproportionately impacted by water-related threats, largely due to socially-constructed norms and behaviors that shape and consolidate structural and institutional discrimination and inequalities against women. This makes the experiences and needs of women rather different, and limits their resilience capacity against water-related stresses, which include the loss of livelihood, intensified care work, and the need to migrate, among others. Against this backdrop, this paper aims to provide an unprecedented exploratory analysis the gender-water nexus in Iraq[1], with the purpose of starting a conversation on the intersection between gender and water scarcity across different demographic groups and spatiality in Iraq, using intriguing specialized and in-depth research. In doing this, the paper will: 1) present an overview of the drivers of water scarcity and pollution in Iraq, 2) provide an exploratory analysis of gender-water dynamics in Iraq, shedding light on six concrete examples, and 3) infer recommendations on how to integrate a gender lens in water-related policies and responses and how to transform water-related threats into opportunities for advancing gender equality and women empowerment.

(1) Based on the literature review conducted for this paper and to the knowledge of the author, this area of research (water-gender dynamics in Iraq) is extremely under researched and a knowledge gap persists.

2. Methodology

This paper is based on thorough desk research and a literature review of water scarcity and its related threats in Iraq, gender norms and constructions, gender-based discrimination and inequalities across the Iraqi society, as well as linkages and synergies between environment and gender across different contexts within the Global South. Moreover, a number of focus groups and expert interviews were conducted to better contextualize the paper and assess its findings. These included interviews with female lawyers, academics, male and female farmers, and human rights activists, particularly from southern Iraq.

3. An Overview of Water Scarcity in Iraq

Over the last three decades, the environmental situation in Iraq has continuously deteriorated. In 2018, the Iraqi federal government indicated that the water flowing through the Euphrates and Tigris - the country's main water resources - has shrunk by 30 percent since the 1980s. This trend is expected to continue, reaching a decrease in water discharge by up to 50 percent by 2030[2]. Likewise, the overall water supply is expected to decrease by up to 60 percent between 2015-2025[3]. The shrinking availability of water and inaccessibility to affordable and potable water is driven by a myriad of inter-related factors. This section will provide a succinct overview of the main drivers behind Iraq's water scarcity.

3.1. Corruption and Water Mismanagement

Despite the growing evidence of the destabilizing impact of water scarcity, the Iraqi government has failed to effectively manage water scarcity and its associated threats. This inefficacy towards implementing a comprehensive water management plan, improving the water infrastructure and providing a waste-free water system is partly driven by the prolonged negligence, corruption and nepotism from the side of the government. Field records from Basra, Al Diwaniyah and Nasiriyah indicated that there are personal farms and illegal fish fields owned by politicians that depend entirely on water stolen through artificial tributaries or underground pipelines[4]. Compounding this, the agriculture sector continues to use outdated and wasteful water practices, and the country's sewage system is highly dysfunctional, which severely damages the quality of the water.

(2) Dockx, Pieter-Jan. Institute of Peace and Conflict Studies, 2019, Water Scarcity in Iraq: From Inter-Tribal Conflicts to Water Disputes, www.ipcs.org/issue_briefs/issue_brief_pdf/ipcssr203_contested%20waters%20project_water%20scarcity%20in%20iraq_p%20jan-dockx_may%202019.pdf.

(3) More than Infrastructures: Water Challenges in Iraq. Report. July 2018. https://www.clingendael.org/publication/more-infrastructures-water-challenges-iraq.

(4) Sulaiman, Khaled. Water Guards - Drought and Climate Change in Iraq. Al-Mada, 2020. P.49

3.2. Transboundary Water Tensions Between Riparian States (Turkey, Iran and Syria) and Iraq

Measures and decisions taken by riparian countries - Turkey, Iran and Syria – are prime contributing factors to Iraq's shrinking availability of surface water. The conflicts over the utilization and distribution of Euphrates and Tigris water resources date back to the 1970s, when each riparian country embarked, unilaterally, on projects for building dams and water infrastructures. Turkey has established its position as a regional hydro-hegemon, exploiting opportunities across Syria and Iraq to strengthen its control over critical water sources and control water levels to its favor. Most significantly, Turkey is implementing a grand project of water infrastructure building, called the Southeastern Anatolian Development Project (GAP), which includes the construction of 22 dams, 19 hydroelectric power plants and an extensive irrigation network. The filling of the Ilisu dam reservoir has the potential of reducing the water flow to the Tigris river by 50 percent[5]. While Ankara reinforces its right to achieve its development ambitions, by intensifying energy generation and providing job opportunities, this will pose serious threats to Iraq's water resources, agriculture sector and livelihood opportunities. Despite the potency of hydro-politics in jeopardizing Iraq's water resources, there is no legally-binding and comprehensive water management agreement that brings together Turkey, Syria, Iran and Iraq to organize and manage the equitable and sustainable sharing of Tigris and Euphrates[6].

(5) Ibid, 4.

3.3. The Weaponization of Water

Another important factor that has contributed to the deterioration of Iraq's water resources is the instrumentalization of water infrastructure to consolidate power, punish opponents and delegitimize political rivalries. In 1991, Saddam Hussein's regime diverted the rivers' flow and dried out the Marshes in Southern Iraq as a strategy for weakening his political opponents and consolidating his power over the Marsh Arabs. The drainage of the Marshes had devastating impacts on the Marsh Arabs community.

The absence of water has constrained the role of women in society, which traditionally included collecting reeds, raising water buffalo and other livestock, producing milk, cheese and yoghurt, and making handicrafts. Records also suggest that women are no longer passing traditional knowledge to younger generations, largely due to the disruption of these activities[7]. When Saddam Hussein was toppled by the 2003 US invasion, local communities across Amarah, Basra and Nasiriyah destroyed the dams, allowing the water to flow again

(6) Webinar "Iraq: Climate, Water & Conflict in 2020". August 2020. https://www.youtube.com/watch?v=GnGtEMPEXDM&feature=emb_logo&ab_channel=ClingendaelInstitute.

(7) Minority Rights Group International, 2019, Minority and Indigenous Trends. Available at: minorityrights.org/wp content/uploads/2020/08/2019_MR_Report_170x240_V7_WEB.pdf.

towards the Marshes. However, regional dam building, droughts and harmful irrigation practices have obstructed the flow of water at its usual rates[8]. Likewise, ISIL (Islamic State for Iraq and the Levant) exerted control over critical water resources and key water infrastructure to further its political and strategic goals and advance its territorial expansion strategy. This was manifested in two ways. First, ISIL controlled dams by holding water behind them, diverting water flows and temporarily cutting off supplies, which led to the drainage of certain communities. In parallel, it released water at dams and caused flooding to drown government-controlled territories or impede the movement of government troops. Second, ISIL contaminated water resources, rendering them unsuitable for drinking, agriculture and livestock farming[9]. The utilization of water resources as a military tactic or battlefield weapon has had devastating consequences on Iraq's water infrastructure. The Ministry of Water Resources estimates the cost of direct damages to hydraulic infrastructure at USD 600 million[10].

(8) Solomon, Erika, and Laura Pitel. «Why Water Is a Growing Faultline between Turkey and Iraq.» July 2018. https://www.ft.com/content/82ca2e3c-636911-e890-c29563-a0613e56; ibid, 4, p.4950-

(9) Von Lossov, Tobbias. THE ROLE OF WATER IN THE SYRIAN AND IRAQI CIVIL WARS. Report. May 2020. https://www.clingendael.org/publication/role-water-syrian-and-iraqi-civil-wars.

(10) Environmental Issues in Areas Retaken from Isil Mosul, Iraq. Report. 2017. https://www.unenvironment.org/resources/publication/environmental-issues-areas-retaken-isil-mosul-iraq-technical-note.

3.4. Climate Change: a magnifier of water-related threats in Iraq

Given its unique hydrological limitations, Iraq is one of the most vulnerable countries to climate change impacts in the Middle East and North Africa (MENA) region, particularly due to its arid and downstream location. Throughout the last decades, the country has witnessed rising temperatures, variability and unpredictability of rainfall precipitation, which has caused recurrent droughts (1998-2000 & 2007-2009), heat waves and erratic rainfall[11]. Iraq depends on precipitation outside of its borders for half of its water supply. This makes it highly vulnerable to changes in precipitation levels. Moreover, the low water level in Southern Iraq coupled with sea-level rise in the Persian Gulf has led to the intrusion of soil in Shatt El Arab and groundwater resources, increasing the salinity of water and causing serious damages to the surrounding lands[12]. Flash floods, droughts and extreme weather events put additional stress on Iraq's dilapidated water infrastructure, which negatively impacts industries and livelihoods activities, increases the risk of food insecurity and water-borne diseases, and disrupts education and healthcare services[13].

(11) Hassan, Kawa, Camilla Born, and Pernilla Nordqvist. Iraq: Climate-related Security Risk Assessment. Report. 2018. https://www.preventionweb.net/publications/view/61579.

(12) Fact Sheet: Climate Change in Iraq. Report. Accessed 2012. https://reliefweb.int/sites/reliefweb.int/files/resources/Climate change In Iraq Fact sheet - English.pdf.

(13) Ibid 4, p.77

3.5. Macro-Trends: insecurity, population growth, urbanization and economic stress

Understanding Iraq's water scarcity and its associated threats requires an assessment of the broader political, security and socio-economic context, where all of these systems interact against the backdrop of post-conflict reconstruction and development. In the security landscape, Iraq has engaged in a prolonged conflict with terrorist organizations, namely ISIL. The country is characterized by political instability and fragmentation, inter-sectarian tensions, regional rivalries and superpower hegemony (Iran-US, Turkey-Kurds, Iran-Saudi Arabia, Turkey and Iran)[14]. On the humanitarian front, there are approximately 1.4 million internally displaced persons and 4.1 million people in need of humanitarian assistance in Iraq[15]. The loss of livelihoods and disruption of basic needs due to water deterioration is influencing migration dynamics and intensifying internal displacement, particularly in Southern Iraq. Additionally, the Iraqi population is expected to reach 50 million by 2030, while in 2050 it is estimated that it will have increased to 80 million people[16]. This means that water demands will continue to increase in the coming decades. Compounding this, Iraq is highly dependent on oil revenues, accounting for more than 90 percent of government revenues, making it highly vulnerable to international oil price shocks and fluctuations. For instance, the government's 2020 budget was prepared on an assumption of $56 per barrel, while prices in 2020 dropped to an average of $ 30/ barrel, largely due to the economic repercussions of COVID-19 pandemic[17]. Furthermore, around 70 percent of Iraq's population resides in urban areas, and the rate of urbanization is expected to increase annually by 3 percent[18]. Additionally, water-related threats can exacerbate rural-urban migration patterns and increase demands on urban water systems.

4. The Differentiated Impact of Water Scarcity on Women and Men in Iraq

The convergence of these factors has severely deteriorated Iraq's water resources, which has led to the loss of livelihoods, economic stress, disruption of health and educational services, spread of water-borne diseases, and internal migration, among other issues. However, while water-related threats are pronounced across the Iraqi society, their impacts are far from universal: water scarcity and its associated threats have important gender

(14) Ibid 10

(15) «Iraq.» OCHA. August 19, 2020. Accessed October 17, 2020. https://www.unocha.org/iraq.

(16) Ibid 06

(17) IMPACT OF THE OIL CRISIS AND COVID-19 ON IRAQ'S FRAGILITY. Report. United Nations Development Programme in Iraq. August 2020.

(18) «Iraq Urbanization.» Iraq Urbanization - Demographics. Accessed October 17, 2020. https://www.indexmundi.com/iraq/urbanization.html.

dimensions that shape how women and men experience and cope with these problems. Gender is understood as "the social (rather than biological) attributes, norms, roles and attitudes considered appropriate for groups of men and women by a given society at a given point in time and learned through socialization. Gender shapes and reinforces power relations between and among these different groups[19]." Accordingly, women and men experience water-related threats differently, women being disproportionately impacted. Women face a multitude of structural and institutional barriers, including sexual and gender-based violence, restricted mobility, and confinement to traditional gender roles – to mention a few - that not only shape their experiences but constrain their ability to cope and withstand stresses and shocks, in comparison with their male counterparts. However, women are not a homogenous group; the diversity among them is due to the intersection of gender with other identity-makers, such as age, ethnicity, socio-economic status, education, religion and so on. These identities and affiliations overlap and interact with one another forming a complex and unique identity of different groups of women[20]. This elucidates that extensive research is required to fully grasp gender-water dynamics across groups of women with different identity constructions in the Iraqi society. This section aims to provide initial insights on gender-water dynamics in the Iraqi society by laying out six concrete examples, as follows:

4.1. Women Are Prime Managers of Water at The Household Level

The management of scarce water resources on the household level puts additional burdens on women and increases the likelihood of intra-family disputes and domestic violence. In southern Iraq, local populations suffer from severe water scarcity and water pollution. In many of the homes, there is no running water. Accordingly, family members purchase water from multiple sources to secure their basic water needs for drinking, cooking and cleaning. An anecdote from a woman living in Nasiriyah indicated that although her home is close to the center of the city, she would have to call the local water services to come with water tanks and fill the water reservoir of her building on a weekly basis. She indicated that while the governmental service is supposed to pass by periodically and transport water free of charge, she would have to call and pay 5,000 Iraqi Dinar (4.20 USD) for each water tanker, otherwise she would be out of water for days. This water is used for cleaning purposes, including bathing and washing of clothes, but it is not suitable for drinking or cooking, given that it is of poor quality[21]. Accordingly, women

(19) Gender, Climate and Security: Sustaining Inclusive Peace on the Frontlines of Climate Change. Report. June 2020. https://www.unwomen.org/-/media/headquarters/attachments/sections/library/publications/2020/gender-climate-and-security-en.pdf?la=en&vs=215.

(20) Ibid 18

(21) Focus group conducted with Ms. Fadwa Tawama, Iman Khedr, Amal Hussein and Abullah Al-Anzi on 17 October 2020.

from Nasiriyah, similar to many cities in the South, are required to buy water with better quality from purification stations to use it for drinking along with bottled water. Water accessibility is considerably better for households in Northern and Central Iraq where running water is available, such as Baghdad, while the situation is significantly worse for women and communities that live in informal urban settlements or remote areas (Check Box 01).

Aside from managing the purchase of water and the financial burden that it poses, women are primarily responsible for managing this scarce water inside the household and for ensuring that it is being consumed carefully while searching for ways to reuse and recycle it. This requires increased household work for women, where they have to sort and carry water in order to fill the containers. This situation increases household pressures on women and negatively affects their well-being, particularly in the hot summer where the temperature might exceed 50 degrees Celsius. With this in mind, water scarcity and its associated risks increase the likelihood of intra-family disputes and domestic violence, particularly spousal violence. Data shows that one in five women (21%) in Iraq aged 15 - 49 has suffered physical violence at the hands of the husband[22]. These are the official numbers, but the actual rate of violence is likely to be much higher. This situation becomes compounded when families have to deal with urgent and concurrent problems. For instance, numbers indicate that domestic violence cases have increased by an average of 30% since the coronavirus pandemic has hit Iraq and curfew was put in place[23]. This suggests that emerging threats, including health or water-related threats, are often aggravators of gender-based violence.

Box 01: Women's Daily Journey for Water Transport in Al-Burwaished Village

Every day, Um Ali (35 years old) along with the women of Al-Burwaished village travel for around three kilometers, back and forth two to three times a day, to bring clean water - water free of salt and sulfur - to their families. At dawn, each woman carries a large pot above her head and walks towards the nearest river. They make this journey again at noon and before sunset to collect water for their household use and for bathing their children. Women would take turns to fetch water from the river or to bathe in it (without using soap, given that it doesn't foam because of the murky water). It is important to note that the available water doesn't meet the daily needs of the whole village. Additionally, women from surrounding villages would also come to the banks of the river – named by the local community "Al-Besrukeya"

(22) «Violence Against Women in Iraq Fact Sheet.» November 2010. https://www.refworld.org/pdfid/4cf4a67d2.pdf.

(23) «Spike in Domestic Abuse Cases Hits Iraq:» The Arab Weekly. April 2020. Accessed October 30, 2020. https://thearabweekly.com/spike-domestic-abuse-cases-hits-iraq.

– to wash their utensils. They also cover each other with robes to bath in between canes. In this way, the women use some of their daily water needs at the source, saving some water from being transported back home.

The village of Al-Burwaishid, which is affiliated to Al-Badir district in Al-Diwaniyah Governorate (200 km south of the capital Baghdad), inhabits about 700 people, the majority of whom are women and children. Houses and silos for storing grain and food are constructed of mud-brick by the hands of women, girls and children, while men provide mineral drinking water from the city of Al-Badir, which is 60 km away.

This story has been reproduced from an article on the impact of drought and bullous disease on women and children, written by Tahsin Al-Zerqany. Available at: https://daraj.com/32784/

4.2. Water-Induced Migration is Often Shaped By Gender Considerations

The scarcity of water as well as land degradation have jeopardized the rural livelihoods of many families across Southern Iraq. This has triggered the internal migration of rural communities; these migration patterns are often shaped by gender considerations and have different implications on women and men. Basra, Missan and Thi-Qar – the three southernmost governorates of Iraq – have witnessed the highest number of water-induced internal displacement throughout the past decade. In some villages, particularly in Thi-Qar, up to half of the homes were abandoned[24]. In rural communities, women are responsible for taking care of household chores, but they also engage in subsistence agriculture. Male farmers work in agriculture fields, particularly wheat and barley, while women perform unpaid farming activities in nearby groves. This includes the collection of dates and the planting of vegetables, such as mint, parsley, celery, eggplant, okra and green pepper. These products are usually sold in the village's market to provide a small income for the family. Unlike the seasonality of agricultural crops, these groves are suitable for planting throughout the year. However, many of these groves have been damaged due to water scarcity. Additionally, the precarity of the water situation, namely the changing availability of water throughout the years, has disincentivized farmers to invest in their lands and forced many to move, including female farmers[25]. Evidence shows that there is diversity across the migration patterns of rural communities. On one hand, rural families do move to other rural communities. Data from the International Organization of Migration (IOM) suggests that most families displaced by Iraq's water crisis in 2019 moved from one rural area to another, nearly a quarter of whom moved to other villages. Social capital, including family and tribal connections,

(24) Guiu, Roger. No Matter of Choice: Displacement in a Changing Climate. Report. February 2020. https://www.internal-displacement.org/sites/default/files/publications/documents/202002-iraq-slow-onset-report.pdf.

(25) Ibid 20

is a significant factor in shaping families' decision to move, largely on the basis of livelihood opportunities. Social capital is usually a critical factor in shaping people's ability to cope and adapt with challenges, and in patriarchal societies, men are often placed in more favorable and better-connected positions. On the other hand, many other families move to urban areas, and usually reside on the outskirts of urban clusters or in lands that are registered as agricultural. For instance, in Dawaya Center, two new neighborhoods have emerged over the last decade[26].

In some cases, men move to urban cities in search of better economic opportunities, while women and children stay behind. In other cases, women and children travel with their husbands and reside together in their new home[27]. In Baghdad, men usually join security institutions, including military and police, or carry out precarious daily labor, such as garbage sorting and the selling of recyclable materials. Traditionally, women are expected to stay home and conduct household chores, but the stressful economic situation and the absence of the 'breadwinner', due to the protracted conflict, has forced many women to search for a source of income, conducting informal daily labor, in addition to garbage sorting activities. While it is difficult to accurately estimate the number of female-headed households (FHHs), figures indicate that 1 in 10 Iraqi households is headed by a woman[28]. An anecdote from a female lawyer living in Baghdad has explained that throughout the last decade Baghdad has become a hotspot for "in-migration", including farmers. However, most of these internal migrants reside in alarmingly growing urban slums and illegal urban settlements. These areas are characterized by violence, gangs and militias, drug smuggling, child trafficking and prostitution. Accordingly, women and children are subject to different forms of direct and structural violence[29]. Also, the influx of rural migrants into Baghdad poses additional pressures on Baghdad's water facilities. There are records of destruction, diversion and stealing of water by residents of urban slums[30]. This increases the likelihood of societal tensions and aggravates the notions of violence and insecurities, which women are disproportionately impacted by.

Box 02: El-Tawashat الطواشات (female date collectors) have lost their source of livelihood due to land levelling in Baghdad.

Not so long ago, Iraq was home to the highest number of palm trees in the Arab region. Nowadays, agricultural lands and palm trees in areas next to the Degla river in Baghdad have been leveled for

(26) Ibid 23

(27) Expert Interview with Maha Yassin, Junior Researcher at the Planetary Security Initiative, Clingendael

(28) Nasiri, Murtada. IOM-IRAQ SPECIAL REPORT FEMALE HEADED HOUSEHOLDS. Issue brief. February 2020. http://www.uniraq.com/index.php?option=com_k2&view=item&id=11876:iom-iraq-special-report-female-headed-households&Itemid=626&lang=en.

(29) Ibid 20

(30) Ibid 20

commercial use by investors and well-connected politicians. The absence of these agricultural lands has hindered the seasonal movement of El-Tawashat (female date collectors) from their rural villages to Baghdad's palm groves to harvest dates and generate income that usually suffices their families for the rest of the year, particularly in the absence of a breadwinner.

El-Tawashat are rural women whose livelihood depends on the season of date harvesting. In the early hours of the morning, El-Tawashat travel to palm groves to collect and sort dates. Given that this is their main and only source of income, women conduct this intense labor despite its precarity. An owner of a palm grove has indicated that this work is conducted exclusively by rural women and girls because they are better able to bear the physical labor required for this work, which is usually arduous and tiring. He added that these women are poor and need to support their families. The protracted conflict in Iraq has widowed many women, which has forced them to search for livelihood opportunities.

Source: Expert interview with Ms. Amal Hussein, Lawyer and Human Rights Activist from Baghdad and an article by Iraq Radio Free: https://www.iraqhurr.org/a/24840053.html

4.3. The Intersection Between Gender, Water and Insecurity

Across the Iraqi society, gender, water and insecurity dynamics come into play, causing a feedback loop and perpetuating direct and structural violence against women. Decades of violence, conflict and political fragmentation have severely worsened the status of Iraqi women in society, reversed hard-won gains and subjected them to many forms of violence. Under ISIL, women have faced kidnapping, extrajudicial killings, rape, slavery, human trafficking and forced marriage to fighters. Also, many women who were directly or indirectly associated with ISIL face stigma and societal rejection, which prevents them from receiving the protection and support they need. Also, domestic violence is ubiquitous in Iraq, largely due to patriarchal constructions and the adherence to customs and traditions, which usually normalizes or justifies such criminal actions. So-called honor crimes, child marriage, trafficking of women and girls and female genital mutilation (FGM) are among other forms of violence against women[31]. There is extensive evidence that conflict landscapes are increasingly being gendered. This means that gender-based violence (e.g., rape, slavery and abduction) or gender associations, such as the association of women with honor and family image, are being instrumentalized for political or military goals, including the exertion of dominance and control over communities and the dehumanization of opponents through the humiliation and traumatization of the

(31) Abed, Anfal. «Violence Against Women in Iraq: Between Practice and Legislation.» Middle East Centre. July 09, 2020. Accessed October 2020. https://blogs.lse.ac.uk/mec/202008/07//violence-against-women-in-iraq-between-practice-and-legislation/.

women of those groups, which often has far-reaching destabilizing effects on these communities[32]. Likewise, since the adoption of UNSCR (United Nations Security Council Resolution) 1325 (2000), the case for the disproportionate and differentiated impact of conflicts on women and girls has been strongly proved and evaluated across different conflict situations[33].

Against this backdrop, sexual and gender-based violence interacts or overlaps with water dynamics in three specific ways. First, it reduces the resilience of women to cope, withstand and recover from water-related threats, such as the loss of livelihood, daily mobility of women for the purchase or transport of water, and the search for alternative livelihood opportunities, due to the different forms of harassment and abuse that they are exposed to. For instance, southerner men that have served in the Popular Mobilization Forces (PMF) or women that have been forcibly displaced face limited livelihood alternatives given that they can no longer return to their villages because of the precarious and devastating situation of the countryside[34]. Second, water scarcity and pollution increase the propensity for the politicization and securitization of water, inter-tribal and inter-ethnic conflicts, societal tensions (e.g. rural-urban migration) and social unrest. For instance, in July 2018, Basra governorate had witnessed a social upheaval against the government, which was triggered by repeated water and electricity shortages in the hot summer months[35]. The increase of violence and instability that is partly motivated by the scarcity and the pollution of water exacerbate insecurities even further, which does not only hinder the efforts towards the protection of women, but rather aggravates women's vulnerabilities and inequalities. Third, the strongly-rooted cultural violence against women subjects female environmentalists and civil activists to harassment, defamation and stigma. Anecdotes by women activists in Iraq elucidate that the perceptions of honor and gender-based moral associations are a pretext for harassment, violence and even killing of women activists by accusing them of being dishonorable or unethical[36].

4.4. Caregiving Activities Are Primarily The Responsibility of Women

Similar to many communities, caregiving activities are primarily the responsibility of women across Iraqi society. Women

(32) United Nations Security Council Resolution 1820 (2008). Available at: https://www.securitycouncilreport.org/atf/cf/%7B65BFCF9B-6D274-E9C-8CD3-CF6E4FF96FF97%D/CAC%20S%20RES%201820.pdf

(33) United Nations Security Council Resolution 1325 (2000). Available at: https://www.peacewomen.org/SCR-1325

(34) Solomon, Erika, and Laura Pitel. Why Water Is a Growing Faultline between Turkey and Iraq. July 2018. https://www.ft.com/content/82ca2e3c-636911-e890-c29563-a0613e56.

(35) Mustafa Salim, Liz Sly. «Widespread Unrest Erupts in Southern Iraq amid Acute Shortages of Water, Electricity.» The Washington Post. July 14, 2018. Accessed October 30, 2020. https://www.washingtonpost.com/world/widespread-unrest-erupts-in-southern-iraq-amid-acute-shortages-of-water-electricity/201814/07//b9077b9086-c2-11e89-e064-db52ac42e05_story.html.

(36) Ibid 4

look after the wellbeing of their children and play an integral role in fulfilling their physical, psychosocial and emotional needs[37]. Accordingly, water-related illness and the disruption of schooling, due to environmentally-related hazards, put additional emotional stresses on women and intensify their care-giving duties. In the summer of 2018, the Basra governorate faced a water crisis, where drinking water became contaminated and many residents didn't have access to potable water. As a consequence, approximately 130,000 people, half of which were children, were hospitalized after contracting water-borne diseases[38]. Also, the absence of clean water, broken toilets and dry pipes in schools, coupled with overcrowded classrooms, created breeding grounds for diseases and forced many children to drop out of school[39]. According to the Norwegian Refugee Council (2018), more than 277,000 children were at risk of contracting a water-borne disease in schools across Basra, where water and sanitation facilities were severely damaged[40].

As explained in the first section, Iraq's water crisis is driven by a multitude of factors, including climate change, which intensifies the prospects of heatwaves, droughts and floods. These climatic hazards cause serious damages to infrastructure, homes, schools and other vital services. For instance, in the spring of 2019, heavy rains and floods hit many regions across Iraq, including Baghdad, causing severe damages to infrastructure and disruptions in water services, which forced some communities to use flood water to meet their basic water needs. This has exacerbated health risks and increased the likelihood of disease spread. The increasing frequency of climate-related natural hazards coupled with water scarcity and dilapidated infrastructure exposes children to a myriad of threats, including illness, school dropouts, and disruption of recreational and sports activities, and increases their need for humanitarian assistance[41]. According to the Ministry of Environment in Iraq (2017), women, children and elders are most vulnerable to the negative impacts of climate change, due to their limited resilience capacity in the face of the health, economic and environmental consequences of climate-related threats[42]. Field records reveal that poverty due to the loss of agriculture-based livelihoods and food insecurity were push factors for girls to drop out of school, engage in child labor and be forced into child marriage[43].

(37) Ibid 4

(38) Baker, Helin. «Clean Water Saves Lives.» Norwegian Refugee Council. November 2019. Accessed October 30, 2020. https://www.nrc.no/gmm/clean-water-saves-lives/.

(39) Ibid 36

(40) «Iraq: Basra's Children Face Disease Outbreaks in Rundown Schools.» Norwegian Refugee Council. October 2018. Accessed October 30, 2020. https://www.nrc.no/news/2018/october/iraq-basras-children-face-disease-outbreak-in-rundown-schools/.

(41) Ibid 4

(42) The Status of the Environment in Iraq. Report. 2017. http://moen.gov.iq/Portals/0/الواقـع البيئي/الواقـع البيئي 2017.pdf.

(43) Ibid 4, p.69

Box 03: An Investigative Field Visit: Water Scarcity, Inter-Clan Conflicts, Disease Spread and Extreme Poverty

This is an anecdote by Iman Khedr, Agriculture Engineer and Human Rights Activist from Nasiriyah Governorate in Iraq.

As a result of my work in the humanitarian and environmental field in Thi-Qar Governorate, I was once approached by one of the locals while I was conducting fieldwork with one of Thi-Qar's Parliamentarians. This local asked me to pay a visit to one of the villages and inspect the miserable situation of the villagers due to water scarcity. When I asked him why haven't the villagers communicated their problems to the local government, he indicated that they contacted the local government multiple times, but no one has extended a helping hand. Accordingly, I decided to visit the village while being accompanied by the director of the parliamentarian's office and his media officer. When we arrived there, we found the villagers living in extreme poverty and facing serious water shortages.

The villagers complained about water scarcity and lack of access to the river's water as well as to drinking water. They expressed that despite their repeated complaints to the municipality, there were no attempts to solve the water problems facing the village. The municipality would only send vehicles with water barrels; each barrel costs 5,000 Iraqi Dinars, although the water comes directly from the river without any treatment. The villagers of this area belong to the Bani Al-Assad clan. They abandoned their lands in the 1990s under Saddam's regime due to the drainage of the Marshes. When their lands dried, the Bani Al-Assad clan moved to western governorates and worked in the agriculture sector, but after 2003, they decided to return to their lands in Thi-Qar.

However, they realized that the area is being controlled by powerful clans that are deliberately drying up the lands as a way of pushing them out again. I also visited the women and children of the village, who had red spots on their faces due to water-related skin diseases. It is important to note that when we contacted the Governor and described to him the dire situation of the village, he denied and undermined the situation, framing the problem as a competition between clans over land use. Due to the inaction of the Governor, we resorted to the local environmental administration and they were responsive.

They inspected the village and found out that the river's course has been diverted and water sources were cut off by Al-Jubeir clan who are well-connected politically. Also, they found 250 dead buffalos and others were blind due to prolonged thirst. In response to this, the Ministry of Environment has constructed a desalination unit and returned the riverbed to the village. The inaction towards this dire situation would have led to the destruction of the entire village.

4.5. Girls Are Disproportionately Impacted By The Inadequate Access to Water and Sanitation Services

Damaged and dysfunctional water infrastructure and lack of access to basic sanitation facilities across schools in Iraq, particularly in rural areas, have disproportionately impacted girls. While both girls and boys struggle because of lack of water and appropriate toilets at schools, which forces them to buy bottled water to be able to maintain basic hygiene,[44] girls face additional hurdles when they have to deal with their monthly menstrual cycle. Although menstruation is a normal biological function of the female body, the societal associations and constructions of it as something shameful, inappropriate and impure, force many girls to skip school to avoid facing social embarrassment and exclusion. Moreover, the absence of clean water and functional toilets at schools makes it difficult for girls to manage their menstruation in a hygienic and private manner. This jeopardizes girls' continued engagement in the educational process. Some girls might even walk to the nearest water source, or resort to neighboring homes to use the toilet[45], which may increase their exposure to harassment and gender-based violence.

4.6. Local Communities Are a Valuable Source of Knowledge

While local communities are disproportionately affected by water scarcity and pollution and its associated threats, they provide valuable knowledge on how to sustain ecosystems, preserve scarce water and adapt to this changing environment. Given their proximity to nature and their integral role in the management and provision of water, local women are a vital source for innovation and for devising "nature-based solutions"[46]. A field visit conducted by Khaled Suleiman to Sumar town, located about 30 kilometers north of Diwaniyah city, provides a vivid example of a local woman's knowledge of climate change and water pollution and her utilization of innovative tools to adapt her land to the changing climatic conditions. Halimah al-Sawady, a farmer and breadwinner from Sumar town, works in the field on a daily basis to provide for four families, who depend entirely on the agricultural land for their sustenance. Over the past years, Halimah has been suffering because of water scarcity and climate change, where summers are increasingly hot and prolonged, while winters are short but fraught with heavy rains and floods. For three decades, Halimah has been working closely on the land. While she has had limited education, Halimah uses scientific facts and surfs through her phone

(44) Ibid 4, p.64

(45) Ibid 4, p.60 / «Water, Toilets, Hygiene... and Women's Empowerment.» WaterAid UK. March 2018. Accessed October 30, 2020. https://www.wateraid.org/uk/blog/water-toilets-hygiene-and-womens-empowerment.

(46) Ibid, 4/ «'Water Guards': New Book on Environmental Stresses in Iraq.» Planetary Security Initiative. July 28, 2020. Accessed October 30, 2020. https://www.planetarysecurityinitiative.org/news/water-guards-new-book-environmental-stresses-iraq.

for online knowledge on climate change, water pollution and agriculture, to innovate solutions that are directly inspired by her contact and intimate understanding of nature. Over the last years, droughts and scarcity of groundwater have forced Halimah to search for unconventional irrigation methods, so she adopted a drip irrigation system, which she received from the local agriculture department. Additionally, when she realized that modern agriculture practices, such as adding ripening agents, were a cause of disease spread, namely cancer, she decided to switch to organic fertilizers. Similarly, Halimah employs traditional practices, such as the use of garlic to treat aphids, which has the potential of destroying crops[47]. Moreover, women are well-positioned to bequeath traditional knowledge about nature, agricultural and water management practices to their children and the younger generations. Given their close proximity to their children, women can also play an integral role in embedding environmentally sustainable values into their children and raise awareness about the local impacts of water scarcity and climate change and the means to adapt to these new conditions across the community.

Box 04: Key Trends: Water and Gender

The following is a non-exhaustive list of the most common gender-water trends in the global south and rural communities.

Further research is required to better contextualize, assess and evaluate these trends in Iraqi society, while keeping in mind the intersectionality approach and other variables that interact or overlap with gender constructions.

1. Women are the prime collectors and transporters of water across rural communities. In Africa, 90 percent of the work of gathering water and wood, for the household and for food preparation, is conducted by women. On average, women and children travel 10-15 kilometers per day to collect water and fill up to 15 liters per trip[48].
2. Girls are more likely to skip school and dropout of education when their homes are located far away from a water source. This is due to their engagement in water collection activities, which could take up to 4-5 hours a day.
3. Inadequate access to safe, hygienic and private sanitation facilities is a source of physical discomfort and insecurity for millions of women across the world. Due to societal stigma and shaming, women often leave their homes before dawn or after nightfall to maintain privacy when using a toilet or open defecation site, while girls skip school when they are menstruating.
4. Women face a multitude of health problems due to their transport of water barrels and tanks or carrying pots over their heads. Health issues include fatigue, spinal and pelvic deformities and reproductive

(47) This field visit was conducted by Khaled Suleiman, an Iraqi writer and journalist. The full story is available on this link: https://daraj.com/en/42857/

(48) Facts about Women and Water. 2004. http://www.gender.cawater-info.net/what_is/facts_e.htm.

health problems, such as spontaneous abortions[49].

5. Women are most often responsible for the management of water resources on the household level and in irrigated and rain-fed farms. Accordingly, women have valuable knowledge about water resources, including quality and reliability, and water management techniques, such as irrigation methods, water storage, among others.

6. Women are often deprived of land ownership and access, which limits their access to water sources that are usually designated for the irrigation of the lands. This drives many female-headed households into poverty and deprives them of clean water. Across the globe, women own less than 2 percent of private land. Moreover, when women have the legal right to land, customs and traditions often become a barrier to their de-facto control over the land and natural resources[50].

7. Data shows that women are responsible for half of the world's food production (as opposed to cash crops) and in most developing countries, rural women produce between 60 to 80 percent of the food. Accordingly, in rural areas, food security is heavily dependent on women-led subsistence farming[51].

8. Indigenous and local communities are a valuable source for traditional knowledge and skills on nature-based water and land management. Women are often holders of 'water knowledge' and can provide solutions for effective water management in their settlement areas[52].

Box 05: Delving Deeper into Iraq's Water-Gender Dynamics: Suggested Research Questions

1. What are other gender constructions and norms that shape the experience of women and men in relation to water scarcity in Iraq?

2. What are the main structural and institutional barriers that reduce women's resilience capacity in the face of water-related threats?

3. How do water-related threats in their convergence with structural factors and megatrends exacerbate gender inequalities and vulnerabilities?

4. How does gender and its intersections with other variables shape the experiences of different women groups across Iraqi society? For example, how does the experience of urban women differ from rural women?

5. How can the management of water resources in Iraq become an entry point for peacebuilding, social cohesion and women empowerment?

6. What are the main coping mechanisms that make women and men better able to manage, withstand and recover from water-related threats? (the notion of resilience)

(49) Ibid 47

(50) Gender, Water and Sanitation: A Policy Brief. Issue brief. 2006. https://www.unwater.org/publications/gender-water-sanitation-policy-brief/.

(51) Ibid 49, p.04

(52) Ibid 49, p.08

5. Towards Inclusive and Sustainable Water Responses: recommendations

The exploratory analysis of water-gender dynamics in the Iraqi society - articulated in the previous section – reveals that 1) women and girls, particularly in rural areas, are impacted differently by water-related threats and are subjected to different forms of direct and structural violence, stresses and inequalities, including harassment, gender-based violence, school dropouts, mental and physical pressures as well as violence associated with inter-clan disputes, 2) women and men perform different roles and responsibilities to cope with water scarcity and associated threats. For instance, women are often the primary managers of water at the domestic level, and 3) women are key repositories of information, whose unique knowledge and skills provide an invaluable resource for devising innovative, inclusive and nature-based solutions. Accordingly, the disproportionate and differentiated impact of water-related threats on Iraqi women along with their unique position as positive agents and change-makers postulate the imperative for mainstreaming gender in water policymaking and programming, while transforming water-related threats into opportunities and entry points for women empowerment and gender equality. Inclusive and people-centered water policymaking and programming ensure that the needs and experiences of the full spectrum of the society are being accounted for and that interventions are designed in a well-targeted and sustainable manner. In achieving this, women inclusivity and meaningful participation – based on a structured and well-informed gender analysis – are guarantors for the sustainable management of water resources. Against this backdrop, the following section suggests recommendations on the local, national and regional levels to advance sustainable and inclusive water responses that place gender sensitivity at its core.

5.1. Local Level

Non-governmental organizations and local community groups, including women and community leaders, should be meaningfully represented in national women bodies and in the development of water-related policymaking and programming. Local organizations are often key informants of unique and localized knowledge about water-related threats, the roles and responsibilities of men and women in the management and distribution of water, communal coping mechanisms and locally-grown solutions for dealing with water scarcity. Additionally, local organizations and community groups are often mediators between local communities and local or national authorities. They can provide access and knowledge about spaces that usually lack government presence.

5.2. National Level

The removal of deeply-embedded structural and institutional barriers is imperative for strengthening women's resilience in the face of water-related threats and enabling their full and meaningful participation

in society on the political, economic and familial levels. The analysis of gender-water dynamics in Iraq inferred that structural barriers, such as the confinement of women to traditional gender roles, the increased exposure to sexual and gender-based violence, and the association of women with the notion of honor, among others, are often primary causes for increasing women's vulnerabilities and limiting their coping capacity. Accordingly, addressing the structural and institutional barriers, including discriminatory rules and regulations as well as the informal patriarchal construction of legislation, education and awareness-raising, is a first step towards creating an enabling environment for women to be able to manage water-related threats and participate meaningfully in devising solutions. Over the past decade, the Iraqi government has been trying to pass a first-of-its-kind legislation to deal with domestic violence. However, due to strong opposition from some political parties in the Iraqi parliament, the draft of the legislation has been rejected and must now undergo a process of revision and re-drafting. Additionally, there are discriminatory laws that justify or incite violence against women under the pretext of protecting the family's honor[53]. Furthermore, while Iraq's civil law grants women and men equal rights in land ownership, customary laws and traditions force women to forego their rightful share of land inheritance to their male family members, particularly to their brothers. This is to avoid the control of the family lands by the husbands of their female family members. The refusal of women to forego their land inheritance, or their resort to the justice system to retrieve their rightful property, might be a source of violent and deadly inter-clan conflicts[54].

The establishment of a strong national body for women affairs is a precondition for advancing gender equality and women rights in Iraq. Although the Iraqi government has its committee for women affairs, the committee has limited authority and means for implementing wide-scale plans and strategies. In 2004, a Ministry for Women Affairs was established without a ministerial portfolio, meaning it had no authoritative status, no allocated budget and very limited staff (the Minister and 13 employees). These conditions have made the Ministry's efforts rather symbolic and have disabled any meaningful engagement or implementation of women-related programs. In 2011, under the rule of Prime Minister Haider al-Abadi, the Ministry of Women Affairs was dissolved and there was a total absence of any mechanism for women affairs in the Iraqi government. In 2017, a new mechanism was established in the General Secretariat for the Council of Ministers, but again with very limited power and resources. Accordingly, there is a strong need to establish a national women body with a ministerial portfolio and allocated budget or/and an independent committee of gender experts, academics

(53) Expert Interview with Dr. Bushra Al-Obaidi, Head of Law Department at Al-Mustafa University College and Member of the Women's Consultative Group representing the Secretary-General of the United Nations in Iraq. Conducted on Saturday, 8 November 2020.

(54) Ibid.

and government representatives to address the rights of women in Iraq. International organizations, namely UN agencies, can play a critical role in financing such an institution and in building the capacities of relevant experts and government officials.

National women bodies and mechanisms are integral players for advancing the rights of women, shedding light on their differentiated needs and experiences, and devising gender-sensitive natural resource management interventions. Authoritative national women bodies and their associated women networks are strongly-positioned to generate and disseminate context-specific knowledge about the experiences and needs of women in relation to water scarcity, mainstream gender in natural resource management planning and programming, devise targeted and gender-sensitive interventions, and transform water-related threats into opportunities for women empowerment and gender equality, through creating local women committees for natural resource management, upskilling and building the capacities of local women on irrigation techniques, and providing of micro loans for the conduct of small businesses, among others.

Women's engagement in natural resource management decision-making and policy-making, as well as mainstreaming water and environmental considerations into women-related national policies and plans, are important steps for building synergy between gender and environment policy-making. Despite the growing evidence of the interconnectedness between gender and environmental issues, national policies and plans relating to these two are often put in place in silos, with little consideration for the synergy between them. For instance, a recent study by the Stockholm International Peace Research Institute (SIPRI), which examined 80 Women, Peace and Security (WPS) National Action Plans (NAPs), concluded that only 17 of these included language that specifically referred to climate change[55]. Likewise, Iraq's NAP (2014-2018) has only referred to the environment in relation to the removal of mines, without any reference to climate change, water scarcity or natural resource management[56]. By the same token, a study of 65 countries by the International Union for Conservation of Nature (IUCN) indicated that only 15 percent of those countries had a gender policy in their water-related ministries, and only 35 percent had integrated gender-specific considerations in water policies. Accordingly, Iraqi national plans for reinvigorating the agriculture sector and the reform of the irrigation system have to be informed by a gender analysis, through the inclusion of non-governmental organizations (NGOs), local communities and women groups in consultation processes. The same considerations apply to the Iraqi Ministry of Water Resources' new strategy for sustainable water management[57].

(55) Climate Change in Women, Peace and Security National Action Plans, Elizabeth Smith, Stockholm International Peace Research Institute, June 2020.

(56) Iraq National Action Plan for Implementation of United Nations Security Council Resolution 1325 Women, Peace and Security (20142018-). Available at: https://www.peacewomen.org/nap-iraq

(57) Ibid 6

Box 06: Taking Stock of Natural Resource Management for Women Empowerment: Main Lessons Learned from the Joint Project "Promoting Gender-Responsive Approaches to Natural Resource Management for Peace" in North Kordofan, Sudan.

The aforementioned project was the first pilot project established by the global joint Program on Women, Natural Resources and Peace, which aims to promote natural-resource based interventions as a tool for women's political and economic empowerment in peacebuilding contexts. This project was implemented jointly by the Sudan country offices of UNDP, UNEP and UN Women. The implementation of this project provides three important lessons on how natural resources can become an entry point for women's empowerment in post-conflict settings, as follows:

1. The engagement of women in natural resource governance, such as decision making over access to land, water rationalization, irrigation techniques, resource sharing and sustainable livelihood alternatives, provides critical opportunities for strengthening women's leadership skills in local conflict prevention and resolution, given the growing number of intra- and inter-communal tensions over scarce natural resources.

2. Sustainable natural resource management provides key opportunities for advancing women's economic empowerment, particularly when climate adaptation and natural resource programming provide livelihood alternatives for disadvantaged women, such as microloans, small-scale agriculture projects, the establishment of greenhouses, and capacity-building for modern agriculture techniques, among others. This does not only directly benefit women, but the impact of these interventions trickles down to the whole community, strengthening its well-being.

3. Natural resource management can advance social cohesion by bringing opposing women groups into cooperative dialogues and problem-solving platforms. In Sudan, "bringing women from sedentary and pastoralist communities together in cooperative farming schemes, and including pastoralist women in dialogue and decision-making structures has resulted in building trust and collaboration that can extend into other areas".

Source: United Nations Environment Program, UN Women and UNDP, 2019, Promoting Gender-Responsive Approaches to Natural Resource Management for Peace in North Kordofan, Sudan, postconflict.unep.ch/publications/Sudan_Gender_NRM2019.pdf.

5.3. Regional Level

Gender-inclusive water governance is a cornerstone for the sustainable and equitable sharing of transboundary water resources. As indicated in the first section of this paper, the resolution of Iraq's water problems is contingent upon the establishment of a legally-binding and comprehensive water management agreement that brings together

both upstream (Turkey, Iran and Syria) and downstream (Iraq) countries. Despite the growing recognition of the invaluable knowledge that they bring to the negotiations table, women remain highly underrepresented in water governance processes at the local, national and transboundary levels. Given women's differentiated roles and responsibilities in water management on the household and community levels, women are holders of context-specific and transgenerational knowledge and gatekeepers of water points and living environment, providing valuable inputs for the protection, sharing, and allocation of increasingly scarce and polluted water resources. Data from UNDP-SIWI Water Governance Facility (2017) elucidates that "involving women in water projects has made them more sustainable, more effective and also up to seven times more efficient"[58]. Accordingly, creating arrangements and modalities for the inclusion of women, including NGOs, local community groups and women leaders from across the wide array of women groups in Iraq, is a prerequisite for the design and development of an inclusive, sustainable and locally-owned water-sharing agreement.

(58) Fauconnier, Isabelle, Annemiek Jenniskens, and Page Perry. «Women as Change-makers in the Governance of Shared Waters.» 2018. doi:10.2305/iucn.ch.2018.22.en.

Box 07: Women and Water Diplomacy in the Nile (WIN) Network: Towards Promoting Effective Transboundary Dialogue

The engagement of various stakeholders across various societies in transboundary decision-making mechanisms ensures the integration of a wider scope of environmental and social considerations into water management agreements, and harnesses the diverse knowledge and skills that are at the disposal of different community groups. In the Nile Basin, Stockholm International Water Institute (SIWI) established a network of women water professionals across the 11 countries of the Nile Basin under the 'Women and Water Diplomacy in the Nile (WIN)' platform to build the capacities of women on leadership and negotiation and support their engagement in decision-making and peacebuilding in the Basin. Discussions across women water leaders have identified four challenges for the meaningful participation of women in transboundary water negotiations, as follows:

1. **Deeply-rooted cultural beliefs and norms** that naturally associate or delegate decision-making and diplomacy to men, while making it more difficult for women to have a recognized and well-heard voice in decision-making, even when they are present.

2. **Discriminatory and unequal education opportunities,** partly driven by gender constructions and stereotypes, prevent women from acquiring the knowledge and skills that would help them build competency and equally compete with their male counterparts.

3. **Persistent bias and discrimination in the workplace,** including job insecurity, comparatively lower pay levels, sexual harassment, and discrimination against women candidates during recruitment due to potential maternity leaves, among others, make it difficult for women to assert themselves in the workplace and fulfill leadership positions.

4. **Gaps in institutional and legal frameworks** undermine the advancement of gender equality in transboundary water governance. This includes 1) the absence of national laws or regulations, such as gender quotas, that ensure the meaningful inclusion of women in water decision-making, 2) treating water and gender issues as separate, 3) the lack of gender-disaggregated data and gender-informed water policies.

Source: Tapping Our Potential: Women's Water Leadership in the Nile Basin. Issue brief. July 2019. https://www.siwi.org/wp- content/uploads/2019/07/WomensWaterLeadershipInTheNileBasin_Digital_20190814SecondVersion1.pdf.

Regional mechanisms, such as the League of Arab States (LAS), the Arab Water Council (AWC) and the Arab Women Organization (AWO) can provide a much-needed platform for generating and disseminating knowledge and policy recommendations on gender-sensitive transboundary water management. Despite Iran and Turkey not being members of the aforementioned regional organizations, these organizations are critical regional knowledge hubs that can provide best practices and lessons learned on gender inclusivity in water policy making and programming on the regional level, and can bridge the silos between environment and gender in regional plans and strategies.

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III

Streaming Tears of The Middle East

How to Clean The Euphrates and Tigris Basins?

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Preface

As an international and interdisciplinary team of researchers, we aim to share good practices on how rivers can be cleaned, particularly in the Euphrates and Tigris basin.

At first readers may directly think of lessons learned on technological advancements in treating polluted water. However, having learned from less successful experiences, we are convinced that knowledge transfer from one basin to the other without considering the socio-economic, cultural, environmental, and political compatibility of both regions may result in higher risks of failure.

Technology is only one part of the solution, which should comprise other components. Therefore, we do not restrict this paper to the lessons learned from existing technologies to clean Euphrates and Tigris, but rather we focus on the necessary prerequisites and institutional arrangements for a successful technology transfer. We trust that this knowledge would support the practitioners in choosing and investing in the proper technologies that fill their demand, considering the facts that:

- The Euphrates and Tigris basin is a transboundary basin, shared among six countries.
- The source of water pollution and its effects are disentangled.
- Iraq is located in the downstream region of the Euphrates and Tigris basin.

Discussing the river's share in Iraq means dealing with pollution whose source may be in an upstream country. Therefore, it is challenging to devote efforts for a clean Euphrates and Tigris at the Iraq level without considering this basin's transboundary context. At the same time, we are interested in lessons learned practices applicable at the Iraq

level, even if the transboundary collaboration is not yet in force. Indeed, to set up a partnership at the transboundary level, each riparian country should provide the required infrastructure and legal and institutional arrangements at the country level. Therefore, the lessons learned addressed in this document are applicable to both levels, i.e., country and transboundary basin. In fact, Iraq could play a key role in forming such a partnership by presenting a showcase of the region's best practices.

Moreover, ensuring a clean Euphrates and Tigris is mostly about avoiding pollutants' sources from entering the rivers. As many sectors may be identified as sources of pollution, e.g., industries, farmers, consumers, and other stakeholders, they should be involved in the effort to clean the river, supported of course by legislation, monitoring, and financial mechanisms. Integrated Water Resources Management, to a good extent, provides the required frameworks for this purpose.

Based on the above-mentioned arguments, we have selected the example of the Rhine basin for knowledge transfer of best practices that can lead the way forward to clean the Euphrates and Tigris. The Rhine basin is a successful and inspiring case for transboundary cooperation and water resources management practices.

We are fully aware that transferring knowledge from the Rhine basin to the Euphrates and Tigris basin is ambitious. Though the pollution situation in the current Euphrates and Tigris basin is comparable to the Rhine basin in the past, the two regions experience very different social, economic, and political conditions. Those differences may influence the degree of the feasibility, applicability, and success of the lessons learned. Still, we believe that the lessons learned in this work could serve as an inspiration for stakeholders in Iraq and the Euphrates and Tigris basin. This paper presents a collection of different frameworks, infrastructures, and actions implemented to clean the Rhine basin.

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Summary

The Euphrates and Tigris basin consists of all the rivers, canals, and streams that drain to the Euphrates and Tigris rivers, involving tributaries that flow from neighboring countries and join in Iraq. Water in the Euphrates and Tigris basin is highly polluted, especially in Iraq - the most downstream country. Demographic pressure, hydro-engineering development, and the impacts of agriculture and industrial development in the riparian countries are counted as the main reasons.

Improving water quality in the basin is a complex challenge controlled by many factors of physical, legal, and political nature. As it is shared between Turkey, Syria, Iraq, Iran, Jordan, and Saudi Arabia, the transboundary status of this basin adds more complexity to the challenge. The riparian countries are highly dependent on the Euphrates and Tigris; however, transboundary cooperation between the countries sharing the Euphrates and Tigris basin is relatively low. Preserving good water quality is imperative to ensuring sustainable development in these countries.

During the last decades, different approaches have been developed and implemented in many transboundary basins worldwide to conserve and enhance the water quality of rivers. Examples of best practices include, but are not limited to, the Rhine and Danube river basins.

Transferring knowledge from such basins, with regards to the prerequisites and best practices for cleaning rivers and preserving good water quality under transboundary conditions, is crucial. However, to ensure the efficiency and effectiveness of the lessons learned from other transboundary basins, they should be sifted through, and their application has to be adapted according to the specific conditions in the Euphrates and Tigris basin.

In the current study, literature review and expert interview approaches are used to produce evidence-based knowledge that is understandable and applicable to a broader audience. This paper aims to support policy-makers, public authorities, environmental Non-governmental Organizations (NGOs), International NGOs (INGOs), and environmental activists to better understand the water quality status in the basin, the operational conditions, and potential pathways to enhance water quality and restore a clean Euphrates and Tigris basin.

The paper describes the status of water quality in the basin based on a detailed literature review. Moreover, a framework of the controlling factors in preserving clean rivers is created and a list of best practices is compiled. The case study results are fine-tuned by interviewing local experts concerning the socio-economic, political, and ecological conditions of the Euphrates and Tigris basin.

1. Along The Euphrates and Tigris

1.1. Geographic Setting

The Euphrates and Tigris river basin is a transboundary basin shared mainly between Iraq (45.8%), Turkey (20%), Iran (18.9%), and Syria (13.1%), with tiny portions in Jordan and Saudi Arabia (McCracken and Wolf, 2019). Both rivers originate in Turkey. While the Euphrates rises near Mount Ararat at an elevation of around 4500 m above sea level (a.s.l) near Lake Van, the Tigris river's leading source is Hazar Lake, which is located at an elevation of 1150 m in the southeastern region of Turkey. Most of their streams go through the highlands of eastern Anatolia in Turkey and the valleys of the Syrian and Iraqi plateaus before entering the arid plain of Mesopotamia and joining each other near Qarmat Ali, about 160 km above the head of the Persian Gulf (also known as Arabian Gulf), forming the Shatt al-Arab river (Issa et al. 2014). However, upstream within Iraq, both rivers are connected through several human-made canals. Figure 1 displays the geographical location of the basin with its riparian countries. This basin's water is crucial to sustaining human lives and the socio-economic development in the riparian countries, especially for Iraq, Turkey, Iran, and Syria - the countries that heavily rely on its water.

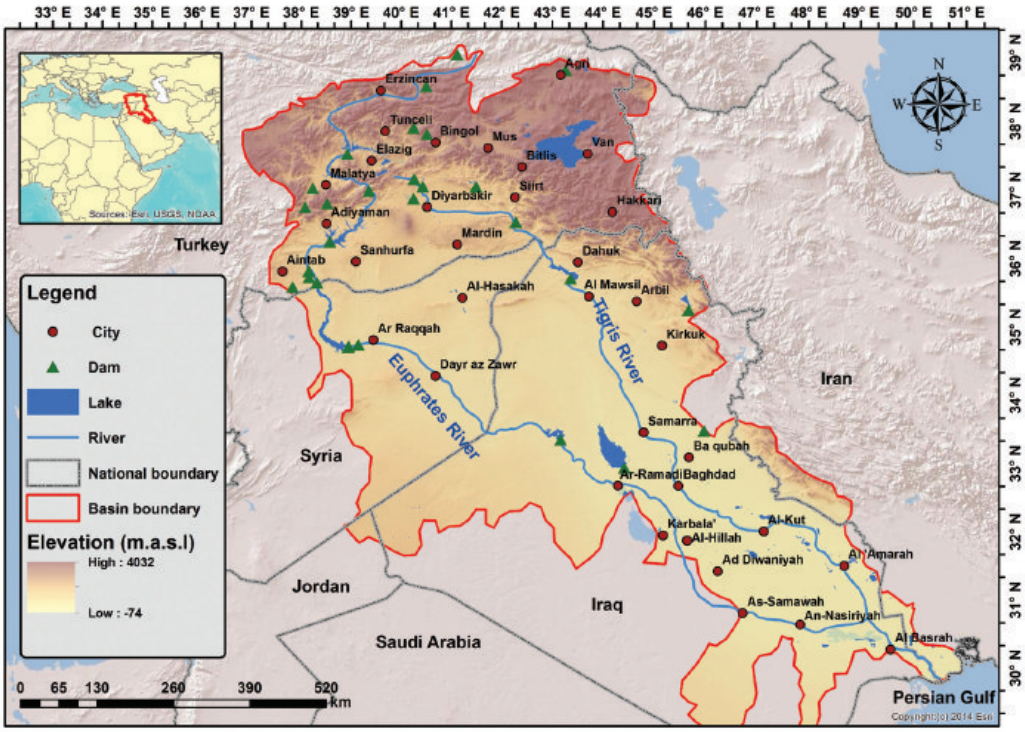

Figure 1. Location map of the Euphrates and Tigris basin with the riparian countries.

Data sources: DEM: SRTM Tile Grabber (https://dwtkns.com/srtm/); River network: WorldMap (https://worldmap.harvard.edu/maps/8246); Major cities: ArcGIS Hum (https://hub.arcgis.com/); Major dams: Global forest watch.org (https://data.globalforestwatch.org/).

1.2. Current Status of Surface Water in The Basin

The Euphrates-Tigris river basin is characterized by large temporal and spatial variations in rainfall with an average of 335 mm/year (New et al. 2002). Water resources in the basin consist of surface water mainly from the Euphrates and Tigris rivers and their tributaries, and from limited groundwater resources. The region currently faces water shortage problems due to the rapid growth and development in the region, which makes it challenging to meet the increasing demand and creates competition and tension between the riparian countries over the available water resources. Figure 2 shows the percentage of water withdrawals by each of the riparian countries. Issa et al. (2014) showed that Iraq receives 45.4 and 25.52 billion cubic meters (BCM) of water annually from Euphrates and Tigris, respectively. Those figures are expected to decrease down to 9.16 and 8.45 BCM in 2025 on average (UN Iraq, 2013), mainly due to the expected effects of climate change and the upstream countries' storage projects.

Box 1: Water - the most basic resource

Water is a vital resource to sustain life and socio-economic development on Earth. Look around you! Nothing on the planet can survive without water. Some organisms, such as certain types of bacteria, can live without oxygen, but they cannot survive without water. Every living thing, from humans and animals to plants and bacteria, needs water to flourish. Would you be surprised if you knew that the human body is composed of a large amount of water? On average, an adult's body consists of 60-65 %

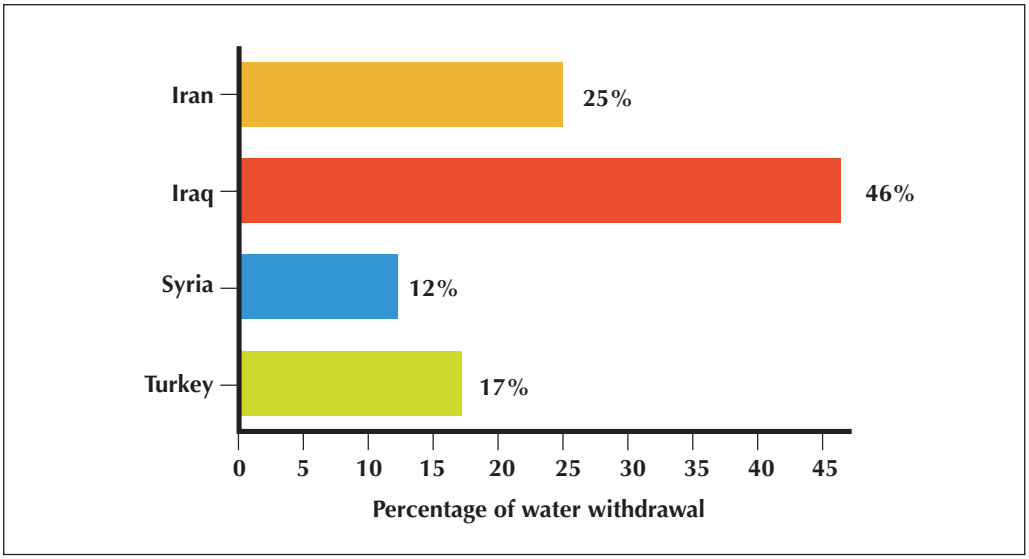

Figure 2. Total water withdrawals by the different countries in the Euphrates and Tigris basin (in percentage of the total withdrawal) based on data from TWAP (http://twap-rivers.org/#global-basins)

water by weight. Humans need water to drink, irrigate crops, grow livestock, generate energy, and produce goods in factories. Water has played an essential role in human history. A closer look at the ancient civilizations' distribution map reveals that these civilizations are centered mostly along rivers and nearby water resources. Examples of such ancient civilizations include the Akkadian, Sumerian, and Babylonia along the Euphrates and Tigris rivers, and the Pharaonic, Nubia, and Aksum civilizations along the Nile. Water has played a key role in the fall of many old civilizations, including the Akkadian Empire in Mesopotamia and the Old Kingdom in Egypt, which had collapsed due to severe drought that extended over a long period of time (Sheffield and Wood 2011).

All of the water in the Euphrates river comes from outside the Iraqi border, while its tributaries inside Iraq supply around 60% of the Tigris discharge whereas the rest comes from Turkey. Groundwater aquifers in Iraq consist of extensive alluvial deposits of Euphrates and Tigris, and have limited potential because of the low water quality that results from over-abstraction.

Artificial storage to manage the basin's surface water resources is necessary due to environmental conditions. Flow rates in the Euphrates and Tigris rivers fluctuate considerably between seasons and years, making water use for irrigation and other purposes difficult without proper planning and management. Water storage plays an important role, mostly in overcoming spatial and temporal variation of water availability. That is why around 32 major dams and several diversion canals have been built in the basin during the last decades by the riparian countries. Figure 3 shows the percentages of water withdrawals for different purposes in the main countries in the basin.

By constructing the Al Hindiya and Ramadi-Habbaniya dams on the Euphrates in 1914 and 1951, respectively, Iraq was the first country in the basin to construct engineering projects in both rivers. The primary purpose of these dams was to control floods and use the stored water for irrigation purposes. More dams and irrigation canals were then constructed to continue managing the water of the Euphrates and Tigris rivers and their main tributaries for irrigation and other uses, with a total on-river storage capacity of 115.9 BCM (FAO, 2009; Issa et al., 2014).

As demonstrated in figure 3, most of the water in the basin is allocated for irrigation purposes. However, in all riparian countries, the agriculture sector's contribution to the Gross Domestic Product (GDP) is relatively small (Table 1). Yet, it should be considered that the agriculture sector in the whole region mainly consists of small farm households and subsistence agriculture. Moreover, though the agriculture sector's GDP share is low, between 10% to 20% of the total employment in the riparian

countries is in agriculture, which is the main water-consuming sector in the basin. For instance, although around 46% of the total water withdrawals in the Euphrates and Tigris basin are taking place in Iraq and 87.3% of the water is used for irrigation purposes, the agriculture sector's contribution to the GDP of Iraq is only 2%.

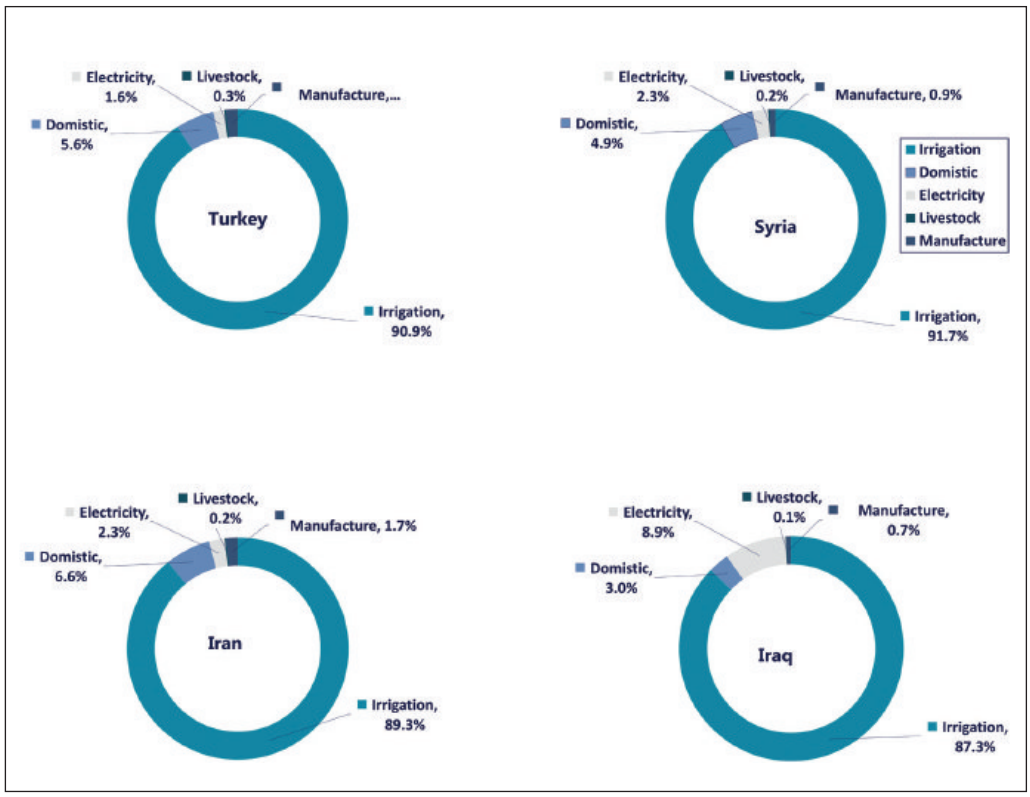

Figure 3. Dependency of different sectors on water availability.

Source: TWAP (http://twap-rivers.org/#global-basins)

Country	GDP (Gross Domestic product) (Billion US$)	GDP per capita (current US$)	Agriculture, forestry, and fishing, value-added (% of GDP)	Employment in agriculture (% of total employment)
Iran	445.35 (2017)	5520.31 (2017)	9.5 (2017)	17.816 (2020)
Iraq	234.09 (2019)	5955.11 (2019)	2 (2019)	17.788 (2020)
Syria	40.41(2007)	2032.62 (2007)	19.54 (2007)	10.494 (2020)
Turkey	754.41 (2019)	9042.49 (2019)	6.43 (2019)	18.02 (2020)

Table 1. The economic status of the Euphrates and Tigris riparian countries (Saudi Arabia and Jordan are not included because of their small share of the area).

Source: (World Bank, 2020)

Box 2: Transboundary basins

There are around 310 transboundary basins (McCracken and Wolf 2019) around the world shared between two or more countries, including the Euphrates and Tigris, Nile, and Rhine basins. These basins are significant because they accommodate a large fraction of the world population. What makes these types of basins challenging for water resources management is that the political boundaries do not confine water, and a river that originates in one country might cross the border and flow to a neighboring country. Managing water resources in such transboundary basins is more challenging as each riparian country might have its own development plans and water use policies. This can cause severe disputes between these countries, especially if there is no cooperation framework or treaty to guide and govern water sharing between the riparian countries. Examples of such conflicted river basins in the Middle East region include the Euphrates and Tigris, and the Nile. For example, Iraq cannot manage the Euphrates and Tigris without communicating and cooperating with Turkey and Syria - the upstream countries. Interventions at the upstream parts of the transboundary basins would affect the downstream regions. Usually, these riparian countries have different and perhaps conflicting development plans, and any intervention in the upstream countries might have consequences on water quantity and/or quality in the downstream countries. Without cooperation between the riparian countries that share transboundary basins, proper water management in such basins might be a complex challenge.

1.3. Water Sector in Iraq

1.3.1 Main stakeholders in the Iraqi water sector

The Ministry of Water Resources in Iraq is the main responsible body for water resources management. It takes measures to overcome all challenges related to water resources in the country by having well-defined strategic water management plans, including cooperation and coordination with other riparian countries, research and development, improving agriculture and sanitation sectors, and conducting public awareness programs. Other stakeholders involved in the water sector are the water users (e.g., environment, municipalities, agriculture, and industry), the Ministry of Health and Environment, the inter-ministerial National Water Council, the private sector, and NGOs involved in water and sanitation work.

1.3.2 Main water users in Iraq

According to recent estimates by the Ministry of Water Resources in Iraq, the vast majority of water in Iraq (more than 85% of the total withdrawal) is used for agriculture (Fig. 3). Municipal and

industrial water needs, as well as those of the Mesopotamian Marshlands, come in the second place, although the actual water sent to the marshes varies from year to year. In third place (at 6%) is water sent to the Gulf via the Shatt al-Arab river as an environmental flow requirement, and then finally comes water use for fish farms and livestock. The Iraqi Energy Institute (IEI) in 2018 reported the current water supply to urban areas to be around 73% coverage. In rural areas, this falls to 40 - 45%.

Box 3: Water is not just water!

Earth is composed of several distinct but continuously interacting systems. These systems include, for instance, the hydrosphere (all water on Earth, including rivers, lakes, and oceans) and the biosphere (all living organisms, including humans, animals, and plants). Water is a connector resource that links many of the components of Earth's systems. Therefore, for the sound management of water resources, one should not overlook such crucial interlinkages. For example, humans (bio-sphere) are severely affecting water resources (hydrosphere), not only in terms of water quantity but also in quality. Currently, there is a wide agreement on the importance of holistic (integrated) approaches for water management, the so-called «Integrated Water Resources Management (IWRM).» The main objective of the IWRM concept is to manage all the available water and land resources in a coordinated and integrated way and an equitable manner, to maximize their economic return and social welfare, taking into consideration the sustainability of those resources for the future generation. It looks at water resources beyond the political borders between riparian countries and promotes managing the basin's resources as one system. Water management involves several disciplines, including, but not limited to, science, water, social sciences, economy and project management. These disciplines should be involved in water management activities to ensure the effectiveness of the proposed solutions.

2. Problem Dimensions: why is the basin's water quality so bad?

Iraq is facing many challenges in managing its water resources, partially due to external reasons, but mainly because of the mismanagement of internal water resources. This, consequently, has affected water services, which in some cities are limited to a few hours per day, and where the water is often of poor quality and, in many cases, undrinkable (Al-Ansari, 2013). These challenges are summarized in figure 4. Among them, the two overarching challenges that affect water quality in the basin are the lack of adoption and implementation of Integrated Water Resources Management (IWRM) principles, and the poor transboundary cooperation between the riparian countries.

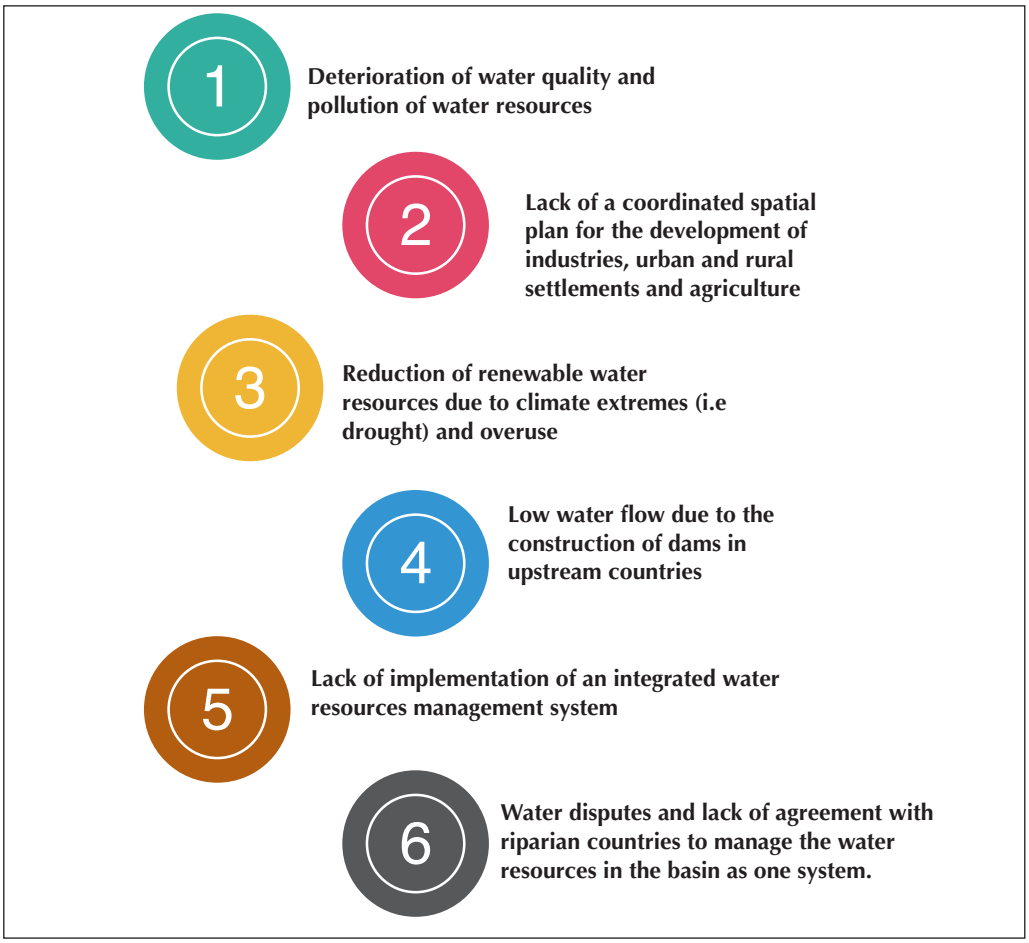

Figure 4. Main challenges in managing water resources in Iraq.

2.1. Lack of an Integrated Water Resources Management (IWRM) in The Euphrates and Tigris basin

The riparian countries of the Euphrates and Tigris basin need to establish an IWRM plan and implement the concept to maximize the benefits for the whole system and use the resources efficiently and sustainably. This includes cross-sectoral management of different economic sectors within and between the riparian countries, by involving all the relevant stakeholders in the decision-making process. This sounds easy to implement; however, the IWRM concept was not successful in the basin, despite the attempts over many years to agree on an integrated solution and management for the water resources. This could be related, in part, to some geo-political obstacles (e.g., political instability) as well as social and demographic differences that must be tackled, first by the riparian countries if they want to manage the available limited water resources in the basin according to international legal principles, and second by following proper planning grounded on science-based knowledge.

2.2. The Euphrates and Tigris Transboundary Water Management

Turkey, Syria, and Iraq rely on the Euphrates-Tigris river system to ensure their water, energy, and food securities. Syria and Iraq are severely dependent on Turkey - the upstream basin riparian country – and its willingness to share its surface water supply (Future Directions International, 2016). Construction of dams in the upstream part of the basin has decreased the flow of both rivers with an impact on the water quality, especially in Iraq followed by Syria (Al-Ansari et al. 2018).

International cooperation is crucial for agreeing on a water allocation mechanism and on water resources and water pollution management strategies that avoid the deterioration of water quality. Water treaties play an essential role in the peaceful resolution of water-related conflicts, including the water pollution from upstream and its consequences for the downstream. In total, seven treaties and agreements exist among the basin riparian countries. However, the treaties and agreements stay weak in improving the situation as long as workable monitoring provisions, enforcement mechanisms, and specific water allocation provisions addressing variations in water flow and changing needs are not in place.

Moreover, the mode of negotiation among the Euphrates and Tigris riparian countries defines the success of those agreements. One River Basin Organization and commission (ORB) exists in the basin. The ORB ensures joint decisions of its member states on the shared resource (Schmeier, 2013). However, the Joint Technical Committee on Regional Waters (JTCW) for the Euphrates and Tigris rivers failed to come to any consensus decision on the principles of water resources management between Turkey, Syria, and Iraq; it eventually ceased to exist (Islar and Ramasar, 2009).

Trust-building among riparian countries is a common good necessary to achieve a united Euphrates and Tigris. In particular, sharing data and information are of the utmost importance. Considering the spatially disentangled source of pollution and its effects, Widmer (2019) argues that interconnected and multilevel collaborative arrangements that support institutional capacity building are the best approaches for addressing such a social-ecological mismatch.

3. Water Quality in The Euphrates-Tigris

With its geo-political position as the most downstream country within the Euphrates and Tigris, Iraq is experiencing severe water pollution. According to different studies, the quality of water in these rivers and their tributaries near the border with Syria and Turkey is relatively good (FAO, 2009), including the water originating from tributaries within Iraq. Expansion of irrigation areas in upstream countries and the rivers' return flow is the main cause of the water pollution

that enters Iraq. Water quality degrades while moving downstream, especially in urban areas near rivers like Baghdad and Al Basra. This could be associated with many factors, such as the rapid increase in population growth rate, which reached 2.25 % according to the World Bank Statistics (2011), but also the degradation of water-related infrastructure and sewage systems, as well as direct pollution caused by industrial and domestic sectors - which are, in most cases, discharging their wastewater directly into the river without prior treatment.

According to a study done by Al-Ansari (2013), more than 500,000 m^3 of raw sewage are discharged into rivers in Iraq every day. The quality of water in both rivers is further degraded by return flows from irrigation activities in Iraq. Furthermore, the Euphrates and Tigris rivers' declining water flow in Iraq due to the upstream developments also contributes to the problem.

The high rate of evaporation, sharp climatic variations, repeated frequency of drought events, accumulation of salts and sediments, poor drainage, and low

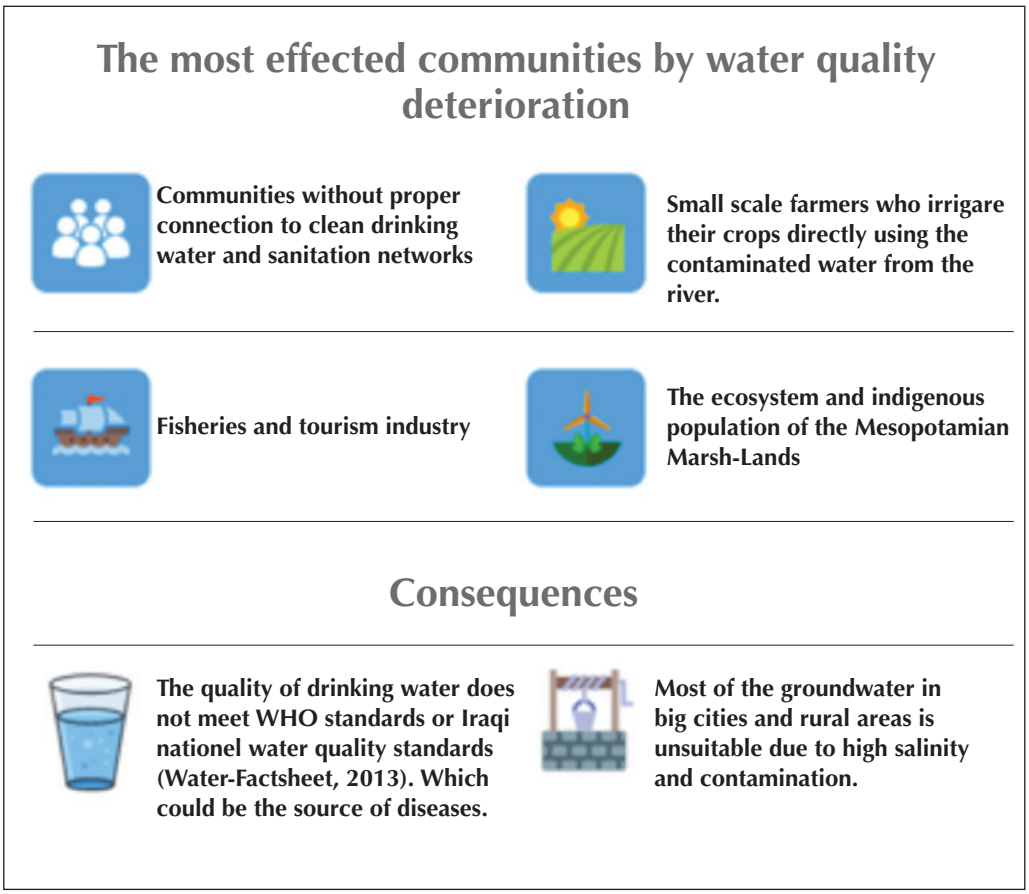

Figure 5. Consequences of water quality deterioration on the affected communities

soil quality in the lower reaches of the Euphrates and Tigris, are all natural causes that exacerbate the damaging effects of human pollution. The deterioration of water quality and the heavy pollution from many sources, in addition to the rapid increase in water salinity, are becoming serious threats to Iraq, imposing urgent challenges that need to be solved. This is amplified by the lack of adequate water monitoring networks, making it difficult to understand the extent of the problem and to subsequently take measures to address water quality and pollution. Below, figure 5 shows the communities affected by the problems mentioned above, as well as the consequences.

Box 4: Why are we currently concerned about water?

Firstly, we should know that freshwater represents a small fraction of the total amount of Earth's water, and most of this small fraction is found in glaciers, ice and groundwater, which are difficult to obtain. Therefore, the remaining surface and more accessible freshwater on Earth are quite limited and unevenly distributed worldwide. While some regions enjoy relatively abundant quantities of it, others face extreme scarcity. For instance, European countries enjoy abundant amounts of surface and groundwater resources and receive large amounts of rainfall annually. Simultaneously, regions such as the African Sahel - one of the driest areas in the world - have limited surface water sources and receive negligible rainfall quantities. The quantity of water is a problem of concern, but preserving its good quality represents a significant challenge. Worldwide, water can be found in various qualities, ranging from clean and drinkable water to highly polluted. Because of human activities and other natural phenomena (e.g. seawater intrusion into groundwater), global freshwater has become a scarce resource. Sources of water pollution can be from industry, agriculture, mining, and untreated sewage. An increase in the global population and increased demand for water for socio-economic development, such as food production, is putting this vital resource under tremendous pressure.

3.1. Assessing Sustainable Development Goal (SDG) Target 6.6.1

Indicator 6.6.1 tracks change in the extent of water-related ecosystems over time, and includes data on the spatial extent of water-related ecosystems and the quantity and quality of water within them.

Water-related ecosystems are those dominated by freshwater or brackish water, and include vegetated wetlands (swamps, swamp frosts, marshes, paddies, peatlands, and mangroves), open water (rivers and estuaries, lakes and reservoirs), and groundwater aquifers (Dickens, et al., 2017; UN-Water, 2020).

Iraq is characterized as one of the

lowest-ranked countries in the world based on the United Nations (UN) ranking when it comes to meeting the SDG indicator 6.6.1, with a 15% negative change in the extent of its water-related ecosystem compared to the historical reference. This situation is also reflected in the Euphrates and Tigris river basin, as all downstream countries have a negative change in their water-related ecosystem, while Turkey's performance in achieving target 6.6.1 is relatively good, not only compared to other countries in the basin, but also in the world (Fig. 6). Assessing this indicator here points to the fact that the water-related ecosystem in the basin and especially in Iraq is facing a big problem, and that it is being used in an unsustainable way, which will increase the deterioration of the quality of these resources and their availability for future generations.

Box 5: The United Nations Sustainable Development Goals (SDGs)

The 17 Sustainable Development Goals (SDGs) of the 2030 agenda call for action by all countries to promote prosperity and ensure a sustainable future for all, while protecting the planet (UN.org, n.d). They became effective on the 1st of January 2016 and «address the global challenges, including poverty, inequality, climate change, environmental degradation, peace, and justice» (UN.org, n.d). Due to the significance of access to safe drinking water and adequate sanitation and hygiene for everyone, this has been highlighted with a particular goal (Goal #6), which ensures sustainable management and access to water and sanitation for all. It has six main targets, which should be monitored in an integrated way.

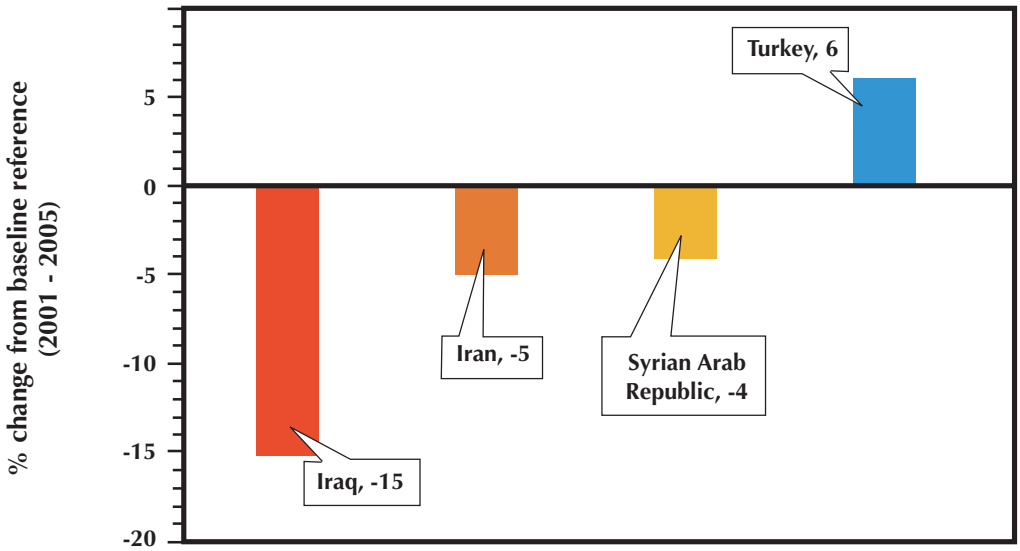

Figure 6. Status in different countries (or areas) in the basin on SDG Indicator 6.6.1 Change in the extent of water-related ecosystems over time (%) (2016) compared to the baseline reference 20012005-.

Data source: UN-Water (2020)

4. Is There Hope for a Clean Euphrates and Tigris?

4.1. Role of Knowledge Transfer

On the global level, pressure on water resources necessitates the adoption of effective policies and the development of modern technologies in order to efficiently address the great challenge that faces humanity today. Many transboundary basins have succeeded in restoring good water quality (e.g., the Rhine basin). As many countries and river basins are quite advanced in developing and adopting such modern technologies and policies, knowledge transfer is central; countries can learn from each other's experiences.

Many of the challenges related to the deterioration of water quality and pollution could be addressed through lessons learned from successful case studies. The Rhine transboundary basin, located in Europe and shared between nine countries, will be studied to facilitate knowledge transfer to the Euphrates and Tigris cases. This will help answer questions such as how

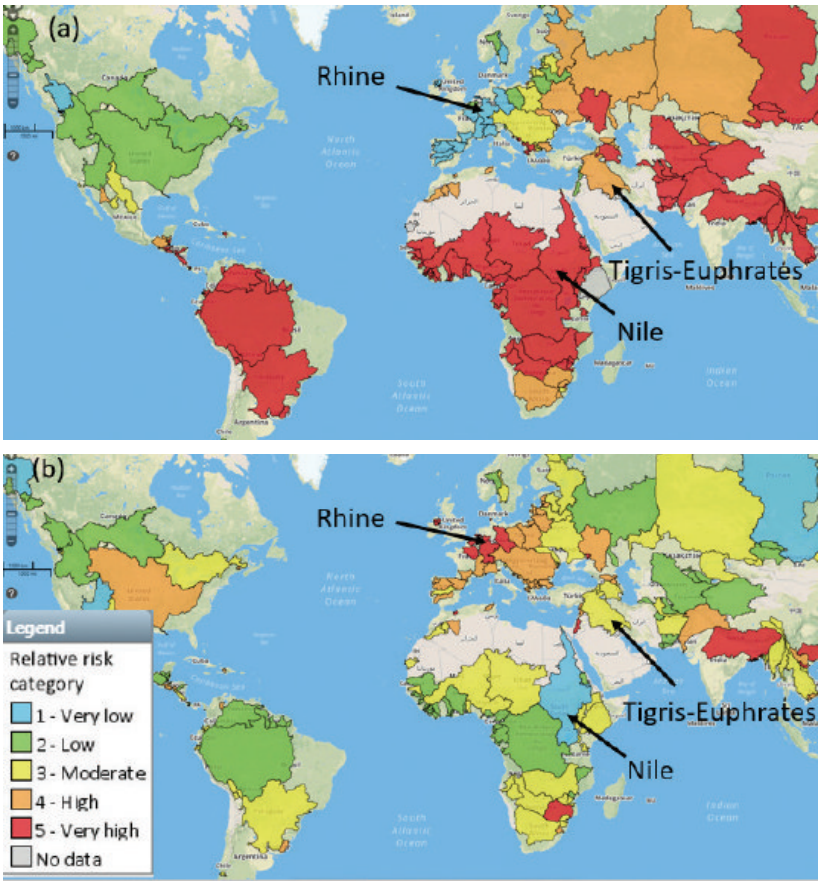

Figure 7. Comparison of Euphrates and Tigris, the Rhine and the Nile in terms of a) wastewater and b) nutrients pollution.

Source: TWAP (http://twap-rivers.org/#global-basins)

Euphrates and Tigris can be cleaned, and the prerequisites and actions that need to be taken to do so.

Knowledge transfer can facilitate the adoption of the most effective approaches without the need for trial and error (Vinke-de Kruijf et al., 2013) - an approach that can result in costly solutions in time, effort, and financial resources.

Transferring knowledge from other basins is an excellent practice to plan and implement solutions that aim to enhance and maintain water quality in rivers. However, not all basins are the same and the challenges faced in each case could differ depending on several factors, including socio-economic, political, and financial. According to the Transboundary Waters Assessment Program (UNEP-DHI and UNEP, 2016), all the transboundary basins located in the Middle East and North Africa (MENA) region, including the Nile and the Jordan basins, are displaying high-risk levels regarding water quality, especially regarding wastewater pollution (Fig. 7). Moreover, some of these transboundary basins are projected - like the Euphrates and Tigris - to be hotspots for future transboundary conflicts (Farinosi et al., 2018). Despite the local context and setting (e.g., socio-economy), other basins (e.g., the Rhine) could be a good model of how highly polluted rivers can be turned into rivers with high water quality. They represent good examples of the adoption and implementation of IWRM concepts and provide evidence-based knowledge on how effective transboundary cooperation has contributed to the success in improving water quality.

4.2. Think Global and Act Local

Management of water resources differs from region to region according to the geographic setting. Therefore, knowledge transfer between, for example, developed and developing countries, is challenging and needs to take special care, particularly with regards to the cultural and political differences. Best practices on water management, especially water quality, should consider these relative differences, and the solutions should be customized and adapted according to the local circumstances (Campbell and Barlow, 2017). The lessons learned from successful river cleaning cases could be adapted to the Euphrates and Tigris with particular attention to the parameters of «source of pollution, type of pollution, funding limitations, transboundary conflicts, water Governance, law and legislation, social and cultural concerns.» Adaptation of the knowledge from other basins to the Euphrates and Tigris basin's local specifications would facilitate proposing tailor-made solutions.

Table 2 provides the knowledge transfer framework of different factors influencing the applicability of lessons learned (limitations and potentials) from the Rhine basin to the Euphrates and Tigris. The findings lead to the lessons learned, which are presented in section 6.

Factor	Rhine (1986) *	Rhine (today)	Euphrates and Tigris (today)
Area (km2) (UNEP-DHI and UNEP, 2016)	164,000	164,000	868,000
Population (million inhabitant) (UNEP-DHI and UNEP, 2016)	-	48,831	65.437
Number of riparian countries	-	9: Austria, Belgium, France, Germany, Italy, Liechtenstein, Luxembourg, Netherlands, Switzerland	6: Iran, Iraq, Jordan, Saudi Arabia, Syria, Turkey
Economic status (Gross Domestic Product, GDP in current USD) (World Bank, 2020) (UNEP-DHI and UNEP, 2016)	Austria: 99.04 Belgium: 120.01 France: 771.47 Germany: 1046.26 Liechtenstein: 0.78 Luxembourg: 6.92	49,543.47 USD per capita	5,879.19 USD per capita
River discharge (km3/ year) (UNEP-DHI and UNEP, 2016)	-	74.97	147,67
Type of pollution	Physical, chemical (including heavy metals such as cadmium, mercury, lead, and zink), and biological pollution	Micro-plastic (Mani, et al., 2016)	Physical, chemical (heavy metals, salinity) and biological pollution (Al-Bayatti et al., 2012; Mansour and Said, 2018)
Source of pollution	Multiple sources: domestic, agriculture, and industry	Multiple sources: wastewater treatment plants, tributaries, and weir (Mani et al., 2016)	Multiple sources: domestic, agriculture, industry, construction of dams upstream, and remnants of war (Al-Layla and Al-Rawi, 1988; Thana, et. al., 2009; Varol et. al., 2010; Al-Aansari and Knutsson, 2011; Al-Ansari, et. al., 2018)
Pollution intensity	Highly polluted	Good quality in general. However, highly polluted with micro-plastic	Highly polluted
Transboundary agreements aimed exclusively at reducing river pollution	Available	Available	Not available
Information sharing	Exist, but needed to be strengthened	Transparent information sharing mechanisms	Inadequate
Basin-wide early warning system and alert plan	Available	Available	Unavailable

Table 2. A knowledge transfer framework of different factors influencing the applicability of lessons learned from the Rhine Basin for the Euphrates and Tigris

*The reference year 1986 was chosen based on the fact that the riparian countries started to take action after the fire in the pharmaceutical company Sandoz in the Swiss city of Basel, which polluted the Rhine.

**Italy, Netherlands, Saudi Arabia, and Jordan are not included because of their small areas within the respective basins.

The Euphrates and Tigris basin is 5.3 times bigger than the Rhine basin, and the river discharge is 2 times higher. This fact results in a potentially more complicated IWRM implementation process in the Euphrates and Tigris basin compared to the Rhine, especially considering that from where and in what amount pollutants enter the rivers correlate with the size of the basin and the activities that take place. The Euphrates' and Tigris' current water pollution status is comparable to the Rhine in the old days; physical-chemical and biological pollution exists. The Rhine of today exhibits huge improvements, which offers hope for Euphrates and Tigris.

The number of riparian countries involved in transboundary management for the Euphrates and Tigris (6 countries) is less than that of the Rhine (9 countries). Therefore, a less complicated water transboundary setup can be expected. However, due to the region's geo-political situation, and its past and ongoing wars, water has turned into a national security issue in the riparian countries, and has a strategic value. This results in a very specific transboundary context, limiting the applicability of the lessons learned and knowledge transfer from other basins.

The lessons learned derived from the experience of the Rhine, and that are aligned with the knowledge transfer framework, are discussed with stakeholders, including experts from academia and civil society, as well as practitioners and environmental activists.

5. Requirements to Reach a Clean Euphrates and Tigris

Preventing pollutants from entering the river system is a crucial step toward a clean river. This includes monitoring who is polluting the river, the intensity of pollution, and pollutant types. To tackle this, countries prioritize the different sources and impacts of pollution and then target actions to reduce those. Stopping pollution sources is a prerequisite for improving water quality. Generally, point source pollution is easier to reduce and manage than diffuse sources. Strategies that can be employed include:

- Treating wastewater before it is discharged to river systems.
- Managing and minimizing the use of fertilizers in the agriculture sector.
- Decentralized water treatment approaches.

For polluted rivers such as the Euphrates and Tigris, some widely implemented methods and techniques that can be used to clean a river include chemical and mineral cleaning and nature-based solutions. However, successful implementation of such methods at the basin level requires appropriate conditions and infrastructures, as well as integrated approaches, including public participation and government efforts combined. Moreover, such strategies and techniques cannot be successful without transboundary cooperation frameworks with the riparian countries.

Box 6: Bioremediation

Bioremediation is a technology for removing pollutants from the environment using living micro-organisms to degrade environmental pollutants or prevent pollution. It aims to restore the original natural surroundings and prevent further pollution (Sasikumar et al, 2003). This degradation can be optimized through practices including cultivation and the addition of nutrients. The micro-organisms, plants, microbial or plant enzymes are used in this process to detoxify contaminants in the soil and other environments (Gouma et al, 2014). The relatively low costs of this method make it especially interesting for developing countries with limited financial resources. For a successful implementation of the bioremediation techniques, effectively engaging multiple stakeholders is a precondition (O'Brien et al, 2020).

Box 7: Examples of decentralized technological solutions for clean water

There are many decentralized technological solutions to purify water in the household and to clean water bodies. Below are a few examples. Many of these solutions are low-cost, low-tech, and can be produced domestically. Click on the links to learn more about these solutions.

Household systems:

Solar water sterilization: https://en.wikipedia.org/wiki/Solar_water_disinfection

Ceramic and clay filters: https://en.wikipedia.org/wiki/Ceramic_water_filter#:~:text=Ceramic%20water%20filters%20(CWF)%20are,and%20bacteria%20out%20of%20water.

Slow sand filtration: https://en.wikipedia.org/wiki/Slow_sand_filter

River systems:

Trash traps: https://stormwatersystems.com/trash-traps/

River cleaning system: Cleaning System: https://rivercleaning.com/river-cleaning-system/

Sunlight-powered purifier: https://www.sciencemag.org/news/2017/02/sunlight-powered-purifier-could-clean-water-impoverished

The Great Bubble Barrier: https://thegreatbubblebarrier.com/en/

5.1. Inspiration from The Rhine - IWRM in a Transboundary Context

In 1986, there was a catastrophic fire at the Sandoz chemical factory near Basel, Switzerland, which resulted in the release of toxic chemicals that were discharged into the Rhine River. The river flows through four countries - Switzerland, Germany, France, and the Netherlands - before flowing into the North Sea. The massive water pollution from the Sandoz catastrophe and the heavy industrial presence along the riverbanks led to the disappearance of all fish and other living organisms in the river, and made the Rhine river too dangerous to swim in and its water unsuitable to use for any purpose. A public outcry, in addition to politicians from all the Rhine countries, agreed that action had to be taken. The result was the Rhine Action Program of 1987 (BBC, 2014). Accordingly, there have been many measures taken and efforts made to clean the river by the riparian countries, including building new effluent treatment plants along the river course and increasing the chemical companies' safety precautions around the river. There have also been improvements in legislation, international cooperation, monitoring network, and emergency procedures to prevent pollution or minimize its effects. These efforts have been very successful and resulted in a high reduction in nitrate and phosphorus pollution, as well as other types of pollution.

Box 8: Rhine Action Program (ICPR, 2003)

Commitment: Thoroughly rehabilitate the Rhine by the year 2000.

Objectives: Reduce the discharge of noxious substances, increase safety norms in industrial plants, and reduce the pollution contents of river sediments.

The estimated expenses for implementing the Rhine Action Program (RAP) (1989 to 1995) are 13 billion Euro.

The estimated expenses for improvement of wastewater treatment plants are 9 billion Euro.

Involved actors: The Rhine bordering countries, the Länder, the municipalities, and industry all joined forces and implemented the rehabilitation measures.

The process to define targets, conclude agreements, and achieve control is accompanied by more than 150 experts.

The RAP targets are set in the field of chemistry, techniques, and biology.

The extremely successful Rhine Action Program is under the auspices of clearly defined strategy and milestones implemented by all Rhine bordering countries.

RAP has been successful in increasing the political willingness of the countries to engage. Required public means were predisposed to implement the program. RAP has submitted strict instructions to the industry.

Box 9: International Commission for the Protection of the Rhine (ICPR, 2003)

ICPR was founded in 1950.

Contracting parties: France, Germany, Luxembourg, Netherlands, Switzerland, EU Delegates.

Leading civil servants and experts from all contracting parties.

President: Mathias Krafft (2002 - 2004)

Headquarters: Koblenz

The representatives of the different ICPR member states established a highly committed and trusting cooperation. The ICPR secretariat coordinated their meetings, informed the public, and established contacts with non-governmental organizations in the economic sector, municipalities, and nature protection. Thus, a river commission turned into the nucleus of modern water protection.

Different river commissions have used the ICPR model, including the River Elbe (1990), the Rivers Danube, Meuse, and Scheldt (1994), and the River Odra (1996).

5.1.1 Factors that can influence the success of IWRM

Referring to the Rhine river experience, several mediating factors that can influence the success of IWRM in a transboundary context (Medema and Jeffrey 2008) are as follows:

- **IWRM (Integrated Water Resources Management) is about changing perspectives**

The openness of the different actors involved in the water management process would increase the chances of collaboration towards the integrity of stakeholder processes, and of adjustment of the institutional structures required to design and implement IWRM.

- **Level of the integrity of different interests**

A success factor of the IWRM implementation in the Rhine is the involvement of a wide range of stakeholders with different interests throughout the planning processes: those with the power to influence the process and those who are affected by the process. Acceptance and support of these stakeholders for actions and interventions could assure their successful implementation. Moreover, their involvement can create a sense of ownership and responsibility. However, as the number of stakeholders with different interests increases, the negotiation process might become more complicated. Simultaneously, the strong support of diverse stakeholders with different interests is required to assure an agreement and its implementation. In particular, excluding powerful stakeholders from the decision-making process could hinder the achievement of effective solutions.

Box 10: The Integrated Water Resources Management Joint Exchange MSc Program with a focus on the Middle East and North Africa (IWRM MENA)

Programs for raising awareness and educating young water professionals on the principles of IWRM - social equity, economic efficiency, and environmental sustainability - are quite needed to effectively address water challenges such as water pollution problems. An example of such programs is the IWRM master's program run jointly between TH Köln (Germany) and the German Jordanian University (Jordan). Interdisciplinary and multicultural educational programs play a key role in educating agents of change and young water professionals who can understand complex water resources management systems.

Collaboration partners: TH Köln (University of Applied Sciences) and German Jordanian University

Aim: educate experts in Integrated Water Resources Management who can understand, analyze, and find solutions for complex water problems considering the interdisciplinary and trans-disciplinary aspects of water resources management.

Duration: four semesters (first and second semesters in Germany; third semester in Jordan; fourth semester in the MENA region)

Profile of the participants: Mostly from the MENA region and Germany and from different academic backgrounds (social sciences, politics, economics, engineering, environmental sciences… etc.)

The program provides the participants with an interdisciplinary and intercultural atmosphere, with the chance to experience life, education, and systems that work in both regions. For further information: https://www.iwrm-master.info/iwrm-mena/

- **Willingness to collaborate**

The stakeholders' willingness to collaborate depends on many different factors, such as their level of trust in the process. Regular interaction between the different parties through formal and informal networks can create an atmosphere of trust and mutual understanding. Trust between the Rhine basin's riparian countries has been built through long-lasting cooperation (Raadgever et al., 2008).

A sense of urgency and awareness of the environmental crisis could increase the willingness to collaborate. In the case of the Rhine River, the Sandoz disaster was an environmental crisis that provided a significant boost to the work of the ICPR. Climate change is another common threat that has successfully brought different actors together. Another factor that can affect the willingness to collaborate is the social and economic interests of the involved stakeholders and countries. The

economic power of involved stakeholders and countries would affect their priorities, including funding for environmental measures. The Rhine River experience indicates that a similarity of economic development between countries involved is an enabling factor for the integration process.

Box 11: Rhine Clean-up Day

Eight billion kilos of plastic waste are dumped in the oceans every year, 80% through rivers. The Rhine river alone is responsible for disposing of 1000 tons of trash in the ocean. The Rhine River Cleanup is a Europe-wide program of volunteers cleaning up the river. In total, 58 cities contribute to the program. Cleaning, awareness-raising, and promoting collaboration among the stakeholders to reduce the number of disposable products at source are among the main purposes of the Rhine Cleanup Day actions.

For further information: https://www.rhinecleanup.org/de

- **Guaranteeing access to data and information**

The Rhine experience indicates the importance of available, accessible, and understandable data and information for all stakeholders, for decision-making and monitoring purposes. Rhine water management information is publicly available through websites and publications. The availability of information and data is increasing as more sophisticated techniques and methods for data collection and information sharing are being developed. Moreover, at the transboundary level, international inspection capability between riparian countries is needed to monitor the implementation of agreements.

- **Legal arrangements and setting at country level versus transboundary**

The riparian countries have set up the International Commission for the Protection of the Rhine (ICPR) to ensure the implementation of agreed decisions for action. However, as each member state has its own legal arrangements, ICPR has limited legal power, which can cause difficulties; this could be the case in many transboundary settings. In the case of the Rhine, The Water Framework Directive (WFD) and European Commission (EC) are in place to counterbalance the limited power of the ICPR. The Water Framework Directive (WFD) is more specific on how to deal with and involve stakeholders, as well as how to develop formal agreements on problems to be solved. At both country and transboundary levels, clarity of roles and mandates increases simplicity, efficiency, and effectiveness through the implementation process and collaboration.

- **The complexity of the governance systems**

According to the Rhine river experience, an important factor that may impact the duration and complexity of designing and implementing IWRM is the complexity of

the governance systems and institutional structures, as well as unclear roles and responsibilities. A high number of involved stakeholders with very different interests and needs may increase frustration.

At the transboundary level, the complications may increase as the degree of compatibility between riparian countries decreases. Different national policies, interests, institutional structures, legal arrangements, and bureaucracy levels may lead to a time-consuming and frustrating process.

6. Lessons Learned for The Euphrates and Tigris and The Ways Forward in Discussion With The Stakeholders

This section presents the lessons learned from the Rhine experience, adopted for the Euphrates and Tigris in three parts considering the knowledge transfer framework and expert interviews. The first part refers to the integrated and transboundary requirements of water resources management in the basin. It introduces a regional network to increase willingness to collaborate at the regional level. The second part demonstrates different approaches to reduce pollution, from technical solutions to legal frameworks and laws, as well as to raise awareness of the matter. The third part focuses on the financial resources, which have been identified as an obstacle for realizing any of the suggested lessons learned.

The main text presents the lessons learned from the Rhine experience, considering the knowledge transfer framework introduced in previous chapters.

The text in the framed boxes represents the viewpoints of the interviewed experts, their concerns, and the prerequisites needed to realize those lessons learned.

6.1. Changing Perspectives, Creating an Enabling Environment, and Fostering Cooperation: Integrated Water Resources Management (Iwrm)

Holistic approaches are key to solving water quality through multiple lenses (e.g., socio-economic, political, technical, and ecological). Adopting the principles of Integrated Water Resources Management (IWRM) is one of the most successful concepts for the implementation of a holistic approach. This would offer opportunities to discover potential synergies to be promoted and for trade-offs to be minimized. For example, IWRM promotes the management of the whole water cycle. Treating wastewater could protect natural water sources and would provide a new unconventional water source that can be reused. The decision-making process should be based on a good understanding of IWRM.

To implement IWRM in the region, according to the experts, the following obstacles (social, political, technical, ecological …) are to be overcome:

- Lack of a regional strategic plan for the whole basin and for each of its riparian countries.
- Lack of a clear vision for the water sector and strategies at the national level. Decisions are rather political considerations.
- Lack of political will, as well as political instability and corruption.
- Absence of water treaties and cooperation among the riparian countries at the transboundary level, including treaties and laws that would regulate water pollution.
- Lack of enforcement of existing policies.
- A high number of stakeholders involved in water issues, which challenges the implementation of public policies.
- Low awareness and lack of targeted education regarding the IWRM.
- Lack of environmental awareness at different levels from schools and community to the private sector.
- Lack of experts who could implement IWRM at different scales and levels.
- Old technologies and infrastructure.
- Lack of local and national studies about IWRM and automated monitoring for water resources.
- Outdated research and lack of investment for research and application of the research recommendations.
- Limited financial resources available, mainly due to the economic crisis in Iraq.

Implementation of IWRM by all the riparian countries is crucial; political, technical, and economic teams should be present in the negotiation.

- **Transboundary water management**

Under transboundary conditions, improving water quality cannot be guaranteed without all riparian countries' involvement, through, for instance, a water quality treaty. From the Rhine basin experience, the signed water quality treaties were an essential part of the success of this case (Bernauer and Moser, 1996).

The riparian countries need to join forces and prioritize the well-being and security of the Euphrates and Tigris rivers to address the water quality deterioration threats to the Euphrates and Tigris river basin caused by the heavy pollution from different sources. Only through intense collaboration between different stakeholders within Iraq and among the riparian countries can an effective water-monitoring network be initiated, which would provide the members with the required data and information on the water quality and pollution throughout both rivers, the

bottlenecks, potential pollution sources, and workable solutions.

To reduce river pollution in the Euphrates and Tigris, there is a need for a transboundary agreement that focuses exclusively on water quality.

According to the interviewed experts, the agreements signed by the riparian countries for over a century have ended with no solid cooperation. This is mainly due to a fragile political system, lack of incentives to gather the riparian countries at one negotiation table, and not legally binding limitations of the international law for watercourses to enforce (instead of urge) the riparian countries' cooperation.
Therefore, the above factors should be considered in the design of a comprehensive plan of water cooperation at the regional level. Specifically, the riparian countries should agree on the definition and standards of "acceptable water quality". At the transboundary level, however, the legal frameworks and agreements with riparian countries are not enforced. For example, clear laws to prevent the unfair distribution of the water resources, as well as revised operation rules for dams, could reduce the pollution and salinity problem. Moreover, political restrictions from the riparian countries, especially Iran and Turkey, play a key role to avoid dumping waste and agricultural return flows to the rivers before even entering Iraq.

- **Willingness to collaborate at the regional level**

Creating a mutual sense of belonging to the basin and introducing collaboration incentives could increase the willingness of the riparian countries to cooperate.

Creating a sense of common identity and belonging to Euphrates and Tigris among and within the riparian countries could increase their willingness to collaborate and their commitment to a clean Euphrates and Tigris. Despite all the complex geo-political conditions, a sense of shared ownership can be encouraged through different interregional activities and actions that strengthen a shared value and a sense of belonging.

Introducing collaboration incentives to the riparian countries that foster their willingness to cooperate is essential, including the promotion of shared benefits and win-win solutions. It is important to understand the standpoint of different riparian countries regarding the basin in order to identify their potential incentives for collaboration. Referring to the interviewed experts, potential incentives that would promote collaboration among riparian countries include incentives for trading exchange, free trade zones, developing a regional strategy for food production, joint projects and research centers, and security agreements.

- **Establishing regional and national networks**

Establishing a network of riparian countries at the Euphrates and Tigris basin level would facilitate the interactions among the riparian countries. A network is an excellent opportunity to foster dialogue among the members. It provides a solid base for the riparian countries to communicate and collaborate. Depending on the expected outcomes and impacts, the network could be designed at different levels, including different stakeholders from academics, politicians, civil society, and business.

The main concern in establishing regional centers and networks is ensuring their sustainability. According to the expert interviews, specific challenges of such a network in the context of Euphrates and Tigris include:

- The fragile political situation in the region.
- Financial challenges.
- The complexity of communication among the riparian countries and stakeholders.
- Leadership, management, and network structure.
- Logistic and management challenges due to the instability caused by ISIS.

- **Establishing a regional IWRM**

Establishing a regional IWRM higher education program with an interdisciplinary and intercultural focus among the riparian countries would increase their mutual understanding of the problems and the perspectives. It would educate water professionals and agents of change who could transform the water sector at the regional level.

Moreover, according to the experts, the establishment of a higher education program with a focus on IWRM could play a key role to create awareness about IWRM and internalize system thinking and a holistic understanding of water-related issues among the stakeholders at different levels.

To implement IWRM, according to the interviewed experts, the shortage of water professionals in the areas of technology, management, governance, and public policy, as well as a lack of system and nexus thinking, should be overcome. In addition, specific skills needed in order to resolve the water pollution issue include wastewater management experts, experts for laboratory work, and academics; the continuous feeding of information is a necessity. There are plenty of opportunities to do research. The IWRM Master Program could contribute to filling those gaps.

- **Establishing a basin-wide independent research center**

A basin-wide independent research center and joint development projects among the riparian countries could promote interaction and an exchange of knowledge, experience, and perspectives, and could accelerate openness and willingness to collaborate. It is quite important to facilitate data transfer to researchers and to civil society.

- **The establishment of a basin-wide monitoring network**

A basin-wide monitoring network along watercourses, with an early warning system and an alert plan, would help track pollution sources and could amount to responding quickly to potential risks.

However, the successful implementation of a monitoring network requires commitments of all the riparian countries. Only through intense collaboration between different stakeholders within Iraq and among the riparian countries can an effective water monitoring network be initiated, which would provide the members with the required data and information on the water quality and pollution throughout both rivers, the bottlenecks, and on potential pollution sources and workable solutions. According to the interviewed experts, in Iraq, monitoring stations are few and old. Technical expertise needs to be updated, while the collected data has not been used for action. Moreover, although Iraq has installed a modern system for the two rivers, the project has been suffering from logistics and poor communication between several local authorities. An independent institute that collects reliable data from different locations along the rivers in Iraq would be a great step that can be implemented without the riparian countries.

Availability and accessibility of data and information at the local level play an important role in the success of such networks. An important aspect of transboundary cooperation is facilitating the flow of information; this improves our understanding of the water quality risk and builds trust among the riparian countries, which is an important part of any solution effort.

An efficient way to enhance the monitoring network is to establish a community-based monitoring program, by creating local living labs within each city/village, where every citizen would have a role, reporting the situation near his/her place and playing a part of the cleaning process.

- Training programs are required in order to educate local people about the reporting system and dealing with certain technology and devices, such as the Remote Sensing technologies used to collect data and monitor water quantity and quality in the rivers and tributaries.

- **Establishing a Regional Awareness Raising Center**

The goal of establishing a Regional Awareness Raising Center is to initiate a common identity among the riparian countries for the Euphrates and Tigris rivers. Among many different potential activities of such a center would be the organizing of:

- Regional campaigns highlighting the importance of realizing that water is a valuable element for the entire region.
- Regional festivals, art, and cultural awareness-raising to foster the mutual sense of belonging to the basin among riparian countries.

6.2. How Can Water Pollution in The Euphrates and Tigris Basin Be Reduced?

- **Technological solutions to treat the polluted water**

During the last few decades, water-cleaning technologies have advanced. Using advanced and up-to-date technologies can deliver better results provided they are adopted for the Iraqi environment, i.e., taking into consideration the local weather conditions and hydrogeological system. Also, knowledge transfer should be integrated with the technology transfer to ensure its maintenance and long-term performance.

The interviewed experts emphasize the need to address the below points in a prestudy to decide on a technology:

- Is it possible to adapt the technology to the Iraqi environment?
- Which policies are needed to implement a technology that deals with the treatment plants, and which local entity has to be responsible for them?
- How can the sustainability of that technology, especially its maintenance, be ensured?
- What expertise and capacity building for the operating staff are needed to operate that technology?
- What are the expected costs and available financial resources?

Deciding on a proper technology would depend on the type and source of pollution as well as the required cleaning techniques:

- For domestic water uses, the promotion of low-cost water-cleaning and filtering systems, like in-house water filters and small-scale decentralized water treatment plants, could be feasible, considering the current economic situation in Iraq and some other riparian countries.

- Regarding the river's streams and tributaries, a segregation approach for water usage could be implemented: i.e., green water (from rainfall), blue water (used for irrigation), and gray water (polluted). Each has a different treatment phase and technology.
- While the few existing wastewater treatment plants are old, their rehabilitation and maintenance has not been a priority. Some countries in the region (e.g., Jordan) have good experience in treating and reusing treated wastewater, from which inspiration can be drawn for the case of Iraq, where it can be implemented on a large scale.
- Drainage systems should be adjusted to avoid polluted agricultural wastewater (pesticides and fertilizers) in the rivers.
- Technologies to treat waste from oil production are urgently required.

Legal frameworks and the enforcement of laws between polluters and the affected communities

The interviewed experts emphasized the need for new laws and the revision of outdated laws, and clear roles and responsibilities. The process is characterized as time-consuming. It requires full commitment and willingness from the different stakeholders to revise the existing environmental laws, data, and information as well as complementary capacity building programs for the involved stakeholders and decision-makers. The stakeholders include the ministries responsible for environmental and water resources, agriculture, and industry, as well as local committees and local associations and marginalized local stakeholders (i.e., farmers, fisheries, etc.). These should be involved in the decision process and implementation.

The interviewed experts confirmed the need for a stakeholder network in Iraq that connects decision-makers, academics, and private sectors to discuss and understand the shortages and reveal the opportunities.

Successful enforcement of the legal frameworks and laws in Iraq requires the promotion of the stakeholder's incentives to cooperate on the one hand, and to ensure the support of the authorities, i.e., Ministry of Water Resources, on the other hand, which would increase the chances of long-term cooperation with impact on the ground. A good example is the need to enforce the use of biopesticides by law and promote organic agriculture that would reduce water pollution resulting from agriculture practices.

Moreover, communication with stakeholders would increase their wide support and acceptance of the proposed solutions. It is highly important to define suitable knowledge transfer and communication strategies and media to effectively reach the targeted stakeholders.

- **Awareness-raising to avoid polluting the rivers**

Environmental education and awareness-raising would increase the understanding of the stakeholders, including the local people, regarding the multi-dimensional complexities of water problems. It has the potential to increase the willingness of a wide range of stakeholders to gather individual efforts and cooperate toward clean rivers.

Awareness-raising campaigns and educational actions would increase the inhabitants' sensibility regarding the well-being of the Euphrates and Tigris basin, while promoting the best examples of individual and communal activities concerning a clean Euphrates and Tigris.

Evidence-based knowledge transfer to understand water pollution and its causes and consequences:

- Increase the sense of responsibility of individuals regarding their indirect and direct actions and decisions
- Increase understanding of one's role in empowering a clean Tigris.
- Adopting decent educational material and a decent system starting in primary school.
- Awareness-raising for governmental employees to better understand the complexity of water resources challenges.
- Awareness-raising and capacity building for farmers to reduce pollution and the use of pesticides and fertilizers.
- Environmental awareness-raising campaigns focusing on the importance of cleaning the rivers to promote a sense of belonging to the rivers.

Role of Iraqi communities in contributing to a clean basin

Communities play an important role to promote bottom-up approaches that foster dialogue among the stakeholders and commit policy-makers to bring their decisions to action.

Communities could play a key role in environmental awareness-raising. Evidence-based awareness-raising activities and projects that initiate interaction and communication among the stakeholders like the "clean Tigris" project should be promoted.

NGOs could allocate funds and co-design projects to promote practical initiatives for cleaning Euphrates and Tigris. The long-term systematic support of international NGOs for capacity building and empowering local NGOs could sustain this work. In addition, awareness-raising about the importance of civil society and support from the government would increase the effectiveness of their efforts.

Community involvement in the monitoring and data collection process is required. Civil societies and associations could play an important role in the monitoring process and in managing the procedures for water distribution and data collection. However, their role would be rather complementary, with only general overviews, rather than in-depth analyses of the problems.

6.3. Financial Resources

Improving the water quality of the Euphrates and Tigris needs many financial resources. The experts have mentioned the lack of financial resources as a restriction to all the lessons learned.

The current economic crisis in Iraq reduces the ability of the Iraqi Government to finance the implementation of the lessons learned activities in this section. Specifically, **the local government is interested in technology-based solutions to clean the basin, which are cost-intensive.** In the coming year, dropping oil prices, in addition to the pandemic, will surely influence the funding availability and priority.

- **International funding organizations**

International funding organizations such as the World Bank (https://www.worldbank.org/), the Green Climate Fund (https://www.greenclimate.fund/), and other actors could play a great role in helping countries like Iraq to clean the Euphrates and Tigris rivers by facilitating grants, loans, and funds.

The international funds could promote projects and activities that foster peace and stability in the region. However, even if the necessary funds are acquired, the political instability in the region may create insecurity, as well as logistic and management issues, which will hinder the implementation of those projects. Moreover, the sustainability of the development project after the funding phase is a challenge. Therefore, new models of external funding that ensure the sustainability and impact of the project are required. To ensure success and sustainability, the projects should involve NGOs, local people, the government, and academics. Civil society is highly needed to participate in designing and jointly implementing and monitoring the projects.

The capacity gaps to generate funds from international organizations include:

- Defining the clear goals and objectives of the intended project with detailed cost estimations.
- Identifying existing funding potentials.
- Increasing the eligibility of local organizations and institutions that work in the water resources and environmental field for funding, through workshops and training.
- Developing solid financial models from the local government, private sector, and NGOs for getting funds and spending them effectively.
- Proposal writing and understanding common terminologies.
- Implementing the project, in the case that the proposal is accepted.
- Improving transparency to reduce corruption.

- **Commitments from the riparian countries**

Commitments from the riparian countries to provide the needed financial resources and mobilizing funds from the public and private sector is crucial. However, convincing arguments for joint financing of the projects are lacking at the moment.

Finally, enhancing water quality from its current deteriorated status might take quite a long time. For example, improving the quality of water in the Rhine basin has taken several decades. Hence, patience and strong commitment, not only from local stakeholders in Iraq but also in the other riparian countries of the basin, are essential.

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IV

Rivers – The Essence of Civilization

Water Management in Ancient Mesopotamia and Its Powerful Role Throughout Mythology and History

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1. Introduction

Ten thousand years ago, humans lived as hunter-gatherers. In small groups, they would constantly be on the move from one place to another in order to secure access to enough food for their nomadic communities. They also engaged in a long process of observing and understanding nature's ecosystem, which enabled humans to make a breakthrough in developing cultivation and eventually master farming over the following millennia. The development of agriculture was the most revolutionary progress in human history, creating the foundation of modern society. Some groups started becoming more sedentary settlers, and slowly their communities were able to grow in size. This was possible through the control and management of water resources, as well as greater understanding of seasonal weather conditions. This process took several millennia to establish early civilisations, a new and outstanding feature in human history.

These new formations of livelihood happened almost simultaneously in both ancient Egypt and Mesopotamia. Societies in both regions benefited not only from their climate, but also from their access to fresh water. In ancient Egypt, the Nile was the main source of fresh water, while Mesopotamia was covered by a network of streams feeding the two main rivers, the Euphrates and the Tigris. These rivers facilitated the establishment of the first civilisations, which progressed from farming communities to large, urbanised cities, with complex social structures and technologies. The success and prosperity in these regions resulted from both the advantageous climate which enabled agriculture, but also the clever regulation of the water resources. The Tigris and the Euphrates are perhaps the most prominent rivers in the history of human development in Eurasia. Their journey from their sources

in the high mountains of Anatolia, through the flat plains of Mesopotamia, to their confluence in the Shatt al-Arab before flowing into the Arab or the Persian Gulf, is connected to the rich history of civilisation; in many respects, few - if any - other rivers have such a rich history and important role for humankind. The two rivers are witnesses of many hugely influential social and technological innovations, as well as conflicts, and have been the life-givers of the region for thousands of years, enabling some of the most important developments in early human history.

Today, however, access to the waters of the Euphrates and Tigris rivers is threatened as never before, with the region's increasing population and water use not only for agriculture, but also for heavy industries and the production of electricity through hydroelectric dams. Continuous disputes, dialogues, and agreements over the waters have occurred between the modern states through which the rivers flow – Turkey, Syria and Iraq, as well as Iran, since the sources of three main tribute rivers to the Tigris are located inside its borders. It is important to look back at history to understand the value of these two rivers, in order to identify possible common ground for establishing regulations and policy to avoid violent conflicts over water in the near future, and to foster cooperation with a deeper understanding of the same responsibilities which our ancestors once bore. Over the following pages, we review diverse aspects of water usage in Mesopotamia, from ancient mythology to new innovations in water hydraulics, policy-making on water management, and recent conflicts over water resources. While the scope of these topics is wide, they all intersect in one way or another.

2. Mythologies As Transmitters of Knowledge

The value of water can be found in numerous literary texts on clay tablets from ancient Mesopotamia, which we can be categorised in our modern perspective as mythology. Before introducing the stories of water creation in such mythology, it is necessary to understand the reasons why these myths were generated. They are stories that have more to do with the lived reality of humans than many of us would initially think. They focus not on fantastical beings or supernatural abilities, but on seeking to articulate and explain the circle of life, understanding natural phenomena and coping with the hardships of existence. Storytelling is the most powerful tool for transmitting knowledge to others and from one generation to another. It is a vibrant and fluid medium, which retells the existence of a subject in many variations. Seasonal or periodic events in particular are often packed into stories which provide a figurative and vivid understanding of how and why things in everyday life occur. The subject is contextualised in the given reality of the people depending on the region and period in which they live.

On the one hand, mythologies provide an understanding of universal concepts and relief from everyday struggle, while on the other hand, they propagate moral codes and legitimate hierarchical social structures, as well as the duties and responsibilities of humans necessary to achieve prosperity and harmony. Mythology has been a central pillar with which rulers accredit their position and role in society, and justify the policies and regulations inside their realm.

Mesopotamia is a name familiar to many people around the world. The name has survived among us to this day from the ancient Greek term describing the land between the two rivers, the Euphrates and the Tigris. These names have long persisted, although they have been adjusted to the dominant languages in the region at each period. The modern Arabic names, al-Furat (Euphrates) and Dijla (Tigris) are rooted in the Akkadian Purattu and Idiglat respectively. The same origins account for the Old Persian names (H) ufratu and Tigra, from which the ancient Greek names Εὐφράτης (Euphrátēs) and Τίγρις (Tigris) were later derived, and have come to be preserved as the rivers' international names in our modern times. In many myths from the region, both rivers are mentioned together, and in some they are described explicitly as twin rivers. However, there are physical differences between the rivers: the Euphrates is longer and wider, and thus flows slower through the plains, while the Tigris rushes in a fast stream through a narrower riverbed and cuts through hilly land before it reaches flat land and eventually joins the Euphrates. This demonstrates that their identification as "twins" does not result from their being particularly alike, but rather their being considered siblings that were created together. Many myths have sought to explain the formation of the two rivers, with a wide variation of narratives arising, just as there is also no unified story between cultures concerning the creation of human beings. Despite this variety, it is important to note that the two rivers are often explicitly mentioned by their names as having been created by the gods, and thus stand out from the creation of rivers in general. In this conception, it is clear that no earthly power is entitled to claim the ownership of water resources! Rather, the responsibility of reasoned consumption and fair sharing of water is necessary.

The myths about the conception of the rivers also share a common thread of fertility. In the creation story "KAR 4", heaven becomes separated from earth, and the gods establish an irrigation system and define the streams of the Tigris and Euphrates, before creating humans and animals on earth to farm the land to serve and feed the gods. This narration presents the creation of the two rivers, and the construction of irrigation canals from them, as a divine operation, and serves a narrative of it being a royal duty to maintain and extend the canals - a management of powerful forces that cannot be carried out by small communities alone.

Fig. 1: Seal impression of the so-called "Sealing of Adda".

Mythology is part of daily life in Mesopotamia, resources being the motives for their artwork. From left to right: a hunting god with bow and arrow, Goddess Ishtar with wide spread wings, God Shamash holding a serrated blade and emerging between two mountains, and the God Ea (Ea is the Akkadian name, while Enki is Sumerian) standing with one foot on the mountain and water streams with fish emerging from his shoulders, and behind him the two-faced god Usimu.

(Date 2300 BCE, originally from Sippar, today at the British Museum BM-89115)

3. The Creation of Rivers by The Ancient Gods

In other myths, it is the Sumerian god Enki who is responsible for the creation of the two rivers. Enki, not only the god of water but also wisdom and creation, was one of the most prominent gods of the Mesopotamian pantheon (Fig. 1). His attributes reflect the importance of knowledge in managing the essential element for creating and sustaining life – water! "Enki and the world order" is a text with remarkable narration that reflects the development of urbanised civilisation with a well-regulated hierarchy. In this myth, Enki, also responsible for fertility and productivity, is instructed by his brother Enlil, the chief god of the Sumer civilisation, to make the land prosperous and secure. Enki "stimulates the penis and ejaculates. He filled the Tigris [sic!] with [ever] flowing water". Freshwater is clearly associated with insemination and the fertilisation of the land by the gods.

A mythological text, named by modern Assyriologists from its first line "Enuma Elish" ("when on high"), records a story about a time before earth and humans. It is the patron of Babylon, the god Marduk, who is the hero and the creator of the two rivers. The story begins with the three gods Mummu, Apsu, and Tiamat. Mummu is the advisor of Apsu, the male god characterised as sweet water, while Tiamat, the female goddess, symbolises salt water. Apsu copulates with Tiamat,

who bears two children from whom the subsequent generations of gods are born. Here, the god of fresh water is the begetter, symbolising the direction of rivers flowing into the ocean, Tiamat or salty water. However, the new born young gods make too much noise; Apsu and Mummu attack them, but Apsu is killed by the stronger younger gods, making the mother goddess angry. In her anger, she gives birth to monsters and attacks the young gods. In this chaotic fight between generations, it is Marduk who defeats Tiamat. Out of her dead body, Marduk first makes heaven and earth, then creates the Tigris from her right eye and the Euphrates from her left. The semantic beauty of this creation story is that the word for a source of a river in the Akkadian language is īnu, literally "eye", similarly to the Arabic word 'ain, which also means both eye and water spring. Another characteristic is in the orientation of the rivers, with the Tigris (which flows to the east of the Euphrates) on the right and the Euphrates on the left, and the Tigris always being named first. This demonstrates a perspective from southern Mesopotamia looking northwards and in the direction of the rivers' sources.

Besides Enki, many lower gods were associated with water, found not only in literature but also in the material culture of Mesopotamia, such as free-standing statues, on wall reliefs or paintings, and as a variety of other smaller objects. They may be female or male deities, and are easy to identify; they are depicted holding a small, round vessel in both their hands. From the vessel's mouth, multiple lines flow to the right and left in wave-like shapes, sometimes with fish swimming against the stream towards the vessel's opening. One of the most beautiful and creative depictions of such a deity was found at the site of a palace in the ancient city of Mari on the lower Euphrates in modern Syria. In the palace's courtyard stood a stone statue of a female deity, with a water vessel as described above. The statue functioned as a figural fountain, with water emerging out from the vessel. In the same palace, an impressive two-meter-high mural was found, incorporating both naturalistic elements and mythical beings and deities. The main scene of the image is the enthroning ceremony of king Zimri-Lim (1775-1761 BCE) by Ishtar, the goddess of war, love, and fertility. Beneath them are two deities with water-pouring vessels in their hands. The investiture scene is framed by a garden landscape, with palm trees on each side, the queen of southern Mesopotamian standing high, while men climb to collect the fruits. This harvest element is a potent symbol of prosperity. The composition demonstrates how religious ceremonies connected to kingship are related to responsible usage of the od-given water sources to ensure fertility in the land. As mentioned earlier, ancient Mesopotamians believed the gods created humans to farm the land to feed the gods; it is the duty of a ruler to ensure this covenant. In the ancient city of Uruk, the facade of the temple of Inanna (the name for the goddess Ishtar in the Akkadian language) was decorated with bricks

moulded in the shape of water deities in alternating niches. One of Inanna's attributes is fertility, and in Mesopotamia, fertility cannot exist without water.

4. Governing Authorities and Their Duty of Water-Management

The people in the region frequently related the rivers to the geographical dimensions of the known world, with many kings making the much-vaunted claim that they had travelled far on journeys of exploration and had reached the sources of the Tigris and Euphrates. One of the first kings claiming this achievement was Naram-Sin, the successor of Sargon of Akkad. While most ancient Mesopotamian empires, from the Akkadian to the Persian, were able to expand to the east and the west, they were more constrained to the north, in the area where the Euphrates and Tigris originate, and to the south, where they flow together into the Persian Gulf. After the emergence of governing authorities in the area, population and settlement growth continued with a wide territorial expansion, with the rivers being used as transportation. Thus, beside their role in irrigation, the rivers became the most important infrastructure for trade, migration and population resettlement. Much knowledge was transmitted and developed, including the cuneiform writing system.

The earliest civilisations of Mesopotamia recognised the importance of securing irrigation for the benefit of agriculture. It is important to view ancient Mesopotamian policies on water in connection, and the administration of economic issues, with the above described belief systems. While the blessing of water sources was literally in the hands of the gods, the development of sustainable irrigation systems as the lifelines of the land was the responsibility of humans. This included social codes attempting to create peaceful coexistence and solve the conflicts, great and small, which arose over water. As the region became occupied by different groups and their cities grew, the demands for fertile land and secure water resources increased, leading to the emergence of conflicts. Policies and regulations are key for keeping the peace between different interest groups using the same resources for daily life. Such regulations are not only dictated from above to tell the people how to use such resources, but also provide them protection and the assurance of access to resources essential for making a living. The maintenance of water supply remains to this day a complex task involving multiple layers.

In Mesopotamia, the securing of irrigation for settlements and agricultural fields was mostly a duty of the authorities, and included further tasks such as construction, the maintenance of water-distributing infrastructure, the organisation and payment of labour forces, the transport of materials and the water itself, and conflict resolution. The Assyrian Empire dominated northern

Mesopotamia in the second millennium BCE. Through the empire's territorial expansion, people were deported to the hinterland of Assyria and the population increased. This obliged the kings to ensure efficient irrigation systems to not only supply water to the growing cities but also improve agriculture in the surrounding lands to be able to provide enough food for the grown population number. Assyria, like most other regions, was an agrarian society, and its rapid growth placed additional urgency upon the issue of food supply for its people. The topography of the core land in Assyria (Mat Ashur) was hilly, with little flatland. Most of the terrain stood significantly above the plentiful large and small water streams. This geography made it difficult to apply the same irrigation system as in the south, where cuts in the sides of the rivers were made to irrigate the flatland for farming. The use of waterwheels to raise water, such as those which can still be seen in a few cities on the Euphrates such as Hit in Iraq or Hama in Syria is also difficult on the swift-flowing Tigris. Instead, Assyrian tapped water from upstream, and sent it along canals to the desired destination.

Canals thus became the irrigating arteries of the hilly land, starting with rulers such as Ashururbalit (1380 BCE) and continuing under his successors to Tiglath-Pileser (1116 BCE-1076 BCE), who established a new communal and labour-intensive method for creating waterways. The Neo-Assyrian period became one of the most innovative in antiquity, with major constructions of waterworks with a vast impact on the landscape. In the course of time, the Assyrian kings were impressed by the hydraulic engineering of neighbouring regions like Urartu in the north and Babylonia in the south, from which they not only imported new techniques, but also improved them on a larger scale and included new innovations. The most impressive project was the large aqueduct made of stone blocks, standing to this day at the former village of Jerwan, which must have been seen as a wonder at that time. The Assyrian kings boasted about their achievements not only to show their power, but also to document how much they had strengthened the Empire. They not only provided enough water for the pre-existing agricultural use, but also introduced new plants to their homeland, as Tiglath-Pileser claimed in his inscription:

> *I took cedar, box-tree, and Kanish oak from the lands over which I had gained dominion - such trees as none among previous kings, my forefathers, had never planted, and I planted [them] in the orchards of my land. I took rare orchard fruit, which is not found in my land and filled the orchards of Assyria. (Dalley 1933:1-13)*

Tiglath-Pileser reforested the land, since large trees were needed to construct the

roofs of not only normal housing, but also palaces, temples and other large public buildings. A century later, one of his successors, Ashurnasirpal II (883-859 BCE) wrote in more detail what kind of plants he imported, totally changing the availability of fruits and nuts:

> *I dug out a canal from the Upper Zab [a tributary of the Tigris], cutting through a mountain peak, and called it Abundance Canal. I watered the meadows of the Tigris and planted orchards with all kinds of fruit trees in the vicinity. I planted seeds and plants that I had found in the countries through which I had marched, and in the highlands which I had crossed: pines of different kinds, cypresses and junipers of different kinds, almonds, dates, ebony, rosewood, olive, oak, tamarisk, walnut, terebinth [Pistacia] and ash, fir, pomegranate, pear, quince, fig, grapevine […] The canal-water gushes from above into the gardens; fragrance pervades the walkways; streams of water as numerous as the stars of heaven flow in the pleasure garden […] Like a squirrel I pick fruit in the garden of delights. (Bagg 2017)*

Beside augmenting the farming capacity, Sarong II (722 BCE-705 BCE) imported new techniques after invading Urartu, a smaller empire stretching behind the high mountains of the modern city of Duhok in northern Iraq to the territory of today's Armenia, in 714 BCE. He observed an underground tunnel system for channelling water, a method that was then unknown in Mesopotamia. The use of these systems, known as kariz (Kurdish/Persian) or qanat (Arabic) in later periods, spread to China at the furthest east, and Morocco at the furthest west usage. Transporting water from hilly areas downwards to the plains, their advantage over open channels is that they can add ground water along the route to the main water source, and ensure less water loss. This technology proved to be practical for the Assyrian hinterland east of the Tigris, and was implemented efficiently.

5. King Sennacherib – The Mastermind Behind The Most Impressive Hydraulic Projects in Ancient Mesopotamia

Despite all the kings mentioned earlier, it is Sennacherib (705-681 BCE) who stands out as the most active in matters of irrigation, making the land around his capital Nineveh prosper on a previously unprecedented scale. The relief in his royal residence, the "Palace without Rival", not only shows his brutal ruthlessness in subduing rebellious cities, but also shows very prominently how he oversaw all his construction projects himself, as all orders were given by him personally. During his rule, Nineveh expanded from approximately 150 hectares to 750

hectares, and became a megacity of its time. Sennacherib understood his duty as a king was to invest in public buildings, and he improved engineering work to increase the water supply for his capital and the surrounding land. Like his father Sargon II, he drew inspiration from other regions during his military campaigns, and tried to transplant their knowledge back to his homeland. In 702 BCE and 700 BCE, Sennacherib marched with his troops to the marshes of southern Babylonia. Stimulated by the beautiful landscape of the wetland, he incorporated them into his works in Assyria. In his master plan, he built numerous channels with wires and dams to increase water supply from different sources, not only for Nineveh but also the land around it.

Near the modern village Khinis, he managed to use the topography of a canyon to tap water from the Gomel (also known as Atrush) River to carry part of its water in a canal in the direction of the Nineveh plain. To immortalise his name and his efforts, he carved large reliefs on the riff side of the gorge (Fig. 2), with a detailed inscription of the construction work:

> *At that time, I greatly enlarged the site of Nineveh. I had its [inner] wall and its outer wall, which had never been constructed before, built anew and I raised [them] as high as mountain[s]. Its fields, which had been turned into wastelands due to lack of water, were woven over with spider webs. Moreover, its people did not know artificial irrigation, but had their eyes turned for rain [and] showers from the sky. (Bagg 200)*

Fig. 2: Sennacherib's impressive hydraulic project at Khinis.
Large block stone carved with ancient gods, fallen into the Gomel river.
(Photo by Al Baqer Jaafar)

Sennacherib further mentioned eighteen cities in the mountain area from which he dug canals to direct their courses into the Khusur River. He continued describing how he had dug a canal to Nineveh itself. As a good King, he stated that his work was done in accordance with the wishes of the Assyrian chief god Ashur, "by the command of the god Aššur, the great lord". He boasted further about his achievements compared to the kings before him:

> *I d[u]g [that] canal with [only] seventy men and I named it Nār-Sennacherib. I added [its water] to the water from the wells and the canals that I had previously d[ug], and [then] I directed their courses to Nineveh, the exalted cult center, my royal residence, whose site [the king]s, my [ancestor]s, since time imme[morial] had not made large [enough], nor had they expertly carried out its artful execution. (Bagg 200)*

To underline the extent of his empire, he described how he filled the gardens around Nineveh with every type of fruit and spice from around his conquered territory. Proudly, he also addressed his successors, describing the incomparable work that he achieved with a small amount of manpower in a very short period:

> *[To] a later ruler, one of the kings, my descendants, who deliberates [the matter] in [his] heart but is not able to believe [it], [and] s[ays] "How did he have this canal dug out wi[th] (only) these few men?": [I swear] by the god Aššur, my great god, that I dug out this canal with [only] these [men]. Moreover, I completed the work on it within one year [and] three months; […] was completed [and] I finished digging its excavation." (Bagg 200)*

King Sennacherib continued over many more lines counting his numerous achievements, ending his inscription with a curse:

> *At any time [in the future], a future ruler, one of the kings, my descendants, who desecrates the work that I have done, dismantles the [canal] system that I have constructed, [or] div[e]rts the flow of the waters of these canals from the plain of Nineveh: May the great gods, as many as are named in this stele, by their holy decree, which cannot be al[tered], curse him with a harsh [curse] and overthrow his dynasty. (Bagg 200)*

Despite his threats, it was the ravages of time that rendered his great hydraulic innovation obsolete; the canal dried out within a few generations when Nineveh fell and his capital lost its glory.

6. Hydraulic Innovations as Inspiration for Modern Engineering to Solve Water Problems

The greatest innovation under Sennacherib's rule was the construction of an aqueduct (Fig. 3) to bring the water from his canal at Khinis gorge over a depression from a wadi (a riverbed that only carries water seasonally and is otherwise dry). It was an engineering masterpiece for ancient Mesopotamia, hundreds of years before the Romans built their first aqueduct. The aqueduct was over 280 metres long and 22 metres wide. On its highest side, it must have been almost nine metres high. The large stone blocks were carved with unfinished writing in cuneiforms; they were made for an administrative building, but the earlier project appears to have been cancelled, and instead the blocks were installed in random order at the aqueduct. Only a few blocks carry an original text from Sennacherib, in which he claims to be the constructor of this very first bridge for water:

> *[I am] Sennacherib, king of the world, king of Assyria. For a long distance, from the River Ḫaz[ur] [I had a canal dug to the meadows of Nineveh]. Over deep-cut wadis, I had an aqueduct of white stone blocks made, [and those waters I caused to pass over it]. (Bagg 200)*

Fig. 3: The aqueduct of Sennacherib at Jerwan – an engineering masterpiece.

(Photo Al Baqer Jaafar)

The topographic challenges of the landscape were taken into consideration in all hydraulic projects, to make them as efficient as possible. As Sennacherib described, he made many canals to direct water courses, but because of the height differences from the water source to its destination, the water was racing downstream and the flow needed to be slowed down to avoid damages by the water force. After seeing and being inspired by the marshes in south Babylonia, Sennacherib ordered the creation of an artificial wetland in 703 BCE:

> *To make the orchards luxurious, from the border of the town of Kisiri, to the plains of Nineveh, through mountain and low land, with iron pickaxes I cut and directed a canal. For a distance of [1 1/2 bëru] I caused the flow there [of] everlasting waters from the Tebitue. Inside those orchards, I made them run in irrigation ditches. (Bagg 200)*

Modern engineers still advise such methods for regions with water shortage, to create a low-cost solution for sustainable water supply. Such a wetland received the water and slowed down its flow, and attracted wild animals. In this wild reservoir, the king enjoyed the pastime of hunting.

Another hydraulic innovation was the kariz, introduced by his father Sargon II. Sennacherib improved by creating a tunnel from the river Bastora to the ancient city of Arbail (modern Erbil):

> *I, Sennacherib, king of the world, have dug three rivers in the Khani Mountains above the city of Arbail, and added the waters of springs from the right and left sides and made the canal run to the middle of Arbail, the seat of the great lady god [I]shtar, and made the course of it straight. (Bagg 200)*

The distinctiveness of this tunnel was not only in how it took its resources from groundwater, but also from the river. It was built against the direction of the water flow, to let the water run into the tunnel's opening more easily. The Bastora originates from the Safin Mountain and the Salah-i-Din area (Khani Mountains); while its banks are wide, today only a thin stream finds its way through the dry bed to the Higher Zab.

7. Gardens for Relaxation and Tree Shades for Resting – Authorities' Duty to Their People

Under the Assyrian kings, the hinterland of Nineveh developed into extensive farmland, including garden cultivation with diverse plants and herbs, but also into places for relaxation. The intensive planting program development in the Assyrian hinterland must have been the

origin for the synthesis of the "Hanging Gardens of Babylon". When the ancient Greek historian Herodotus visited the region, he was impressed by the fertile land. He describes agricultural production of wheat, barley, sesame, and millet, crops that to the present day are cultivated in the area.

In turning the dry landscape into a green and fruitful region under human control, the Assyrian kings continued a long tradition that had been recommended by the Sumerian king Shulgi, to plant trees in the fields for the wellbeing of their people: not only for food consumption but also in rural areas for places to rest during travels:

> *Because I am a powerful man who enjoys using his thighs, I, Shulgi, the mighty king, superior to all, strengthened [?] the roads, put in order the highways of the Land. I marked out the two-hour distances [and] built there lodging houses. I planted gardens by their side and established resting-places, and installed in those places experienced men. Whichever direction one comes from, one can refresh oneself at their cool sides; and the traveller who reaches nightfall on the road can seek haven there as in a well-built city. (Bagg 200)*

In a region with high summer temperatures, shade is needed to provide cooling and restful spaces. For this reason, water use for cultivation not only has an economic motivation, but is also an important addition to the landscape for ease and pleasure. This is a tradition that has had a major impact in the modern day, where, for example, urban planners provide parks in their communities and plant trees on the sidewalks.

8. Facing Challenges and Conflicts in Sustainable Water Mmanagement

The climate in Mesopotamia makes access to water resources essential. Settlements have been abandoned when water can no longer be secured due to the changes of river courses or mismanagement of canals. For this reason, the ruins of ancient cities such as Uruk, Ur, Kish, Lagash, Girsu, and many more, are found today in arid regions, while a few millennia earlier they were flourishing cities of the Euphrates and Tigris, with the sea much closer to them than the current location of the Persian Gulf. To this day, access to clean water is the main essence of our livelihood; however, it is in danger due to climate change and dam building that reduces water inflow. The unique and long-lasting lifestyle in the marshes was completely destroyed after Saddam Hussein solicited an order to dry out the wetland by stopping the water flow through dams. While the marshes were slowly rehabilitated after the fall of the regime, there exists another threat to water flow and access: efficient regulation on waste-management in Iraq is missing, resulting in pollution inflows

from urban areas and a degradation of the water quality downstream. The importance and the value of the waters is lacking the attention it deserves from a major part of society, as the past conflicts in the country dominate the topics of public conversation while water issues take a back seat.

9. Mediating Water Conflict to End Wars on Water

The ancient cities were independent city-states with loose alliances, creating the Sumerian civilisation of Mesopotamia in what became later Babylonian territory. The city-state of Kish was the strongest among them. The first legal agreement on water resources was drawn up by King Mesilim of Kish, around 2600 BCE. He acted as external mediator regarding the fertile valley on the border between the cities of Umma and Lagash, irrigated with a canal from the Tigris. Both cities claimed control of the canal; in a royal inscription, Urnanshe, king of Lagash, listed his accomplishments as ruler, constructing temples and palaces and digging nine canals for his city-state, including the canal in question. King Mesilim marked the boundaries with a stone stele, also known as the "Mesilim Treaty". One of the agreements in the treaty stipulates land lease for cultivation by Umma on Lagash territory, with an annual rental fee to cover the costs for the maintenance of the irrigation system. The authorities in Umma did not pay the rent they owed for several years, accumulating debts towards Lagash. A military conflict broke out from the dispute, becoming the first recorded war in history that was fought over water access. Several military campaigns were carried out by the king of Lagash Eanatum around 2470 BCE, and his nephew Enmetena around 2430 BCE, with the ultimate defeat of Umma. The conflict was resolved with Umma being forced to accept paying for the reconstruction of the canal, and changing the boundaries settled by Mesilim 200 years earlier.

The defeat of Umma was depicted on a stone stele today called the "Vulture Stele" (Fig. 4), recording Eanatum's victory. The broken fragments of the stele are reconstructed and are on display at the Louvre in Paris, after having been recovered from the ruins of Tello, the ancient city of Girsu. The stele depicts Eannatum leading a phalanx of soldiers into battle, trampling over their enemies; vultures fly above, carrying the heads of the dead soldiers. On the reverse of the stele is a mythological scene, with the mother goddess of Ninhursag holding the enemy's soldiers captured in a net and striking them with a mace. This artistic composition gives credit for the victory not only to the king and his soldiers, but to the support of Ninhursag, one of the seven great deities of the Sumerians. With the support of Ninhursag, goddess of the mountains and fertility, King Eannatum could not only settle the conflict, but also ensure his legitimacy as a ruler, personally and actively ensuring the

Fig. 4: The so called "Vulture Stele"

showing the defeat of the city state Umma under King Eanatum. Excavated at Tello and showcased at the Louvre in Paris.

keeping of the peace and securing water to ensure his land's fertility. However, the newly-established peace did not endure for long, and the conflict between Umma and Lagash repeatedly re-emerged, albeit on a smaller scale, for many generations. It was only finally settled by external political events, when the two city-states lost their independence and fell under the control of the Akkadian Empire.

Another territorial conflict over water access occurred at the end of the third millennia BCE during the third dynasty of Ur, again in southern Mesopotamia. The rulers of the city-state of Ur considered the Amorites, a nomadic pastoral group to the west, a threat to their own territory. King Shulgi ordered the building of a great wall between the Euphrates and Tigris, named Muriq-Tidnim, or "to repel the Tidnum Amorites", so that they could not water their flocks on the banks of the River Abgal, Tigris, and Euphrates. How exactly the conflict reached a stage of physical territorial separation and restriction of water access remains unclear, since the two societies had previously interacted peacefully. Between the nomadic Amorites and the urbanised Sumerians, there was a relationship based on mutual interest and exchange of animal products in

return for agricultural goods and crafted objects. Many Amorites had already integrated into the urbanised society of Mesopotamia, and some Amorite individuals held even high political positions in it. Nevertheless, the societies were rivals, and may have conflicted over local hegemony, as well as practical problems arising with a growing demand for water. However, Ur's restriction of the Amorites' access to water did not go unanswered. The commander tasked with building the wall, Puzur-Shulgi, struggled as the construction work came under Amorite attack, and wrote a letter to Shulgi to request more men to defend the site and to hasten the erection of the wall:

> *The enemy has replenished his strength for battle. However, my strength is limited. I cannot strengthen the fortress further or guard it […] against him. […] As for the sector […] of, the manager of the Sigsig watercourse […] lengths of […] on top of it are no longer fixed. […] As for the sector […] of Takil-Ilishu, the canal inspector […] of the Ab-Gal and Me-Enlila watercourses: 50 nindan lengths of the edge have been removed, and in the middle of it they collapsed. (Black et al. 1998-2006)*

Puzur-Shulgi not only complained about the raids during the construction work, but also reported on the occurrence of complications along different sections of the wall under the supervision of various officials and inspectors. This correspondence between the commander and his king shows how water management suffered under heated and violent circumstances.

In the early stages of Mesopotamian civilisation before urbanisation, seasonal rainfall in the north made rainfed agriculture very efficient, while in the south the use of water canals was essential for farming. Sustainable water use required different stages of water management and regulation, so that irrigation would not lead to flooding, desertification from removing too much water from the rivers, or unwanted salinisation from ruining fertile land. Water irrigation began with simple and most probably locally-organised systems, and evolved into complex state-managed schemes that involved large-scale hydraulic techniques, and building canals with governmental financial support and supervision, including frequent maintenance. As mentioned above, the concept of rulership in Mesopotamia centred on the provision and protection of secure cultivation as the economic foundation of the region. The role of state institutions in these matters thus included not only the construction and maintenance of irrigation infrastructure and the distribution of water, but also the management of labour duties, including payment, and of course the resolution of small- and large-scale conflicts, internally with local communities or regionally with rival groups.

10. Regulation and Policy Making on Water Control Reflected in Ancient Codes and Laws

In addition to irrigation technologies and skilled manpower, water management required some form of legal frame or code, to provide solidarity, responsibility, and accountability with consequences if legal agreements were broken. No detailed guidelines on the organisation of water control and the role of the authorities have survived, but the few available laws from different periods and regions emphasise a common sense of equitably and responsibly sharing water. It appears these are reactions to issues that arose frequently and needed suitable and just regulation. A sense of the socio-political complexity regarding water management can be obtained from the ancient text of cuneiform clay tablets, such as official letters or collection of laws and other inscribed materials.

Laws in ancient Mesopotamia covered a wide range of public and private affairs, including marriage, property rights, and minor and major crimes, as well as the resolution of conflicts between different parties. The oldest preserved law code written on cuneiform tablets comes from the reign of King Urnammu (2100–2050 BCE). It is not preserved completely, and nothing direct on water regulation is recorded. Nevertheless, two paragraphs mention the "river ordeal" to prove the innocence or guilt of a person accused of witchcraft or adultery:

> *If a man accused the wife of a man of adultery, and the river ordeal proved her innocent, then the man who had accused her must pay one-third of a mina of silver. (Civil 2011)*

This action was only taken when other attempts to solve the case had failed; the court sought a judgement from water, which was considered as a divinity itself, or at least a direct creation of the gods. The tradition of dunking suspects into bodies of water was in use during Christian medieval Europe until the 17th century. This juridical role of the river in such cases links water to its divine origin, enabling it to dispense justice within the Mesopotamian worldview.

11. Shamash and Hamurabi As The Most Prominent Law-Makers

Around 300 years later, we can read the first laws concerning water in the famous Codex of Hammurabi (Fig. 5), one of the oldest and completely preserved law-codes. The laws were not newly invented by King Hammurabi, but rather represented a continuity of a long tradition and adaptations of older laws. The Codex of Hammurabi takes the shape of an index finger over two metres high, made of black stone. Whilst older written laws are known to have existed, the black stone of Hammurabi is one of the most significant legal objects for two reasons. It was

excavated not in Babylon (Hammurabi's capital) itself, but in Susa, the capital of Elam. Hammurabi's Babylon gradually sunk under water with the rise of the groundwater level over time. The Elamite king Shutrul-Nahunte conquered the city in the 12th century BCE, and plundered its palace and temples. He and his army took valuable objects, including the Hammurabi stele, to their own capital, around 700 years after the stele's first erection in Babylon. This is significant: while Hammurabi's ruling dynasty had long vanished, the value of his code was such that it was preserved for hundreds of years by successive generations of Babylonians. The fact that the Elamite king did not destroy the stele, but rather transported it undamaged to his palace, also reflects the degree of respect and appreciation for the code of Hammurabi, even from the Babylonians' prolonged arch-enemy. Its value is also shown in the existence of ancient copies spread around different ancient Mesopotamian cities, but also in modern times: the original object, displayed at the Louvre Museum, has become one of the most reproduced objects of ancient Mesopotamia, with replicas standing in numerous museums, as well as at the Law School of Chicago, and in other universities.

The black stone stele of Hammurabi displays on its front, at the top, an image of the king facing the seated Shamash, the sun god who brings light over darkness and is the fulfiller of justice and equity. Underneath the scene, 282 laws dealing with diverse matters are listed. In the

Fig. 5: The Codex of Hammurabi with 282 laws. Excavated at Susa in Iran and exhibited at the Louvre in Paris.

preamble, King Hammurabi claimed to have received these laws directly from Shamash; it was the king's role as ruler to fulfil and enforce the divine laws over his subjects. Four laws refer in detail to water policy, paragraphs 53 to 56:

> *53) If anyone be too lazy to keep his dam in proper condition, and does not so keep it; if then the dam break and all the fields be flooded, then shall he in whose dam the break occurred be sold for money, and the money shall replace the corn which he has caused to be ruined.*
> *54) If he be not able to replace the corn, then he and his possessions shall be divided among the farmers whose corn he has flooded.*
> *55) If any one open his ditches to water his crop, but is careless, and the water floods the field of his neighbour, then he shall pay his neighbour corn for his loss.*
> *56) If a man let in the water, and the water overflow the plantation of his neighbour, he shall pay ten gur of corn for every ten gan of land.*[1]
> *(King 1910)*

The cited laws reflect the mandatory responsibilities for the safe and secure use of water canals in the agricultural fields, preventing harm being done to other neighbouring farmers. Financial reparations were required from the accused to compensate the loss of neighbouring fields. The paragraphs cover active, but also passive, actions of a suspect: having access to water irrigation comes with the responsibility of maintaining the canals, to avoid damage resulting from negligence, and to ensure a controlled and deliberate use of water with properties kept in consideration.

(1) Gur and gan were Babylonian units of weight.

12. Conclusion

We have seen how important the rivers were in ancient Mesopotamia, and they continue to have an indispensable role for the modern state of Iraq. The review on the different challenges, innovations and role of water management both in the past and today are the pillars of peacebuilding. Looking into ancient resources provides us fruitful inspiration for our coming generation to create a better future. Learning from the past is the first step of improving the present.

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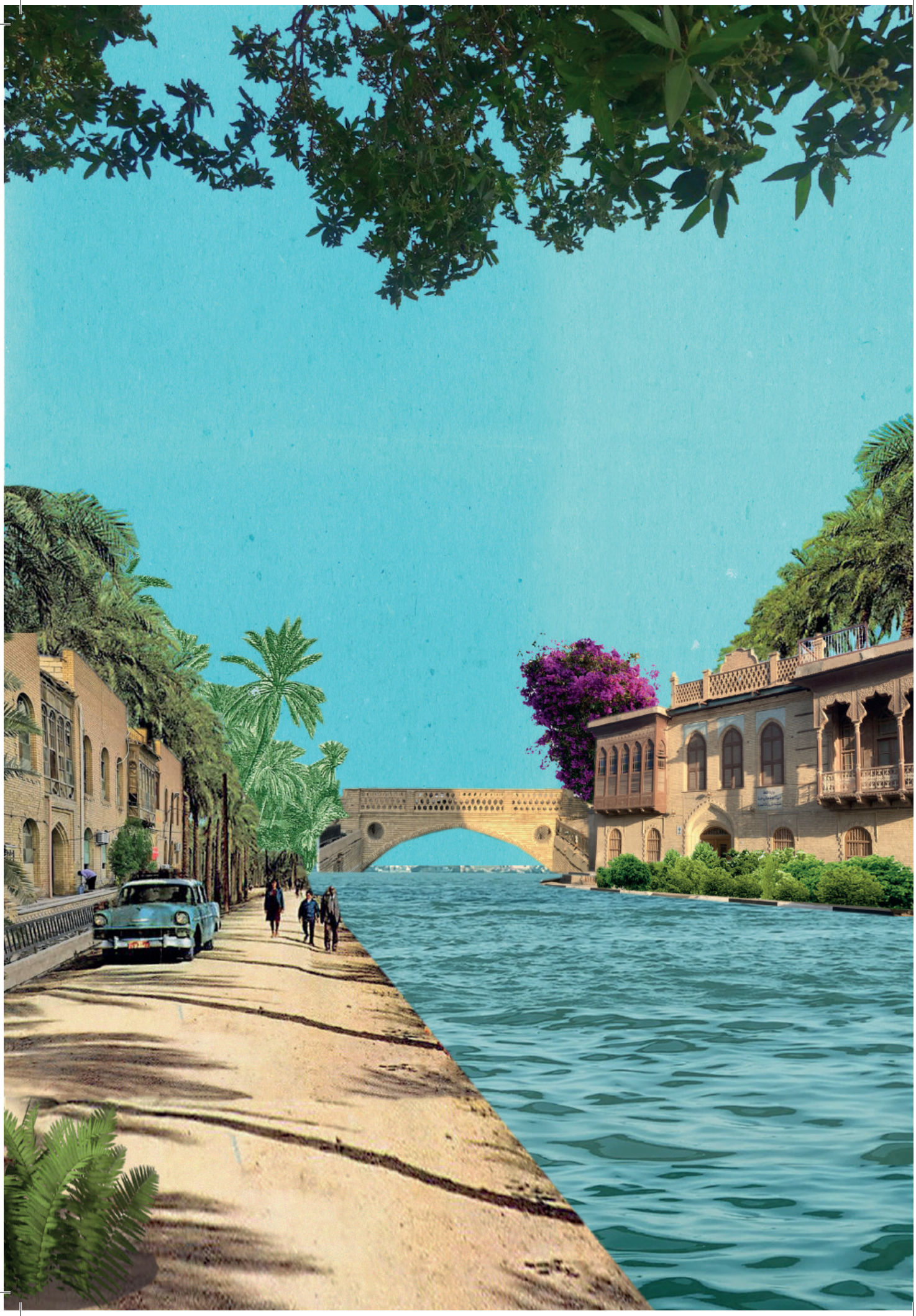

V

A Green and Sustainable Vision for Basra

Dr. Broder Merkel, Dr. Sameh W. Al-Muqdadi,
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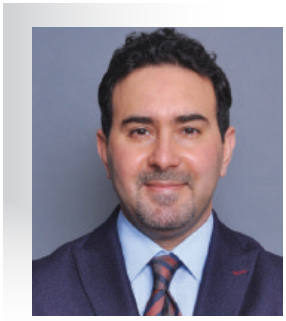
Dr. Broder Merkel

Broder Merkel is a German expert on water and environment. He worked for many years as Professor in TU Bergakademie Freiberg, as well as in many countries in the Middle East, Africa and South America. Today he works as a consultant, editor and author. He is convinced that supplying safe water for the still growing world population is the biggest challenge in the near future.



Dr. Sameh W. Al-Muqdadi

Sameh is an expert on Water management, Water conflict and resolution, holding a PhD from TU Bergakademie Freiberg. He is the founder of Green Charter GC in Germany for Water and Environmental consultancy. Sameh has led several international projects in Europe and the Middle East. He firmly believes that water could be a source of cooperation and peace rather than a reason for conflict.

1. Introduction to The Former 'Venice of The Middle East'

The city of Basra was built in the beginning of the Islamic era in 636 AD. The harbor city was located in the north of the Arabian/Persian Gulf on the strategic location of the Silk Road. The population of the city of Basra peaked in 1977. During the 50s, 60s, and 70s, Basra was called the Venice of the Orient, just as Beirut was called the Paris of the East or the Pearl of the Orient. Today, one can only

Past and present view of Shatt al-Arab corniche

(Copyright Dr. Nawrast Abdalwahab)

imagine the beauty that once characterized this city with great imagination.

However, the population of Basra declined remarkably during the Iran-Iraq war (1980-1988); this, along with both the Gulf war (1990/91) and the US-Invasion of Iraq (2003), had major negative impacts on the city. The aftermath of these wars, together with the deliberate destruction of marshlands during the early 1990s, have another devastating impact on water quality and quantity, the ecosystem, and people. Furthermore, the restoration of the marshland after 2004 had further negative impacts on Basra, specifically due to the changes to the natural system of Shatt al-Arab, which consequently increased its salinity.

Everything in Basra has changed since then: flair, charm, smell, lifestyle, and architecture. The taste of the city as one of the most modern cities in Iraq has gone. Even the memories of people have been deeply affected. The progression of three wars has resulted in an obliterated identity of the city and its people. It is clear that Basra nowadays stands by the ruins of its glory during the 60s and the 70s of the last century.

Basra, like Baghdad and Mosul, has been well known for its diversity and plurality. But the population growth rate and demographic distribution have changed dramatically. Furthermore, the challenges of climate change, water shortage, desertification, and energy consumption, together with poor management, has complicated the current image of the city. The main outcome is an alienation of oneself from the city.

For the last 30 years, people in Basra have been buying water for drinking and cooking. All families engage in this activity, especially the youngest. Therefore, it is quite common to see a young boy or girl with a small jerrican crossing the street to buy water from the neighbor, who is the owner of the closest tank with reverse osmosis (RO) water. Only middle-class families have their own RO tank in their garden, which is refilled once a week by calling the vendor.

Dr. Nawrast S. Abdalwahab

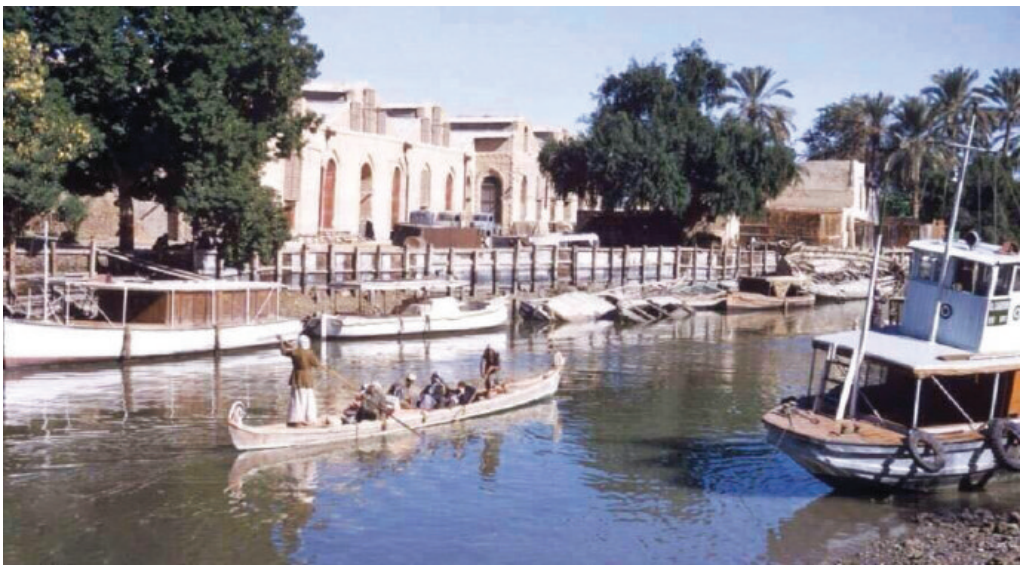
Nawrast is a Geologist and Lecturer at the University of Basrah. She earned her PhD degree of Geology in 2013, from University of Mosul- Iraq. Her research focused on the Basin Analysis of the under-discover Gas and Petroleum of Akkas Field, Western Iraq. Nawrast has a special interest in moving beyond scientific paradigms to philosophical inquiry. In addition to Geology, she lectures on Philosophy of Science and Environmental Geology. Since 2016, she has collaborated with artist Kelcy Davenport to create «From Basra to Cambridge and Back», an ongoing art-geology research project. Nawrast's research on the interdisciplinary of geology and art has led her current project into geology and art as a sustainable approach for complex areas.

Zina Riadh Abdulla

Zina is an architect and academic with a strong passion for environmentalism and sustainability. She has practical professional experience in working with international NGOs on themes such as youth engagement and leadership, entrepreneurship, and higher education development.

Scrap on Shatt al-Arab

(Copyright Dr. Nawrast Abdalwahab)



Just like Venice, this photo shows the typical style of boats called "Ashari".

These boats were built of wood and used in the 19th century and the first half of the 20th century. Their structure is based on the millennia-old reed canoes called Mashḥoof (Arabic: مشحوف), used in the marshes from the very beginning of civilization.

The political and deliberate drying up of the marshes in the early 1990s has had huge effects on the environment, then and now.

The crisis of Basra was exacerbated in 2018, when protests broke out in June with demands for the enhancement of public services, and again in July due to extensive electricity cuts. The crisis reached its peak during August 2018, when up to 118,000[1] people were poisoned by polluted drinking water. The largest wave of protests rose in September with riots and fires set at 12 local political parties' offices. Although waves of protest began in Basra after the 2003 US-invasion for various political, economic, and social reasons, the September 2018 demonstration was the first big protest that was primarily for health and environmental reasons. Women took part in this demonstration in large numbers. The water crisis can be considered a turning point in the nature of civic engagement and alienation from the local government and all political parties in Basra. Moreover, the call for autonomy and independence from the central government in Baghdad was reactivated during November 2018.

Interviewing Basrawis….

Today Basra is an unsustainable city, in terms of water, waste, energy, and environment. To explore these issues, particularly the conditions of water services, we interviewed 46 of Basra's citizens. The questions in the survey were designed to investigate public awareness, consumption patterns, the government and water management performance, the non-governmental organizations' (NGOs) and private sector's roles, as well as other challenging knowledge amongst the respondents.

The results show that 97.8% of the respondents buy drinking water. Nearly half of these buy more than 1000 liters of water per month. Tap water is used for other domestic and personal usages,

(1) Basra is Thirsty. Iraq's Failure to Manage the Water Crisis. 2019 Human Rights Watch

while groundwater and treated water are rarely utilized. A vast majority of Basra people need suction pumps in their houses to fill their rooftop tanks, due to a very low water pressure in the water network. Furthermore, 60% of the respondents do not receive a water bill, while the majority of the respondents would agree to installing a water metric in their houses. However, not only are technical problems in the water pipes common in most Basra districts, but water knowledge is also insufficient.

The lack of trust in the government's management, performance, regulation, cooperation, and negotiation is evident in most respondents' answers. Indeed, well over half of the respondents think that the local government is responsible for the water shortage in Basra. Moreover, the vast majority of people said that oil companies in Basra do not provide clear figures of the quantity of water used in oil production, and that oil companies do not follow environmental regulation, proper treatment, or remediation methods. Similarly, the majority of the respondents think that there is no clear regulation to govern and manage the water shares between the governorates; in addition, they think that the government does not negotiate well with upstream countries to manage the water shares, and that even the restoration of the marshland was not efficiently implemented.

Significantly, three-quarters of the surveyed citizens were unsatisfied with water desalination and treatment by the private sector that already existed in Basra. However, the majority of Basrawis think that NGOs and the private sector could contribute positively in order to solve the water issues, and that the government should cooperate with both. On the other hand, although more than half of the respondents have never volunteered in any campaign related to water and environment, the majority of them are ready to volunteer in any type of these campaigns in the future.

The interviewees also think that agriculture patterns, irrigation systems, and power generation in Basra should be replaced by less water-consuming devices and sustainable and renewable power generation methods. More than half of the respondents agree with Basra's local government plan for seawater desalination, while more than three-quarters of the respondents think that the mitigation of climate change will decrease water scarcity.

2. What's Going Wrong?

Basra is a major metropolitan city suffering from urban heat island effect, with the city center being much hotter than the rural surrounding areas. This is caused by an increase of gas and fine dust emissions due to traffic and diesel-based electricity production, lack of green areas, and roads and sidewalks made from materials that trap heat during the day and release it during nighttime. Basra

is facing multidimensional deficits and challenges with respect to water, energy, and environmental and social issues; these include high unemployment rates, particularly of young people, as well as the city's infrastructure, and lifestyle in the city. Additionally, Basra and other cities in Iraq are facing problems with extreme population increase. These challenges will inhibit the development of the city in the future. Therefore, the deficits first need to be identified, then they need to be analyzed in-depth, followed by an investigation of causes, and finally a search for intelligent solutions.

2.1. Navigation in The Fog

Navigation in fog is difficult and dangerous because one can see nothing. The first step to solve such a miserable and disastrous situation is to gather data about the situation: where am I? What are the obstacles? Where do I want to go? In the case of the city of Basra, the problem already starts at this point, because the knowledge about natural and operating resources, regarding their quantity and quality, is anything but sufficient. This is true for almost all issues addressed in this report, and starts with the demand for energy and water needed because the number of inhabitants is uncertain. Insufficient data about existing power lines and the conditions (diameter, leakage rate, quality) of pipe networks for both tap water and wastewater make it difficult to estimate the current ability of the system in place. There is also insufficient data regarding the actual number of residential houses and apartment buildings in the city, and no accurate information regarding the energy they need or power flow calculations. The same applies to most major facilities in the city, such as kindergartens, schools, hospitals, and other infrastructure.

2.2. Gifts Maintain Friendship

Gifts are important for human relationships; corruption is something else. Corruption can be defined as the illegitimate use of power to benefit a private interest. It occurs around the world on very different scales: from the policeman putting a fine of 10 dollars in his own pocket, to the politician transferring millions of dollars to the Cayman Islands or another tax haven. One important but not isolated factor is the lack of a sense of guilt, which is linked to tradition, socialization and education. Corruption occurs more or less everywhere, in the private sector, the public and private industry, and in NGOs as well. Not all institutions are interested in fighting active and passive corruption. This is true in particular for the private industry and the public sector in non-democratic states.

Corruption is a particularly chronic challenge to the "new democratic" system in post-2003 Iraq, and occurs at different levels and sectors. It is an acute threat to social harmony and to the government's stability and performance. According to Transparency International[2], the

(2) https://www.transparency.org/en/countries/iraq

corruption perceptions index for Iraq is ranked 162/180, which means Iraq is among the top 20 countries worldwide with regards to the prevalence of corruption. A field study shows that corruption in Iraq is systematic, with half a million Iraqi citizens having paid 1.9 million bribes in one year to civil servants[3]. One Iraqi government official estimates the total loss due to corruption to be as high as 300 billion USD from 2005 to 2018[4]. The lack of protection for reporting corruption by "whistleblowers", as well as the lack of awareness of anti-corruption authorities, are major reasons for this.

A good example of water-related corruption is the Al-Faw Desalination plant, which was established back in 2009 in Basra city; the capacity for this plant is 400 m^3/hour and cost ~ 13 million USD. The federal government signed the contract with a private company. In 2010, four hours after the grand opening, the project had already failed, for an unknown reason. Some references claimed that it was because the company did not conduct any ground engineering assessment; the plant was not fit for desalinating water in these areas, because of the high amount of mud in the water[5]. Despite the several official investigations, no results were announced about the failure, but all of the media suspected the project had failed due to corruption[6].

2.3. Education Has to Breed Confidence

Education is a complex process regarding the acquisition of knowledge, skills, beliefs, habits, and ethical and environmental awareness. Learning starts early in the family and is continued in school and during further education (university or vocational training). Ultimately, learning is a lifelong process, but early socialization is the most important factor. Furthermore, education at school depends on many factors, such as the quality of teachers and the purpose of learning, which can be somewhat related to the state's political and/or religious goals. Poor education is often related to the fact that children and juveniles do not spend enough time at school, or to an inadequate curriculum. But even more importantly, poor education can be caused by a certain ideology forced by the state, or by cultural hegemony and socialization in dysfunctional families and clans that deny equal rights and the right of self-determination, in particular for women and girls. The Iraqi educational system was one of the best in the Arab world in the 1970s, but needless to say, it suffered from three wars and the sanctions[7].

(3) https://www.unodc.org/documents/publications/2013_Report_on_Corruption_and_Integrity_Iraq.pdf

(4) https://nationalinterest.org/feature/corruption-iraq-where-did-all-the-money-go-16279

(5) https://www.hrw.org/report/2019/07/22/basra-thirsty/iraqs-failure-manage-water-crisis

(6) http://burathanews.com/arabic/news/168762

(7) http://www.uruknet.info/?p=13605

2.4. Old Is Gold

Iraq goes back to the civilization of ancient Mesopotamia. The name consists of two Greek words: meso,meaning between, and potamia, meaning rivers. Archaeological findings discovered golden art objects and remnants of high cultures in the ancient city of Ur and many other places. Since then, the country has had an eventful history. For the past five centuries, Iraq has struggled to find its own national identity. The country has gone through different political systems, starting with the Ottoman Empire. During that time, it was often a battle zone between the tribal alliances of Mosul, Baghdad, and Basra. As a result of World War I, immediately after the collapse of the Ottoman Empire, Iraq became a British mandate, and a monarchy was imposed. However, the monarchy faced unrest and many coups in a period of political instability. In 1958 the monarchy was overthrown by a military coup and a new order emerged, represented by the Republic of Iraq. In the period between 1958 and 2003, Iraq witnessed several significant events that influenced its national identity (i.e. nationalism, socialism, communism, and a dictatorship). Although the political systems mentioned above show differences, there is one commonality: all were centralistic. In 2003, the United States of America invaded Iraq and settled a new political order. Like the British did after WWI, the USA exported their federal political system to Iraq, which implied a rigid shift in the history of Iraq's political system, from centralization to decentralization. These prominent events and the coexistence under several forging political orders have profoundly influenced the Iraqi identity.

The definition of identity has been a matter of ongoing discussion among scholars[8]; however, the definition of Kowert and Legro (1996), "Identities are… prescriptive representation of political actors themselves and of their relationships to each other"[9], is truly close to the definition of the Iraqi National Identity statement in the constitution of 2005, which reflects the consensus among leaders of opposing Iraqi politics from even before the invasion of Iraq on April 2003, back to the early 1990s during their rounds of meetings in Vienna and Salah ad-Din[10]. Eventually, the final constitution sets the values of democracy, Islam, federalism, pluralism, and human rights - but most importantly, it "guarantees the Islamic identity of the majority of the people"[11], and declares that "Islam is the official religion of the State and it is a fundamental source of legislation"[12]. Accordingly, dissonance in Iraqi society has arisen because the diversity of the Iraqi people was excluded

(8) Fearon, J.D., 1999. What is Identity (As we now use the word)? https://web.stanford.edu/group/fearon-research/cgi-bin/wordpress/wp-content/uploads/2013/10/What-is-Identity-as-we-now-use-the-word-.pdf.

(9) Kowert, Paul and Jeffrey Legro. 1996. Norms, Identity, and Their Limits. In The Culture of National Security, ed. Peter Katzenstein.New York: Columbia University Press. pp. 451–497.

(10) Feldman, N. and Martinez, R. 2006. Constitutional Politics and Text in the New Iraq: An Experiment in Islamic Democracy, 75 Fordham L. Rev. 883

(11) Iraqi Constitute Article, 2(2).

(12) Iraqi Constitute Article, 2 (1).

from the national identity[13]. Furthermore, the new constitution is clearly set on traditional constituents rather than those of modern states, which are legal, political, and economic constituents.

Indeed, what many Iraqis mean by lack of national identity is the lack of an imaginary national identity amongst Iraqi politician elites themselves, not Iraqi people. In October 2019, 14 years after ratification of the Iraqi constitution of 2005, Iraqi people held the slogan "We want homeland" reflecting their desire for sovereignty over their home, especially in regards to the distribution of resources and respecting the law. Such a slogan indicates the feeling of national identity and unity among the people in opposition to the government and political parties.

In fact, two years back in 2018, the water crisis in Basra contributed to unifying the people with one goal: the elimination of corruption and of the sovereignty of political parties. People realized that the successive governments since 2005 were not serious about solving the water, energy, and environmental problems, but rather contributed to exacerbate them through corruption, poor management, and slackness. Besides, people were witnessing a radical change in the nature of Basra as modern, sustainable, and socially diverse, into an unsustainable, chaotic, and colorless city.

Ultimately, the water crisis in Basra is the environmental identity crisis of the city, which we could imagine to be a project for establishing a new identity for a green and sustainable Basra.

2.5. Again No Electricity...

Power failure is a rare event in many countries, but in Basra (and all of Iraq), it happens daily. Three wars, in addition to sanctions and mismanagement, left the city's infrastructure in very poor conditions. The energy crisis has worsened in Basra and the country since 2003. In 2014, electric power plants in Iraq covered only 38% of the actual electricity demand[14]. Distribution of electrical power supply in Iraq in 2016 according to Ministry of Electricity (MOE) can be seen in the following table:

Type of plant	No. of plants	Installed capacity ((MW	(%) Percentage
Steam turbine	8	3,305	14.6
Gas turbine	36	15,000	66.2
Diesel	20	2,498	11.0
Hydro power	8	1,684	8.2
Total	72	22,667	100

(13) Hussein, M.T and Ali, R.M, 2020. Crisis of National Identity in The Iraqi Constitutional System. Centre of Strategic Studies, University of Karbala. https://www.researchgate.net/publication/340978126_azmt_alhwyt_alwtnyt_fy_dstwr_alraq.

(14) https://openjicareport.jica.go.jp/pdf/12307146.pdf

The table shows that 92% is thermal power from fossil fuel; hydropower in northern Iraq is the only alternative source of energy. No solar power systems are installed, although solar radiation exists in abundance in southern Iraq. Additionally, electrical power is imported from Turkey, Iran, and Kuwait. However, daily interruptions of power supply are common, and individuals and private enterprises, hotels, shops, authorities, and universities have their own power-backup system in place if they can afford it. Most of these are based on diesel.

There have been some attempts in the city of Basra to rebuild power plants in cooperation with international organizations, but the issue is still far from resolved, with the current power capacity covering approximately 67-75% of the demand. The Ministry of Energy has failed to meet the needs of the energy demands. This is incomprehensible in a country that is rich in oil and gas.

2.6. Not Enough Water?

Iraq is a country in an arid climate where water scarcity is common. On the other hand, Mesopotamia is blessed by two rivers, Euphrates and Tigris, which made southern Iraq with its marshes the cradle of modern civilization. However, an extreme growth in population in the last 50 years, the reduction of headwaters of Euphrates and Tigris as a result of dams in Turkey, Syria, and Iran, and mismanagement, are all factors that placed Basra and the whole country in a critical situation.

One can distinguish eight sectors of water use: irrigation, industrial, cooling (mainly power plants), domestic (personal hygiene and laundry, cooking food, drinking), ecosystem services (e.g., maintaining the marshlands), recreational (fishery, boating, and swimming), gardening, and hydropower generation (dams). For the city of Basra, it is mostly industrial (oil-production and cooling in power plants) and domestic water supplies that are important. In the following, we focus mainly on tap water for the city of Basra, but a holistic view must also address the demand for the oil industry, which is situated in the direct vicinity of Basra. Rumaila, the biggest oil field of Iraq and one of the biggest in the world, is only 40 km to the west of Basra. It is important to know that the oil and gas industry consumes and produces water with different quality and in very different quantities. It is more or less impossible to give mean numbers for both because it depends on many parameters (geology, point in time, technology, etc.). Thus, a production well may result in up to 100 liters of water for 1 liter of oil, and may create a wastewater problem because the water is likely to be very salty. On the other hand, drilling a new well consumes water, and a production well in the third phase of production (enhanced oil production) consumes huge amounts of water (and carbon dioxide).

The SWC carrying Euphrates water from Al Nasiriyah to Basra over a distance of 250 km

[copyright Dr.Jassim Al-Maliky in 2018 - Basra]

If one assumes 2.5 million inhabitants for Basra Governorate[15] with 200 L/person and day one ends up with a freshwater demand of 500,000 m^3/day for the entire Basra Governorate for domestic water supply (including small business). However, due to the fact that the tap water network in Bara is rather old and not well maintained, it is very likely that more than 50% of tap water is lost in the network by means of leakage[16]. In consequence, more water has to be delivered into the network or less water is available for the consumers.

Tap water for Basra is supplied mainly by means of the open Sweet Water Canal (SWC), bringing water from the Tigris over a distance of about 250 km to Basra. Due to poor maintenance, the canal's state is very bad and an unknown amount of water is lost on its course due to leakage, evaporation, and illegal draw offs.

Water in the Euphrates (and Tigris) river is subject to elevated levels of sewage, agricultural and industrial pollution, oil spills, and increasing salinity in the vicinity of Basra. Thus, this water is anything but ideal, and fails to meet international drinking water criteria. However, the most dangerous pollutants are microbial germs from human and animal excreta, because they can cause immediate and severe health impacts within hours and days. In August and September 2018, Basra experienced a severe health crisis with more than 118,000 persons hospitalized. It is remarkable that an explanation for this was never given, and that there were no warnings about drinking this water without boiling it for a sufficient amount of time[17]. In general, information about tap water quality and disinfection measures (e.g., chlorination of tap water) is not available to citizens. People in Basra, insofar as they have basic knowledge about water and can afford it, do not drink tap water or cook with it, but rather use bottled water and water from reverse osmosis tanks (TO). However, about 32% of the inhabitants have an income of less than 2.20 USD per day (the poverty threshold in 2010) and do not have access to safe drinking water. The real number may be even higher[18].

32% of the citizens live below poverty threshold and have no access to safe drinking water.

With respect to water supply, it has to be mentioned that Basra receives an average of about 150 mm of rainfall in the winter; however, due to the sealing of soils by buildings, streets, and pavements, the

(15) http://www.iau-iraq.org/documents/378/GP-Basrah 2013.pdf

(16) https://www.eea.europa.eu/data-and-maps/indicators/water-use-efficiency-in-cities-leakage/water-use-efficiency-in-cities-leakag

(17) Basra is Thirsty. Iraq's Failure to Manage the Water Crisis. 2019 Human Rights Watch

(18) Water and Sewage Sectors in Iraq — Sector Report: February 2013

majority of rainwater is lost as direct run off to ditches and to Shatt al-Arab, or is diverted to the canalization since no rainwater harvesting and water storing systems are in place.

As a general rule, water supply has to always be seen in unity with waste water management (sewer pipe system and waste water treatment plants). Therefore, it makes sense to handle this as one entity. If for some reason this is not possible or advisable, maintaining close communication between both entities is necessary.

2.7. Hey, Wastewater Is a Resource!

Because the amount of freshwater needed in Basra city does not account for agriculture irrigation, essentially, the total amount of freshwater (500,000 m^3/d) can be treated and recycled for further use. Basra has about 40 water treatment plants in place. A report from 2013[19] shows that the Basra wastewater plant has a design capacity of 286,000 m^3/d, but only 80,000 m^3/d were actually treated in 2010. Actual numbers for 2020 are not available, but it is likely that the situation today is even worse in comparison to ten years ago.

The state of the sewage pipe net and the seepage rate due to leakages is unknown. Sewage leakage due to broken pipes can easily add up to 80% or more. Thus, a huge amount of wastewater is seeping into the shallow groundwater or is spilled without treatment into the Shatt al-Arab. This pollution of surface water is not acceptable, but even more importantly, this water is irrecoverable and is a total loss for the arid area in question. Under humid climatic conditions it would be less important because excess rainwater is available, but in a water scarce region, the negative effects of this waste are twofold. No data is available with regards to wastewater constituents (solids, dissolved constituents including liquid industrial waste, and pathogen germs), the state of the plant itself, or the waste disposal of the treatment plant's left-overs.

2.8. The Trash Is All Over

According to a study from 2012, citizens in Basra produce 0.6 kg garbage per capita per day; other sources report that the amount is 1.4 kg per person per day. Both numbers are less than the USA statistics that show 2.4 kg per capita per day, but still, Basra numbers create big problems. The main components in the above-mentioned study were food (55%), plastic (25%) and paper (7%)[20]. But the biggest problem is that solid waste management in terms of organized waste collection, transportation of waste, waste separation (organic, paper, plastic, metals etc.), supervised waste disposal, and incineration, composting, or

(19) Water and Sewage Sectors in Iraq — Sector Report: February 2013

(20) https://www.researchgate.net/publication/309592726_Integrated_Solid_Waste_Management_for_Urban_Area_in_Basra_District

(Photos source: Dr. Nawrast Abdalwahab in 2020 - Basra)

waste recycling, is not in place. The fact that citizens lack environmental awareness and follow a throwaway mentality worsens the situation. Thus, it is common that waste in Basra is thrown away and nobody cares. Former city-canals and the Shatt al-Arab transformed to waste dump sites; yet again, nobody cares. If and when waste is dumped in non-controlled landfills, the groundwater would be jeopardized in the long term.

2.9. By The Ruins of Its Glory

Basra, an ancient city and the second largest one in Iraq, has suffered from three wars, urban growth, and negative transformation over time. Lacking prominent infrastructure and suffering from political and environmental issues, the city is no longer the "Venice of the Middle East", as formerly known. The historical center has become an area of abandoned buildings that were once aesthetic landmarks in the region.

Random urban sprawl and growth have led to a city layout that lacks appropriate sociable and livable urban spaces for cultural and social activities. Besides, the absence of green areas has to be addressed. Population growth, air pollution, climate change and other factors have caused an urban heat island (UHI) effect. This is not an unexpected phenomenon for a metropolitan city; however, no steps have been taken to minimize the effects of this phenomenon. The high summer temperatures with tar covered roads and heavy traffic create a cruel micro-climate for the people of Basra. Walking along the once beautiful canals of the city has turned into a harsh experience with rubbish-strewn canals and polluted air. Multiple wars and urban maldevelopment have caused the green city areas to disappear, leading to dust storms which have sadly become a characteristic of the city.

The lack of modern building rules and regulations and a failure in implementing current laws have become serious matters of concern with a wide range of aspects, aesthetic- and energy-wise. The population growth has led to higher demands for residential units, causing land owners to split up their lands into multiple cells. The increasing number of residencies in a certain area, which spiked the population density for that same area, is also an issue that contributed to maximizing the energy demand rates. There are also no rules or regulations regarding building materials and best practice advice to save energy. Many studies have been undertaken by researchers in optimizing housing design but no strategies have been implemented.

2.10. You Can Manage What You Measure

No matter how efficient manpower, technology and solid management are, without good governance and sophisticated policies, the system is likely to collapse. It is unclear in this context who is responsible for water governance and environmental policies in Basra. Is it the local or the federal government? Moreover, which authority is responsible for monitoring and updating these policies? This is a strategic shortage that needs to be bridged because such a deficit would influence the establishment and sustainability of any water- and energy-related projects.

2.11. Summary of Deficits

Living in Basra is anything but easy for a number of reasons: i) the electrical power supply is not stable without a private back-up system at home and in the office, ii) water from the tap is not drinkable without

elaborate treatment (cooking, reverse osmosis filtering), and iii) solid waste management does not exist and leads to the feeling of living in and on a waste dump site. In the summer, the city-climate is hot, humid, and difficult to endure without air-conditioning. Furthermore, the city does not have green areas with shade-giving trees, public transportation is not in place, and sandstorms are frequent. In addition to what every citizen of Basra endures on a daily basis, one has to consider that the missing or non-functioning solid-waste and waste-water management aggravates the water problems of Basra by contaminating soils, groundwater, and surface water in the city and its vicinity. Thus, the situation is constantly worsening and there is no hope in sight for recovery.

3. What Are The Reasons?

3.1. Geography and Neighboring Countries

In general, Iraq is characterized by semi-arid to arid climate, but it is blessed by two rivers (Euphrates and Tigris) delivering huge amounts of water to the country, which led to the early development of high civilizations in the area of Mesopotamia[21]. However, both rivers arise from Turkey and therefore generate a common conflict that will be addressed below. Groundwater is recharged in mountain areas in the East of Iraq (Kurdistan) and in Saudi Arabia in the West. The latter is a classic case of transboundary groundwater, mainly in the Damam and Umm er Rum aquifer. However, these aquifers are rather deep (<400 m) in the Basra area and not well explored. For several reasons, the shallow Dibdibba aquifer contains water with increased salinity. Thus, Basra is mainly dependent on river water (Shatt Al-Arab).

All over the world, the last 10,000 years (Holocene) have been much warmer in comparison to the last glacial period. However, significant climate changes occurred during the Holocene, which affected temperatures but also rainfall (amount and distribution), both time-wise and area-wise. One interesting example is the change in the climate of the lower Tigris and Euphrates area (Mesopotamia), with wet periods during the mid-Holocene, which is apparent in sediment load and composition[22]. The West African monsoon dynamics in the mid-Holocene, which caused a greening of the Sahara[23], is likely to be correlated with the wet period in the Tigris and Euphrates region. During the development of advanced civilization in Mesopotamia, irrigation technologies based on ditches and water harvesting,

(21) Mithen, S. J., 2012. Thirst: water and power in the ancient world. s.l.: Harvard University Press.

(22) Aqrawi, A. A., 2001. Stratigraphic signatures of climatic change during the Holocene evolution of the Tigris–Euphrates delta, lower Mesopotamia. Global and Planetary Change, 1 2, 28(1-4), pp. 267-283.

(23) Gaetani, M. et al., 2017. Understanding the Mechanisms behind the Northward Extension of the West African Monsoon during the Mid-Holocene. Journal of Climate, 30 10, 30(19), pp. 7621-7642.

including water supply in houses (for the first time ever), were invented. People at that time learned to cope with severe climate change scenarios. Salt water intrusion in the south of Iraq (Basra region) and the development of the marshes were one of the most severe consequences.

In recent times, Shatt al-Arab was formed from four rivers: Euphrates (24%), Tigris (35%), Karkhe (8%), and Karun (33%). Both Karkhe and Karun rivers flowing from Iran have been completely cut off from the Shatt al-Arab by the construction of dams. Both upstream countries, Turkey and Syria, constructed several dams, which impacted the water quality and quantity and decreased the flow from Euphrates and Tigris by at least 40%. Furthermore, wastewater from agricultural irrigation canals in all big cities including Baghdad is spilled without treatment into the Euphrates and Tigris, leading to a diminishing of the water quality. Besides this, the Ministry of Water Resources decided to divert river water to the marshlands to restore them. This also decreased the quantity of water in the Shatt al-Arab in Basra. In consequence, nowadays Shatt al-Arab has only 65% of earlier flow (50,000 m^3/sec), which leads to tremendous consequences on water quality due to pollution by waste-water and seawater intrusion.

3.2. History and Politics Matter!

Basra governorate is the last city with access to fresh surface water, since Shatt al-Arab gets saltier the further it is from the gulf. The water resource stakeholder's map is rather complicated. Many stakeholders are involved in decision-making, such as the Ministry of Water Resources, the Ministry of Municipalities, the Governance Office, the agricultural, environmental, and health sectors, as well as a few NGOs working to increase awareness. This leads not only to quality concerns, but also to concerns regarding governance and regulation disordering of the water resources after passing through all Iraqi governorates. This governance aspect is considered as an internal political challenge that has affected the water supply sector, where the sharing responsibility makes it hard to recognize who is responsible for water regulations. Is it the federal government or the local administration within the governorates? The fuzzy boundaries of responsibilities have exacerbated the poor communication between the local authorities within Basra city. In addition, it has led to substantial distrust, escalating the tension between the governorates (Missan, Dhi Qar, and Basra).

Generally, in Iraq, the agriculture sector has the lion's share of water consumption (~70%)[24], but in Basra we face a different situation. The national revenue is over 90% reliant on oil production, whereas the Basra region provides about 80% of Iraq's oil production. Water for oil production is

(24) Frenken, K., 2009. Irrigation in the Middle East region in figures AQUASTAT Survey-2008. Water Reports, (34).

therefore a significant sector consuming water.

One of the fundamental deficits from a governance perspective is the unclear policy in terms of water regulations in the Iraqi constitution and the contradiction between the articles 110 and 114[25]. On the one hand, article 110 establishes the federal control of water resources, and on the other hand, article 114 indicates that management and control is on the regional and government level. This has led to a conflict of interest with the federal government.

From the water supply shortage, the challenge in Basra goes back to the 1990s of the last century; at that time, Iraq was under the United Nations sanctions. The previous administration suggests the Sweet Water Canal (SWC, or named as Albadaa canal), established in 1997, as a temporary solution to provide Basra city with high water quality. The idea is to get water from Tigris (Garraf stream) through an open canal from Nasiriyah city down to Basra. The canal ends with the R0 basin at Basra city that would eventually be linked to the tap water system to cover the demands of 2-3 million people. The minimum recharge capacity to the R0 basin should be 7.5 m^3/sec to cope with the city's demands; in 2017 the recharge declined to 4 m^3/sec due to the drought year, poor communication between the governorates, and not least the lack of management and maintenance. The 20-year-old open canal has been suffering from actual damages where no maintenance has been conducted so far; aside from the high evaporation rate, a considerable amount of water leaks through the 230 km long journey. What adds insult to injury is that over 50% of water pumps that support the water flow through the canal have been defected to end with only half the water allocation reaching the R0 basin and therefore providing insufficient freshwater to the tap water system.

The 2018 water crisis in SWC revealed the poor communication between the authorities, where the Ministry of Water Resources announced that its responsibility is limited to secure the specific water share for each government. Once they do that, the responsibility moves to the local authority inside the governorate. The local municipality claimed that the Governor's office limits their authorities to manage the water shares within the Basra city. The Governor's office claimed that the Ministry of Water Resources does not control the governorates' water allocations, and insufficient water shares reached the Basra city. This endless blame-game model of communication leads nowhere, and never helps in finding sustainable solutions.

The oil industry in Basra consumes 5 times more water than the drinking water supply.

(25) https://web.archive.org/web/20161128152712/http://www.iraqinationality.gov.iq/attach/iraqi_constitution.pdf

Currently, the oil production sector in Basra is consuming ~ 5 barrels of freshwater to produce 1 barrel of crude oil[26]. The current average of oil production in Iraq is equal to 4.779 million barrels per day; this means 3,800,000 m^3/day of water and 114 million m^3/month respectively. That is nearly double the total capacity of the Duhok Dam (52 million m^3) and 12% of the Mosul dam's total capacity (11 billion m^3), used in one year. The amount of used water in this field will increase by more than 20% in the next two years[27] and the projection for oil production development in 2022 is 5.4 million a day. Collectively, this means Iraq is in a tradeoff between developing oil production as its main national revenue, versus reducing the water consumption in this sector, thus protecting the environment. In this context, Basra's water demand will be increasing due to population growth, climate change, and the acute demand of water needed to develop the oil sector and for the production to reach the planned goal of 10 million barrels per day.

The public awareness of energy deficiencies also seems problematic. Energy-saving equipment has only become available in local markets in the past five years. However, because of its higher prices compared to typical devices, citizens prefer the cheaper option. Besides, the use of best practice materials does not conform to the cultural norm. When hiring architects and engineers to plan and construct buildings, people do not look for the best; rather, in most cases, they employ local staff. The result is poorly designed buildings and unsuitable building materials.

4. Ideas for Solving Problems

4.1. Reaching Out for a Holistic Approach

Issues such as power supply, tap water, irrigation water, industrial water, wastewater but also solid waste management, environmental issues, and social and socio-economic matters, are all handled in Iraq and Basra mainly as if they are separate issues. But Basra (and Iraq as a whole) needs a holistic approach. Holistic means to handle a bundle of things as a package. So, the very first question when applying a holistic approach is: how high is the general water demand (tap water, irrigation water, industry water, etc.) nowadays, and what will it be in the future? The second question is: what are the available resources (including wastewater and rainwater that could be harvested, and energy which could be used for treating seawater by reverse osmosis)? Only then can one start out with a plan: i) how to recycle water after a certain use, and ii) how to minimize the loss of water at any point of the utilization chain of water. Technologies that are implemented in Europe and the USA are often not applicable in our case due to climatic,

(26) https://www.researchgate.net/publication/333389868_Water_Resources_in_Basra_And_its_Recent_problems_almward_almayyt_fy_albsrt_wmshklatha_almasrt

(27) ttps://www.bayancenter.org/wp-content/uploads/2018/06/9089765463.pdf

cultural, and financial issues. Besides, the problem is so massive, that one cannot expect the state or city authorities to be capable of handling a holistic management tactic. Therefore, tailored and distributed solutions will be needed. A big hotel can take for example the responsibility for its energy, water, and solid waste management from A to Z; of course, not as an isolated island but rather in a sort of smart grid. On the other hand, citizens, private entities, and NGOs, have to be involved in sustainable solutions.

To develop policy and to practice good governance, the country needs to review the legislation by an expert committee, not only in order to oversee the conflict of interest on water resources, instead of identifying the shortages and gaps for the overall natural resources, but also to keep with the objective to mitigate the risk of tension between governorates, and to centralize water-related challenges as federal decisions. It is also highly recommended to implement a capacity building program for integrated water management, as well as for conservation practices for both the public and the state, in order to ensure effective and impactful awareness.

It is very important to centralize and consider water resources as a federal responsibility. The Ministry of Water Resources established, a couple years ago, the Higher Council for Water Resources (HCWR) which would take the lead for water responsibility for all of Iraq. However, one of the disadvantages of the HCWR is that it is not yet recognized as an independent legal entity or authority; it needs to include permanent staff members such as advisors from the Prime Minister's office, academic members, members from national security authorities, and a member from the head of natural resources authorities of the Parliament. With such multidisciplinary members, this authority would secure flexible communication with the highest authority, raise concerns quickly, and foster practical solutions. Setting the HCWR only under part-time responsibility, even with the direct support from the Prime Minister, will not be sufficient, as it would be hard to gather all of these members when they are busy with other tasks - a situation we currently face. These facts limit the influence of the group commission and add to the struggle of achieving goals quickly. Consequently, such an authority needs to be established in parallel with amending the Iraqi constitution to reflect the centralization of water matters, conversely, to guarantee a smooth collaboration with governorates working under the authority of HCWR in water challenges. It is highly recommended that HCWR supports programs such as joint projects, capacity building, modern tools for water monitoring systems, information transparency and public awareness. Such programs and activities would enrich the knowledge, update the HCWR, and guarantee good local communication.

A multidimensional plan needs to be

developed by: i) encouraging negotiation rounds with Iran and Turkey to get more water shares, especially that a tight economic relationship exists with both countries where the annual economic exchange is over 20 million USD, ii) governing and implementing the wastewater treatment system to decrease the water pollution in Shatt al-Arab and enhance the quality, iii) having a strategic plan to develop the SWC by replacing the open canals with water pipes in order to reduce water loss through evaporation, and by updating the water pumps and implementing a systematic maintenance program, and iv) securing an annual federal budget for the strategic development of water desalination plants to meet water demands in Basra. This budget should be collected by setting a certain percentage for each oil barrel production.

The current water supply system needs to be replaced with modern and sophisticated technology, where intelligent monitoring technology is used to detect the leakage on the spot in order to avoid water loss, and to guarantee high efficiency. It needs to set a metering system and provide online services for payment or maintenance. It is also essential to set a decent tariff for each consumer and with it, provide incentives to guarantee conservative consumption for the end-user.

4.2. Intelligent Solutions

For decades, foreign aid has been characterized by advising developing countries to adopt "western" technologies. Often, foreign aid does not consider aspects such as the local climate, environmental conditions and social boundaries, the local culture, and resource availability. It is unlikely that a water treatment plant designed and optimized for northern Europe will work properly in Basra, due to a rather different climate and the fact that a reuse of the treated water is not intended in northern Europe. However, in areas like Basra, it could be an option to separate wastewater types (rainwater, greywater, and blackwater) and apply different types of treatment, considering from the very beginning the reuse of the treated water for different purposes, such as irrigation of gardens and palm trees, as well as groundwater recharge.

One example of an intelligent solution is power supply, assuming that a person or entity has established a power supply with solar cells and a battery-based back-up system. In case this plant delivers more power than needed at a certain time, the electricity is fed in the grid and automatically accredited to the owner of the power plant. Similar approaches could be established for water supply and for treated wastewater being utilized for irrigation of green areas in the city, such as watering gardens and irrigating farms in the vicinity of the city. Introducing this kind of smart technology will need sensors, computers, software, and maintenance by skilled persons. A positive side effect of this would be the creation of jobs in particular for young people.

4.3. Rethinking Energy - Water - Waste

Generally, Iraq and Basra should seek unconventional sources for energy, considering more than only the most pressing question of how to cover the current demand of electricity in the city. Energy is needed for many other processes as well: modern water and wastewater treatment plants, recycling of waste, and industrial production of goods with high energy demand such as an aluminum plant or the production of hydrogen. Less challenging, but equally worth thinking about, is investing in waste to energy projects (incineration of waste).

Basra city might be a good place to implement a green energy masterplan to promote renewable energy such as biomass, biofuels, and solar energy. Enhancing the existing desalination plant in Faw is another task. The local government of Basra city needs to implement a strategic plan with a clear timeline for how to replace fossil fuel gradually with unconventional sources of energy for the next 10 to 20 years. Intelligent procedures have been developed at the local and international scales. One example is the dream farm concept (integrated, 'zero-emission', 'zero-waste', highly productive) using renewable energies and turning 'wastes' into food and energy resources, reducing the energy demand in the region by 14%[28].

An integrated cropping system was tested for five years in the UK, saving about 8% energy compared with conventional cropping, while Italy saved ~30% energy using a crop rotation system[29]. The biomass for instance, carries several advantages such as saving ~35% of energy costs, decreasing the carbon footprint at the local level, providing an additional revenue stream for the local government in Basra city, and creating jobs[30]. However, energy-water-waste policies are among the gaps that need to be filled, implementing waste segregation and recycling. It is also essential to mandate sustainable development practices for all new projects, such as green building codes, low-water-consuming equipment, and waste segregation.

The governmental strategic plan should also include and implement a capacity building program for schools and universities, as well as conduct national awareness campaigns to educate the public on the advantages of conservation practices. Investing in schools and universities can eventually result in joint research projects with scientists of universities from foreign countries, developing tailored solutions with respect to the specific environmental and climatic conditions in Iraq. The foundation of spin-off enterprises would

(28) Matthew, R.A., 2018. Afterward: Closing Thoughts on the Water–Food–Energy–Climate Nexus. In Water, Energy, Food and People Across the Global South (pp. 325-332). Palgrave Macmillan, Cham, https://doi.org/10.1007/978-3-319-64024-2_13

(29) O Di Nasso, N. B. (2011). Energy efficiency in long-term Mediterranean cropping systems with different management intensities. Energy, 36(4), pp.1924-1930, https://doi.org/10.1016/j.energy.2010.06.026

(30) Nunes, L.J.R., Godina, R. and Matias, J.C.D.O., 2019. Technological Innovation in Biomass Energy for the Sustainable Growth of Textile Industry. Sustainability, 11(2), p.528, https://doi.org/10.3390/su11020528

be the last and rather easy step, if venture capital is available from the oil industry.

4.4. Rainwater Harvesting in Cities

Water harvesting in arid countries has a tradition of several thousands of years. This has included the construction of cisterns - water collection systems on rooftops in urban areas and in fortresses. In hilly and mountainous areas, the construction of terraces, drainage channels, and tunnels (canals) was developed to collect water for drinking, washing, farming, and cattle breeding[31].

Harvesting roof water and water from sealed areas (e.g., streets, parking areas, etc.) is still a potential source of water for private and public uses in urban areas. The collected water can be stored in cisterns (tanks) or infiltrated into the underground (artificial groundwater recharge), if appropriate geological structures are available and known. Cisterns and storage in the subsurface have the advantage that evaporation does not occur. For artificial recharge, suspended matter has to be removed, because otherwise infiltration-wells might clog rather quickly. Another problem in Basra is that the shallow groundwater is likely polluted in many areas, for several reasons including leaking sewers, pit latrines, salt water intrusion, among others. Therefore, a thorough investigation of the Dibdibba aquifer with respect to storage suitability, groundwater quality, and self-purification potential is a necessity.

The management of urban catchments also has to consider soil and vegetation, since both have an important impact on runoff, infiltration, and recharge in the catchment. Any measure in terms of re-vegetation and afforestation requires a long-term approach and will take decades. Afforestation of small areas in cities may influence precipitation patterns locally and on regional scales due to surface-atmosphere transfers of heat and moisture[32]. Genetic differences in tree species show that some species (e.g., date-trees) can use a number of mechanisms to better cope with droughts and salty water than others[33]. By means of genetic technology, it is possible to develop species that cope better with droughts than natural species.

4.5. Urban Development Rethought

Basra is a major metropolitan city suffering from the urban heat island effect, with the city center being much hotter than the rural surrounding areas. There are many ways to minimize the effect of this phenomenon;

(31) Oweis, T., 2017. Rainwater harvesting for restoring degraded dry agro-pastoral ecosystems: A conceptual review of opportunities and constraints in a changing climate. Environmental Reviews, 25(2), pp. 135-149.

(32) van Dijk, A. & Keenan, R., 2007. Planted forests and water in perspective. Forest Ecology and Management, 251(1-2), pp. 1-9

(33) De Smedt, S. et al., 2012. Functional responses of baobab (Adansonia digitata L.) seedlings to drought conditions: Differences between western and south-eastern Africa. Environmental and Experimental Botany, Volume 75, pp. 181-187.

these mainly include enhancing the green areas throughout the city, in addition to reducing energy use and CO2 emissions. The question now is how this can be done. People use energy in their everyday life, whether at home, for heating and cooling and appliances, or for transportation. It has been found in many studies28 that in major cities, developing local mass transport has had a beneficial effect on reducing carbon dioxide emissions. By encouraging citizens to use means of local transport, we decrease the number of personal vehicles in use, resulting in less air pollution and better health benefits for the people. Active transport can especially help in enhancing the health of individuals on a general scale. For this to be effective, the pedestrian experience throughout the city needs redevelopment. Providing shading, for example, and walkable streets that are both entertaining and comfortable, encourage individuals to take on a healthier lifestyle. It is also a scientific fact that green areas are much cooler than urban areas; thus, developing green parks around Basra will help in both UHI effects and in increasing public health. Green areas can also help in reducing the amount and effects of dust storms, which is also an issue in Basra. Green belts surrounding and protecting the city can be a beneficial strategy to lower temperatures, protect from dust storms, and enhance air quality and purity in general.

Another strategy that can be used is energy-saving in buildings. Residential energy use is one of the most demanding sectors in Basra due to its extremely hot summers. The cooling season extends for 9 months a year, causing high cooling demands. The lack of building regulations is a main factor in increasing these numbers even more. The use of highly demanding cooling devices is also an issue. Only recently have the local markets made environmentally-friendly cooling devices available, but as expected, with higher initial costs. The architectural design of individual houses and the used building materials play a vital role in the amount of energy needed for cooling and ventilating. Reducing glazing areas in houses means less solar gains, and therefore, less cooling demands. The use of horizontal shading on south facades, and perpendicular shading on east and west facades, are also recommended strategies for hot climates. Previous studies on house designs in Basra have shown that using insulation in addition to thermo-stone in residential buildings can reduce the cooling demands by approximately 30%[34]. If more building strategies are used, such as increasing airtightness, solar panels, solar chimneys, and green surfaces, savings can increase up to 45%. Using solar panels is also an extremely effective method in houses, as mentioned earlier.

Finally, when talking about sustainable urban development, including citizens in decision-making is always helpful. This way, we can raise awareness among people

(34) Almudhaffar et al, (2014). "STANDARDIZING THE ANNUAL ELECTRIC ENERGY CONSUMPTION FOR A RESIDENTIAL BUILDING IN Basra CITY". Basra Journal for Engineering Sciences, vol. 14, no. 2, pp 162-175.

and encourage their sense of belonging and responsibility towards the city, which will affect their day-to-day life decisions.

4.6. Urban Farming

Urban farming is a concept that leads communities to become more self-sustainable with respect to food supply, in particular for vegetables, fruits, and other fresh produce. Urban gardening and roof gardening are two simple and well-known concepts. These concepts are comparable to the private garden of a family's house. Another very simple and effective concept is integrating farms in town planning. The major requirement for this is a regulation of real estate prices by the state or city council. The easiest way to achieve this is for the land to be owned either by the state or the city, as with public city gardens and parks. NGOs could be the owners as well. The land may then be leased to a private person or an enterprise for farming. It is essential that the owner of the land is not authorized to sell or lease the land for purposes other than farming.

Vertical farming in vertical stacked layers is a rather new concept; one out of several possibilities is using hydroponics, a technique of growing plants without soil[35]. Some benefits of urban farming include its positive impact on city climate, the improvement of the employment situation, and the utilization of treated wastewater, rather than wasting this water to the Shatt al-Arab.

5. Conclusions and Visions

Converting Basra from its current miserable situation into a sustainable and amiable city is a huge challenge, but feasible in the long term. However, many things are needed to reach this goal: i) fighting corruption and population growth, ii) improving education and environmental awareness, iii) introducing the concept of waste and waste-recycling, iv) developing a holistic approach for the utilization of solar energy and water recycling, and v) developing architecture and infrastructure with green areas, urban farming, and rain water harvesting. This requires smart thinking, starting out with pilot projects at different scales, and the participation of citizens, particularly the young generation, and NGOs.

- The vision of green Basra can only come true through solidarity and the cooperation of the local and federal government with citizens, scientists, engineers, stakeholders, and NGOs. Developing the technical aspects is one thing, and the open dialogue with politicians and decision-makers is another. Providing advocacy training and encouraging women, kids, and juveniles to be active in this context is another important aspect that needs to be addressed. Hence, to promote

(35) Gericke, William F. (1937). «Hydroponics - crop production in liquid culture media». Science. 85 (2198): 177–178. Bibcode:1937Sci....85..177G. doi:10.1126/science.85.2198.177. PMID 17732930

social engagement, NGOs, institutions, schools, universities, and professional unions should be empowered and supported in order to activate multidimensional initiatives such as:

- Initiate a Clean Stream Initiative (CSI) to prevent throwing waste such as plastic bags, bottles, and food waste into rivers and canals. The initiative is based on three pillars: i) setting up rubbish bins, ii) organizing rubbish transport and recycling, and iii) creating public awareness regarding waste sorting. The first pillar is realized by cooperating with gas stations, restaurants, and other entities, and by opening a dialogue with the municipalities' authority in order to provide waste container stations. The CSI would annually be rewarding the top 10 companies in the city that prove to be committed to environmental criteria. The second pillar is setting up startup business loans for waste collection and waste recycling entrepreneurs. The successful project will be funded either by state funding, loans with zero interest, or by fees collected from sellers and consumers. Such initiatives will target different challenges, including reducing waste volume and generating jobs and additional sources for energy through the reuse of waste. The third pillar is a motivational and educational campaign to change the behaviour of citizens regarding the handling of waste.
- Establish a Green Roof Campaign (GRC) funded by special grants from the oil industry. This will encourage small businesses and researchers to create green roof areas, in addition to developing urban parks and planting palm trees along roads and canals. Such an initiative provides multiple benefits in terms of environmental, social, economic, and aesthetic perspectives. The GRC would serve to foster the sustainability of Basra city in different ways: reducing the amount of energy needed for cooling buildings during the hot summer mitigates heating up the city's micro climate, which acts as a natural filter for noxious emissions of traffic and oil production. It will further help reduce dust, noise, the production of smog, and particulate matter throughout Basra city. As a side effect, jobs will be created for planning, construction, and maintenance. Furthermore, schools and universities can be incorporated in the campaign through active participation and research by using pre-treated waste water.
- Establish a strategic project "palm tree for each Basrawi"[36] (PfeB). The project aims to farm massive palms in the outskirts of Basra to recover the loss of palm trees that Basra suffered from, and bring back the key symbol of the city. The PfeB project will be conducted on two levels: one, through

(36) Is the nickname for citizens who were initially born and raised in Basra city.

civil society, where pupils and citizens cultivate trees carrying their names, and two, through the governor's office by cooperating with the oil companies and other enterprises to fund the massive cultivation for palms as a multi-purpose mission, including a positive impact on city climate, the introduction of modern irrigation techniques with waste water, public awareness, and the creation of job opportunities.

- Develop the marshlands to be attractive for tourism and scientific research activities. In this context, local authorities, along with NGOs and universities, will cooperate with the Centre for the Restoration of the Iraq Marshlands and Wetlands (CRIMW) at the Ministry of Water Resources. Such an initiative will help to create strong bonds between the citizens of Basra city and nature, as well as enrich the local community in different dimensions: i) increasing public environmental awareness of the wetlands' significant role in developing a productive ecosystem, ii) providing an economic opportunity by generating income and creating jobs through developing, for instance, a day trip for only small groups of visitors, and as such protecting the marshlands from massive tourism, and iii) using this unique ecosystem for research and education.
- Establish an "art agenda" with the aim of bridging a relationship between human and nature. Such an agenda that focuses on shaping environmental consciousness has several goals: feeding the aesthetic vision of citizens, sustaining social memory, and forming a new identity for a modern and sustainable city. This agenda could be achieved by developing art programs for children, teenagers, and young people, and by providing funds for art galleries, workshops, and symposiums with the aim of filling the gap between generations and bridging the image of Basra from its past to the future, increasing artworks in the city, and reforming the spaces by sculptures.

The City, the Water and the Mud: A Memory*

The heavens used to cover our naked bodies, we, who stand on our tip toes at the noontide heat, celebrating with cold mud from the bottom of the river. Our flame-carved bodies become sculptures. We draw our wishes on our chests then throw ourselves into the cold water, to be caught by the hooks of wars.

We hurt a lot, we bleed dark mud, of which fishermen make a statue to stand under the blazing sky. We run dry like rivers.

**Artwork and text by Artist Hamid Saed, 2020. Translated by Dr. Amir Al-Azraki*