Damming the Kurdistan Region of Iraq

Structural gaps in the KRG dam construction policies

Save_Tigris

A report by Save the Tigris Campaign
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Save the Tigris is a civil society advocacy campaign aiming to save and protect the heritage and water resources of Mesopotamia from the impact of large dams and other mega projects, and to promote sustainable management of the Tigris River and its tributaries. We seek to link groups and movements concerned with the adverse impacts of megaprojects on the Tigris and Euphrates. We advocate for policies that secure the sustainable and equitable use of water for all who live in the region. Our campaign believes a paradigm shift is necessary: instead of being a source of rivalry, water could be force for peace and cooperation between all the countries and peoples of the Tigris-Euphrates basin. Our advocacy and awareness activities involve all relevant actors: local communities; civil society organisations; media; national and local institutions; societies of experts and intellectuals; research centres; universities and others.

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Front cover: a shepherd's boy in front of the Deraluk-Reshawa Dam under construction.

Acronyms

BOT – Built-Operate-Transfer
DMP – Dams Master Plan
EIA – Environmental Impact Assessment
EPIB – Environmental Protection and Improvement Board (KRI)
EPID - Environment Protection and Improvement Directorate (Iraq)
GAP – Southeastern Anatolia Project
HIA – Heritage Impact Assessment
IEA – International Energy Agency
IHRC – Independent Human Rights Commission in the KRI
IMF – International Monetary Fund
KRG – Kurdistan Regional Government
KRI – Kurdistan Region of Iraq
MAWR – Ministry of Agriculture and Water Resources (KRI)
MWR – Ministry of Water Resources (Iraq)
PKK – Kurdistan Workers Party
PPA – Power Purchasing Agreement
PPP – Public-Private Partnerships
RCC – Roller Compacted Concrete
SEA – Strategic Environmental Assessment
SWLRI – Strategy for Water and Land Resources in Iraq
UNDP – United Nations Development Programme
WCD – World Commission on Dams

Introduction

The water resources of the Kurdistan Region of Iraq (KRI) in Northern Iraq are under stress. Climate change in the region is visible and expected to reduce the output Tigris River and its tributaries: in the past decade the Kurdistan Region has been suffering from extreme weather, from droughts to heavy rainfall. Instream waterflows were found to have significantly decreased between 1980 and 2010.[1] Across the Tigris-Euphrates basin, temperatures have increased while precipitation has fallen by 10% since 1999. Temperatures in the KRI will significantly further increase according to different academic simulations, further affecting the basin.[2] Water infrastructure has been neglected for decades, environmental regulations safeguarding water quality are not implemented, and water is squandered due to mismanagement. In addition, neighbours Turkey and Iran have been building a large number of dams in the border regions, on rivers that the KRI depends on. Some of these could have a huge impact on the Tigris inflow into the KRI and Iraq. Many more dams have been planned upstream, which will further diminish the Tigris flows downstream. According to UNDP, the water discharge of the Tigris-Euphrates Rivers is set to decrease by 50% between 2009 and 2025.[3] The Kurdistan Regional Government (KRG) which governs the KRI recognizes water security as a priority. In 2013, the Minister of Agriculture and Water Resources (MAWR) Sirwan Baban expressed "the objectives of the Ministry is to ensure water and food security and increase production in the Kurdistan Region."[4] The 2012 report of the Socio-Economic Infrastructure Needs Assessment (SEINA) of the Ministry of Planning of KRI and UNDP recommended that to tackle overconsumption of water, construction of water treatment plants and new investments in water, sanitation and environment are needed.[5] To tackle the issues of climate change, upstream dam construction and mismanagement, the strategic goal of the KRG is to construct a large number of dams across its territory, with the aim of storing water for irrigation and hydropower. Indeed, the MAWR aims to achieve water self-sufficiency and security according to its 2012 roadmap.[6] Consequently, an astonishingly 245 dams have been proposed by the KRG since 2014, on top of 17 large and moderate existing dams.[7] This would leave no river in the Kurdistan Region undammed.

This report has been written to document and share information on the development of dam infrastructure in the Kurdistan Region. It aims to provide an alternative view on the generally supposed social and economic benefits of dams, and shed a light on the high costs for humans and environment. Dams destroy riverine ecosystems on which plants and animals depend. Some of these are Key Biodiversity Areas that require more study.[8] Environmental flows (natural flow regimes) of the rivers are altered, affecting both up and downstream environments. Water quality decreased and sediments are trapped behind the dam which can cause erosion downstream. Dams also cause population displacement and the loss of prime agricultural lands that are submerged under dam reservoirs. The region contains many examples of dam failure. There is little or no debate inside the KRG about the destructive impacts of its proposed dams on free-flowing rivers, biodiversity, water quality, cultural heritage, livelihoods and homes of populations, and the water security of downstream Federal Iraq. Dams are regarded as strategic projects by the KRG and as signs of progress. In a televised speech on 7 December 2019, President Masrour Barzani celebrated "the work that is underway to complete 11 new dams […] to ensure the security of food and water."[9] Dams are generally regarded as an indication of development by most of the population in KRI, while little or no consideration is given to

the downsides. Proponents in the KRI argue that such projects are a way to meet energy and agricultural demands, while this report argues that they are neither clean or harmless. In addition, detailed information of dams is often missing due to lack of transparency on behalf of authorities and the public is not involved in the process of dam development. The region is scattered with examples of abandoned, failed or poorly designed infrastructure projects, and dams are no exception. This publication aims to fill that gap, by providing an analysis of planned dams and the political economy of dam construction. For this report scholarly as well as popular sources were consulted. KRG policy documents, assessments and official data related to dam projects were reviewed, and high-level policymakers were interviewed. A number of construction sites were visited. The resulting report assesses the environmental and social impacts of dam construction and explores ways to develop basin-wide comprehensive water policies, providing experts and decision-makers with tools to improve water management in the KRI. The socio-environmental consequences of dams are numerous, and have been outlined in chapter 1. Chapter 2 situates the KRI within the Upper Tigris basin. It examines the dynamics of international water politics and security, and their impact on the transboundary water resources of the KRI. Chapter 3 provides an overview of all dams currently under or prioritized for construction in the KRI, demonstrating the scale of dam construction in the region today. Chapter 4 aims to build on the previous chapters by describing some of the major gaps in the current dam construction policies of the KRI. It provides several environmental, cultural, political and social considerations which the report argues should be taken into account by dam constructors. The publication concludes with a list of possible alternatives to dam construction for policymakers. This report could also be beneficial for dam construction companies, potential investors in the KRI, international agencies and donors, as well as local and international media and civil society, to learn about the current developments in dam construction in the region.

Chapter 1: Large dams: Are they sustainable?

Dams are intended to impound water and regulate river flows. Dam reservoirs store water which can provide for irrigation, human consumption, industrial use, while hydropower is used to generate electricity. Some dams aim to distribute water between different locations. Currently there are more than 57,000 large dams in the world.[10] The International Commission on Large Dams as defines these as greater than 15 meters in height or having a storage capacity greater than 3 million cubic meters)[11] The age of large dams started at the beginning of the previous century. Around 5,000 of such dams in the world are now more than 50 years old.[12] Currently only one out of four rivers in the world longer than 1000 km are not dammed and considered to be free-flowing rivers least affected by human impacts.[13] Such rivers are the freshwater equivalent to wilderness. In the Kurdistan Region of Iraq, the Greater Zab is considered to be the last free-flowing river of Mesopotamia.

Darbandikhan Dam, Kurdistan Region of Iraq. Completed in 1961. (2017)

Hydropower represents the largest renewable source of energy in the world. Large hydropower dams are often presented as clean and green. However, studies have demonstrated that many of these large-scale water infrastructure projects in Europe and the US have been disastrous for the environment. Dams have a problematic relationship with the Sustainable Development Goals (SDG) of the United Nations, even if they would increase the global share of renewable energy. Dams often irreparably damage the rivers upon which they are built. The risks associated with such water infrastructure are considerable: the investment costs of dams are usually high, coupled with high risks and a long time between the project approval and the start of operations. It has been proven that most of these structures that have been built around the globe turned out to be more expensive than was projected, and its environmental and social costs have often not been taken into account, usually because of the prospect of cheap electricity from hydropower. The ones who benefit most from dam construction projects are in fact the industries. Lack of due diligence in managing the human and environmental violations is common among the actors engaging in dam construction projects, as well as lack of independent monitoring of the socio-environmental impacts.

Dams block the migration of fish and flows of sediments and nutrition. This is a major disruption of the ecosystem process. Dam reservoirs also influence the water temperature and quality, as well as river flow patterns. This can cause disruptions downstream of the river. Freshwater ecosystems are the most threatened and strongly affected by habitat impacts. Its health is defined by water quality and quantity, connectivity to other parts of the system, habitat conditions and diversity of plant and animal species. Forests and wildlife could therefore be destroyed as a result of the flooding of a dam reservoir.

Dams can accelerate climate change. River damming changes the natural flows of rivers and induced water scarcity in downstream areas. It can disrupt and transform the hydrosphere, the most vulnerable part of the climate system, through greenhouse gas emissions and other impacts. Such methane emissions are transmitted through dam reservoirs. Dam construction and associated extractive industries can cause the destruction of forests, where carbon is absorbed. Dams in itself are vulnerable to climate change; they may be out of operation due to droughts or flooding. Civil society organisations around the world have called to eliminate financial incentives for new hydropower projects within climate change mechanisms, such as the Green Climate Fund.[14]

Local communities are displaced when their area is submerged. Dam reservoirs have displaced up to 80 million people around the world, without compensation.[15] Dam-affected communities typically do not have a say in the construction of dams in their area. The livelihoods of populations living downstream from the dam are affected as well; an example is the loss of income for people living off fisheries. Often the impacts on populations further downstream are not taken into account. Dam construction has typically been accompanied by the construction of access roads, immigration, land grabbing, logging, deforestation and mining. On many occasions such socio-environmental conflicts have led to violence, considering that many dam projects have been constructed without prior consultation or consent from local dam-affected communities. Dams are often presented as beneficial for local communities, but research has demonstrated otherwise. Issues of governance and sustainability are often not addressed by the constructors. Local populations are promised cheaper energy, new jobs and updated infrastructure, but such benefits often never reach the communities. In the case of the Belo Monte and Jirau Dams on the Amazon River in Brazil, electricity costs went up and new jobs were mostly taken up by non-locals and faded out within several years.[16] Populations can also suffer the loss of cultural heritage as a result of dam construction. Water infrastructure has on many occasions threatened cultural heritage sites. 51 UNESCO World Heritage sites have been affected or threatened by water infrastructure around the world.[17] An example of the loss of heritage as a result of dam construction is the submerging of the ancient town of Hasankeyf in Turkey by the Ilisu Dam. The marshlands of Southern Iraq, a World Heritage Site, are threatened by upstream dam construction in the KRI.

The International Hydropower Association (IHA), which represents the global hydropower sector, believes growth in hydropower dams is driven by International Financial Institutions such as the World Bank, the demand for energy in emerging economies, "South-to-South" investment and trade, and multilateral agreements and goals.[18] Large dam projects are usually proposed within centralized decision-making

processes which lack transparency, citizen participation and strategic planning. Ideally comprehensive assessments which takes into account all social, environmental and economic costs and benefits should be promoted. Social and environmental impacts are often downplayed in studies commissioned by private dam construction companies, while environmental impact assessments are typically conducted by dam proponents mostly concerned with demonstrating project viability. The recommendations of the World Commission on Dams (WCD) are particularly relevant in this regard. The WCD was an independent international body consisting of representatives from governments, industries, academia and civil society. It reviewed and addressed environmental and social impacts of large dams. The WCD released its final report in 2000 and recommended the following:[19]

1. Dam development needs and objectives should be formulated through a participatory process.
2. An assessment of all options needs to be conducted, which gives social and environmental impacts the same significance as technical, economic and financial factors.
3. Outstanding social and environmental issues from existing dams should be addressed before new ones are built.
4. All stakeholders have the right to informed participation in the decision-making process.
5. Dam projects should provide compensation to affected populations to make sure they receive a share of the project benefits.
6. Affected populations should be able to negotiate legal agreements to ensure compensation.
7. Dam projects require a basin-wide assessment of the river ecosystem.
8. Dams should provide sufficient release of environmental flows in order to maintain the ecosystems downstream.
9. Compliance mechanisms with regulations and agreements should be established.
10. Dams should not be constructed on a shared river if a riparian state objects to the project.

The ancient town of Hasankeyf on the Tigris River in Southeastern Turkey was flooded by Ilisu Dam in 2019. (2016)

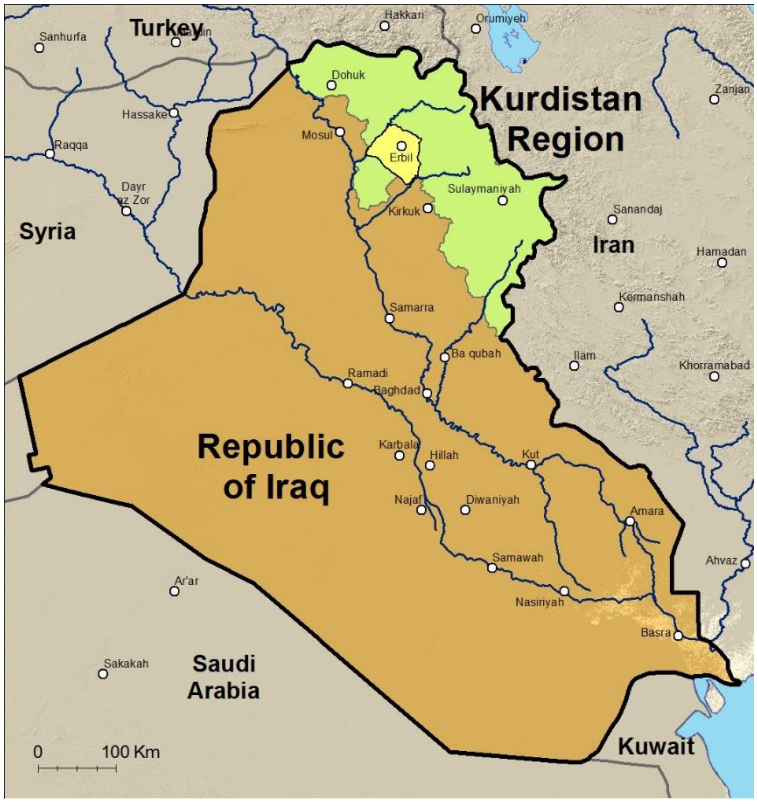
Experts have advocated to maintain and foster scientifically-based environmental flow regimes for water flow regulation by dam reservoirs. Such environmental flows describe the quantity, timing and quality of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods and well-being. In many countries the conservation of environmental flows is inscribed in the law, but its implementation is often heavily biased in favour of dam constructors. In Iraq or the KRI, environmental flows are not inscribed in legislation.

Of the existing non-fossil energy options, hydropower has the most negative impacts on the environment and populations. Wind, solar and biomass can produce low-carbon electricity without damming rivers. Decision-makers could consider these alternatives and diversify energy sources. In addition, dams have a finite lifespan. While many new dams are planned and being constructed in Africa and Asia, dam removal is now common in the developed world. Most of these are small and medium in size. Though dam removal is complicated and could bring radical changes to its environment, it can be up to three times as cheap as dam reparation and can restore freshwater ecosystems.[20] Thousands of dams have been removed across the world for restoration of the ecosystem.[21]

Chapter 2: Situation of the Kurdistan Region in the Upper Tigris basin

The two great Tigris and Euphrates Rivers historically feed the fertile crescent of Mesopotamia, stretching across present day Turkey, Syria, Iraq and Iran. The area was home to the earliest known human civilizations. Agriculture was vital in Mesopotamian societies, with such activities dating back to 8000 B.C. Because of the arid climate of the region, agriculture depended on the flooding of the Tigris-Euphrates Rivers for soil fertility. The two rivers form a transboundary basin with a total area of 879,790 km2, with the Tigris rising in the mountains of eastern Turkey and flowing through the highlands of the Kurdish region of Turkey. After following the Syrian-Turkish border for less than 45 km, the Tigris flows through the valleys of the plateau of Iraqi Kurdistan before descending into the arid plain of Mesopotamia. The Tigris joins the Euphrates in Southern Iraq near Qurna in the combined flow of the Shatt Al-Arab, which empties into the Persian Gulf. To this day, the local population of Mesopotamia still uses the Tigris as a source of fresh water and water for agriculture. Irrigation is commonly used for growing crops. In Central and Southern Iraq, the population is almost entirely dependent on the Tigris-Euphrates Rivers.

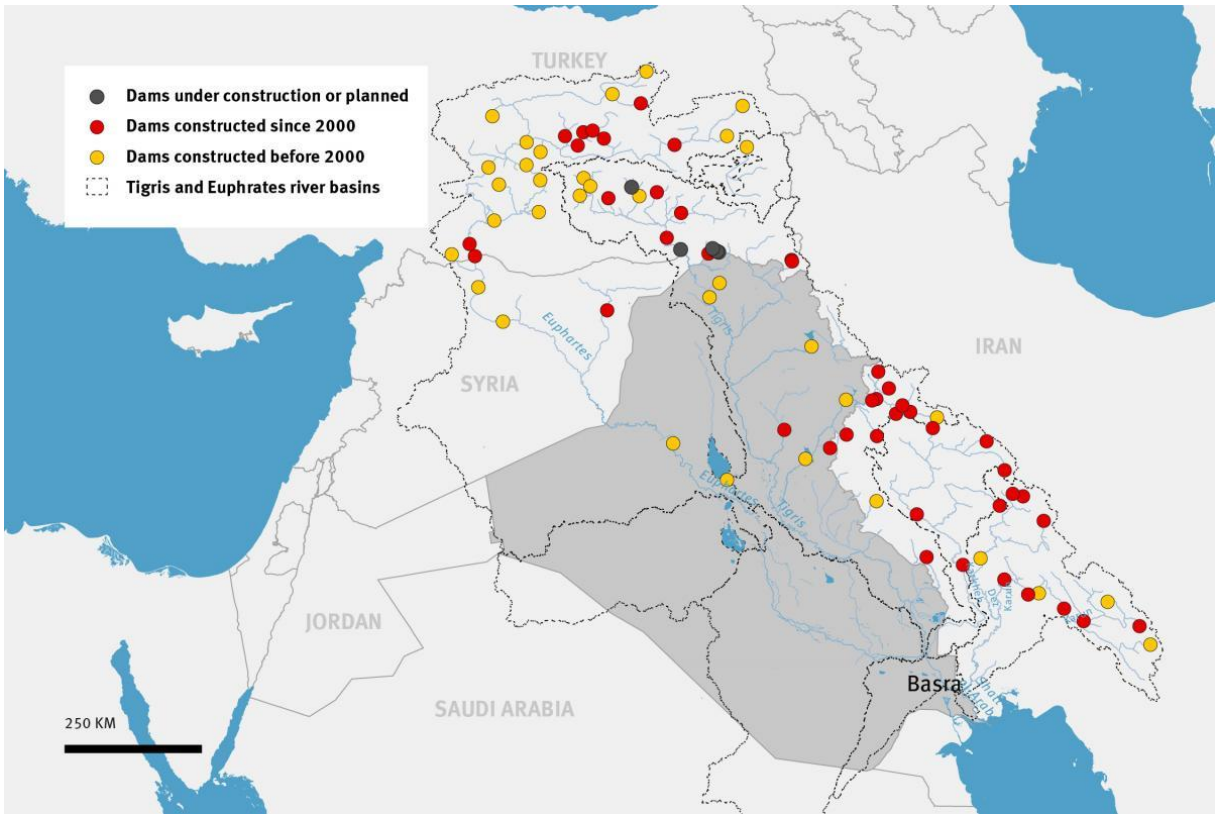
Iraq recognizes the autonomous Kurdistan Region in the north of the country since 2005, governed by the Kurdistan Regional Government (KRG) in Erbil, while the Kurdistan political parties are represented in the federal parliament in Iraq. The KRI makes up 15% of the population of Iraq. Though the KRG follows its own foreign policy, internationally it acts as a non-state actor and it is therefore often represented by the central government in Baghdad. The power-sharing agreement between Erbil and Baghdad however is still unresolved and remains in a stalemate, three years after the Kurdish independence referendum of 2017. The Tigris straddles across the border of the KRI and Federal Iraq for 60 km, and several tributaries flow through the Kurdistan Region into the Tigris. The major ones are the Khabour, Sirwan, Greater Zab and Lesser Zab. Emanating in Turkey and Iran, their contribution to the total flow of the Tigris is significant (more than 27 BCM).[22] The Greater and Lesser Zab contribute to approximately 50% of the Tigris River flow downstream in Baghdad.[23] Other major tributaries flowing into the Tigris from outside of



Map of Iraq, including the Kurdistan Region in the North (green). (Source unknown)

Iraqi Kurdistan are the Karkeh and the Adhaim. The KRI is a landlocked region located in the Upper Tigris basin. Since the Tigris and the aforementioned tributaries flowing through the KRI originate in upstream countries, it is essential to understand the dynamics of water security in the area before we touch upon dam construction within the KRI. We therefore briefly draw an overview of current dam politics in the Upper Tigris basin.

Since the early 20th century, the Tigris has seen intensive construction of dams and canals for irrigation and averting floods. Construction of large dams on the Tigris started in the 1950s and 1960s in Syria and Iraq, mostly for hydropower. In this period, the two major hydropower dams of the Kurdistan Region, Dukan and Darbandikhan Dam, were constructed. Turkey and Iran followed in the next decades. This has altered the dynamics of the river, with impacts on ecology, water quality and human populations. Construction of such water infrastructure often demonstrated lack of consideration of the cultural heritage, biodiversity and local communities. Dam construction in Turkey and Iran has inflicted a dramatic impact on the water flows to Syria and Iraq in terms of water quantity and quality. Central and Southern Iraq has seen the levels of the Tigris River vastly decrease in the past decades. In 2018, for the first time, people were able to cross the Tigris by foot in Baghdad.[24] The KRI has been affected by these upstream dam developments as well.



Current and planned damming in the Tigris-Euphrates basin. (Source: Human Rights Watch, 2019)

Turkey enjoys abundant surface water and groundwater resources and is aims to use the Tigris River mainly for hydropower and irrigation. Under the Southern Anatolia Project (GAP), Turkey envisages the construction of 22 dams and 19 hydroelectric power plants on the Tigris and Euphrates. The first dams under this project were built on the Euphrates River from the 1980s. The Ataturk Dam, constructed in 1992, is the largest on the

Euphrates. In the 1990s Turkey built five medium-sized dams on the Tigris. In 2019 Turkey finished the Ilisu Dam, the largest dam on the Tigris River under the GAP project. Its dam reservoir is being filled as of writing (March 2020). This controversial Dam would provide hydropower to Southeastern Turkey, but has been met with local and international protests against its negative impacts. Within Turkey, Ilisu has flooded the 12,000-year old settlement of Hasankeyf, an important cultural heritage site on the Tigris River. For Iraq, the impacts are a major reduction in water flows coupled with water pollution as a consequence of return flows from irrigation in Turkey. Turkish dams on the Tigris will not have a big impact on the KRI. Only the district of Zakho in the northwest would be affected by Ilisu Dam.[25] Turkey is developing three dams on the Greater Zab, which flows into the KRI.[26]

Demonstrations near the Iranian Consulate in the city of Sulaymaniyah in the Kurdistan Region of Iraq, against reduced Lesser Zab water flows from Iran. (July 2017)

Large parts of the KRI are affected by Iranian dam projects, mostly on tributaries of the Tigris. Iran has profiled itself as the third-largest dam constructor in the world. As of March 2019, 178 large dams are operating in Iran, with 41 billion cubic meters of water stored in its reservoirs, in addition to 54 hydroelectric power plants.[27] The country has in the past two decades developed large-scale water transfer projects mostly for the purpose of transferring water from the western part of the country (bordering Iraq and the KRI) to the central and eastern provinces. Five of Iran's largest dams are located on the Karun River in the Southwest of Iran, feeding into the Shatt al-Arab. The largest Iranian dam affecting the KRI is the Daryan Dam (169m), constructed on the Sirwan River and completed in 2019, mainly for irrigation purpose. This large dam has the potential to significantly reduce inflow to the provinces of Sulaymaniyah and Halabja in the KRI, affecting drinking water supplies, agriculture and even the hydropower production of Darbandikhan Dam, which is dependent on the Sirwan River. Two other major dams on the Sirwan are the Gavoshan (built in 2004) and the Qeshlagh (built in 1979). Recently, Iran started developing the Lesser Zab river. Sardasht Dam is a major hydropower infrastructure in Iranian Kurdistan, which went into operation in 2019. Iranian officials have expressed one of the purposes of Sardasht Dam is to "control and drain surface and transboundary waters"[28] which could allow for influence over downstream neighbours.

As of April 2020, Iran was in the process finalizing the construction of a tunnel which would transfer water from the Lesser Zab to Lake Urmia.[29] In 2017 and 2018 border areas of Qaladze in the Kurdistan Region faced significantly reduced flows of the Lesser Zab, which originates in Iran.[30] In 2012 and 2017 the town of Khanaqin, located in the disputed territory between Erbil and Baghdad with a predominantly Kurdish population, reported the drying up of the Alwand River, flowing from Iran.[31] Such events have led to protests among the affected populations in the KRI.[32]

The large dam storage capacities of Turkey and Iran allow them to control water flows to downstream regions, which includes the Kurdistan Region. Water infrastructure could be used by upstream countries as a tool for achieving political hegemony. Turkey has insisted it has the right to develop the resources within its own territory, and together with Iran it has not been willing to sign any agreement so far which would guarantee the water shares of Syria and Iraq. The KRI also lacks the political leverage vis-à-vis its neighbours: it has addressed the matter with the Iranian consul in the KRI or the Iranian Ministry of Agriculture,[33] but according to Iraqi law only the Federal Iraqi government is allowed to negotiate and sign international agreements with neighbouring countries over water resources.[34] The KRG would have to report its concerns over Turkish and Iranian dam construction with the central government in Baghdad.

Mosul Dam, the largest dam in Iraq, provides electricity to the city of Mosul. (2019)

Plagued by instability since several decades, the potential for conflict in the region is real. The weaponization of dams is increasingly common in the region, and water is increasingly regarded as a security asset. Non-state actors such as Daesh (ISIS) have used dams in Syria and Iraq to flood or retain water from communities. In 2014, Daesh captured Mosul Dam, located on the Tigris River with its reservoir on the border of the KRI and Federal Iraq. There was growing concern that Daesh would weaponize and destroy the unstable dam, hereby unleashing a giant flood into the city of Mosul. In 2017, Tabqa Dam on the Euphrates in Syria was damaged in a major assault between Daesh and Syrian Democratic Forces. Dams have also been politicized by state actors. Turkey on several occasions cut water flows of transboundary rivers to the Autonomous Administration of North and East Syria (NES),[35] which resulted in decreased agricultural

output and electricity supplies. The KRI on various occasions suffered from decreased flows of the Lesser Zab due to restricted flows from Iran. As a result, the KRG partially cut water flow to Central and Southern Iraq.[36] The KRI believes that the issue of reduced flows from Turkey and Iran can be tackled by constructing its own dams. This would allow the KRG to store water in order to reduce the impact of Turkish and Iranian dams. Akram Ahmed, Director-General of the Directorate of Dams and Water Reservoirs of the KRG, has expressed that he believes the KRI should not oppose dam construction in neighbouring countries, but focus internally on the management of its own water resources.[37] Consequently, the KRG has proposed the construction of 245 dams since 2014.

Chapter 3: Ongoing and planned dam construction in the KRI

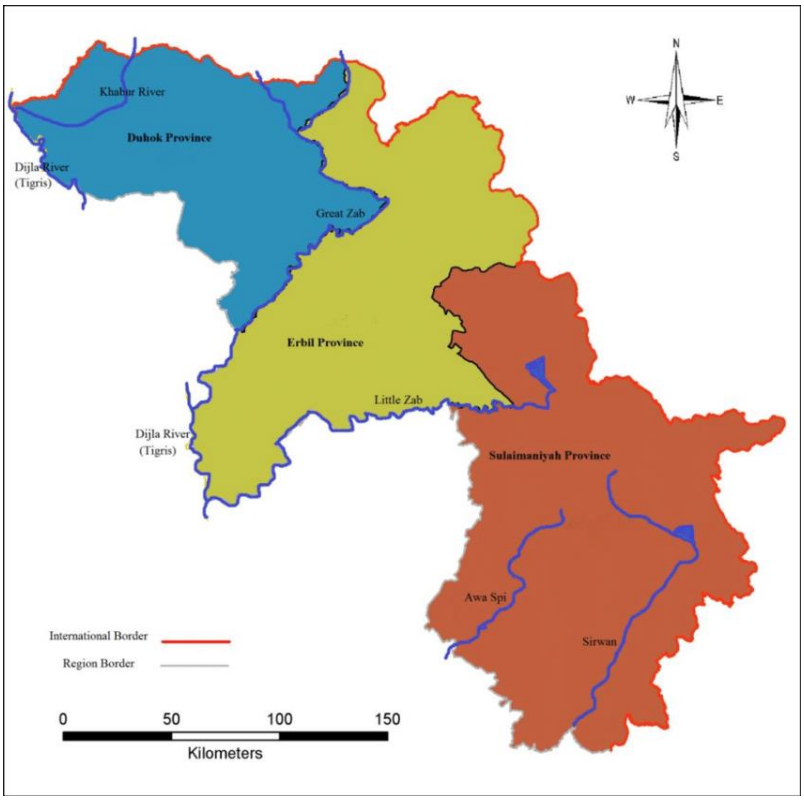
In the past decade, a large number of dams were proposed by the KRG but many of these have never been constructed for political, economic and financial reasons. It is often unclear which dams are still under construction and to what extent they have been completed, who is financing these dams, which companies are responsible for construction, and what the socio-environmental impacts would be, including the cumulative impacts of several dams built in the same basin. This chapter aims to provide an overview of the current status of all dams currently under construction or prioritized for construction.

Current stage of dam construction in the KRI

The Kurdistan Region of Iraq is located in the catchment area of the Tigris River and five of its tributaries: Khabur (45% of the catchment basin within KRI, originating in Turkey), Greater Zab (67%, originating in Turkey), Lesser Zab (74%, originating in Iran), Sirwan (63%, originating in Iran), and the Basara/Awa Spi (100%) tributaries. More than 85% of the water passing through the Region is not stored by dams or otherwise used.[38] As of December 2019, there are 17 dams in the Kurdistan Region.[39] These include three large and strategic dams: the Dukan, Darbandikhan and Duhok Dams. They were built by the Iraqi government in the 1950s and 1960s on tributaries of the Tigris River. Dukan Dam is located on the Lesser Zab River, Darbandikhan Dam on the Sirwan River and Dohuk Dam on the Dohuk River. The three dams collectively store more than 10 billion cubic meters of water. Bekhme Dam on the Great Zab River was a large dam project of which construction started in 1987, but it was never completed due to sanctions and controversies surrounding its construction. Bekhme was to be the largest and most strategically significant of the dam projects in the region. It currently is not scheduled for completion and therefore will not be further discussed in-depth in this report.[40] It is however occasionally referred to in policy debates., but due to the sheer scale of the project coupled with lack of funds the construction of the Bekhme Dam will not be realized anytime soon.

Dam construction and operation fall under the Ministry of Agriculture and Water Resources (MAWR) of the KRG. The Ministry has a broad range of responsibilities, which include: agriculture and food production, land management, water resources (surface, ground, storage and irrigation), veterinary and forestry.[41] It consists of 13 general directorates and 17,000 employees in total. Competencies are often not well-organized: Serwan Baban, the former Minister of Agriculture and Water Resources from 2012-2014, said the organization has "difficulties with establishing clear functions and line management duties."[42] Within the Ministry, two general directorates are relevant here: The Directorate of Water Resources and the Directorate of Dams and Water Reservoirs. The latter basically deals with large dams, while the other directorate deals with other projects such as small dams, irrigation and groundwater. The Directorate of Dams and Water Reservoirs in 2016 employed 110 people, in addition to 650 employees in the governorates.[43] The MAWR has a strong focus on agricultural expansion, and most dams are built for irrigation. Relatively cheap agricultural products from neighbouring countries flood the markets of the KRI, at the expense of locally produced agricultural

goods that cannot compete.[44] The main strategic priority for the Ministry is therefore to achieve food self-sufficiency and security.[45] As part of this strategy, it aims to provide sustainable sources of water for agriculture through increased storage capacity.[46] Policymakers in the MAWR regard irrigation systems as crucial for agricultural sustainability. Besides increasing competitiveness and productivity, food security would be achieved by and improving storage and preservation.[47]



The main river basins of the Kurdistan Region of Iraq.
(Source: Hayder Mohammed Issa, 2014)

17 large and moderate dams existed in 2014. Of these, 12 were constructed after 2007 by the Directorate General of Dams and Water Reservoirs of the KRG: Awa Sipi, Bedohy, Bawashaswar, Chami Simor, Degala, Hamamok, Hashaziny, Hassan Kanosh, Jali, Kodala, Shiwaswr, and Qadir Karam.[48] These 12 projects costed the KRG 96.5 billion IQD (roughly $80 million).[49] The cumulative storing capacity of these 12 dams is more than 72.5 million cubic meters of water, with the capacity to irrigate more than 40 square km.[50] In 2009, the KRG approved a strategic plan to develop the local agricultural sector.[51] According to this plan, eight large dams and 19 small and medium-sized dams were to be built across the region over the next five years.[52] In 2010, the MAWR of the KRI published a tender for a 'panel of consultants' to advise on dam construction and management, which resulted in the appointment of the Czech Renewable Energy Alliance (CREA) Hydro-Energy, a cluster of companies, research institutions and universities in the Czech Republic.[53] This alliance provided consultations on several dams which since then have been constructed or are still in the process of construction.[54]

Construction of 17 dams started in 2011; at that time the budget of the Directorate General of Dams and Water Reserves stood at IQD 28 billion. By January 2012, four small dams had been completed out of the 27 planned. These were the Hamamok Dam in Koya, the Bawashaswar Dam in Kifri and the Hassan Kanosh and Jali Dams in areas of the same

name. The Directorate General of Dams and Water Reserves then developed the Kurdistan Dams Master Plan (DMP) in 2014 with Aquaproiet SA (Romania), which presented a plan for development of dams for electricity production, irrigation and water supply. The plan specified 245 storage reservoirs,[55] 18 of which would be large dams with more than 500 MCM capacity. The DMP took into account several criteria for each dam and storage reservoir: economic (investment and maintenance costs), social (aesthetics, tourism, recreation, quality of riparian water and flood protection), ecological (deterioration of ecosystems and modification of the river), conformity with restrictions (water storage areas during floods, protected areas restrictions, protection of public services).[56] It is not clear to what extent these social and environmental impacts were emphasized or discounted. The DMP prioritized each proposed dam only according to storage volume and capacity (existing/completed, under construction, first priority, second priority, third priority, fourth priority). The DMP was also produced without transparency or citizen participation. As a consequence of the economic crisis following the war against Daesh from 2014, the KRG enforced austerity and all dam construction was halted due to lack of funds. Many dams were left incomplete. In August 2016, the then Minister of Agriculture for the KRG, Abdulsattar Majeed, requested $9.3 million from his government to complete eight dams.[57] The Minister warned about the collapse of dams whose construction have been halted. Regardless, the Ministry that year announced the construction of two new dams.[58] In April 2017 Akram Ahmed, Director-General of the Directorate of Dams and Water Reservoirs, requested 11 billion IQD to complete unfinished dams. His argument was that dams near completion should be completed, otherwise the structures will decay and investments will be lost.[59] In mid-2018, following the defeat of Daesh and an economic revival, the KRG started to allocate new budgets and resume projects, which had been stalled or halted over the past few years.

The Lesser Zab in Sulaymaniyah Governorate. (2020)

As of 2019, the Ministry has prioritized 114 dams:[60]

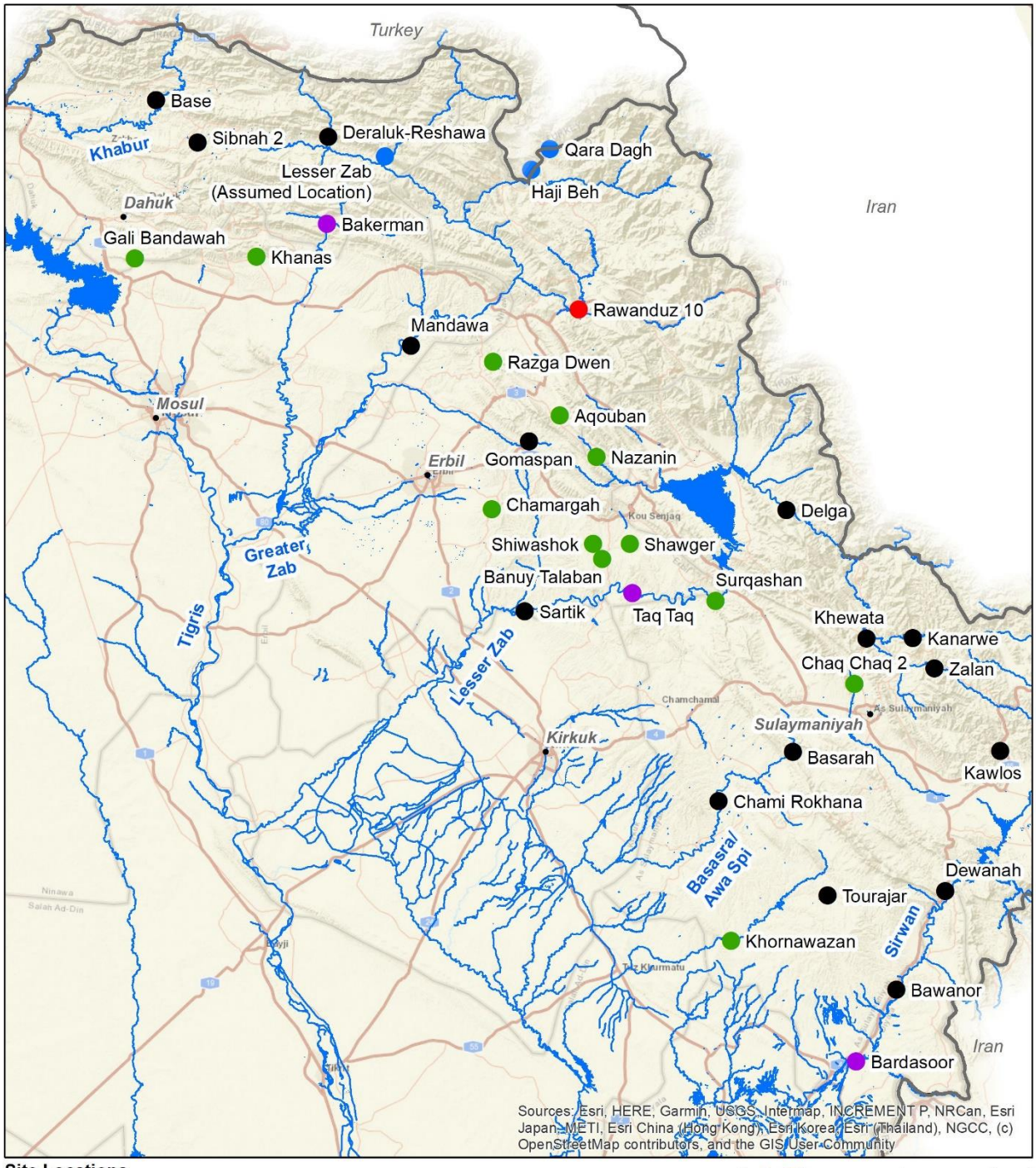
- 2 dams on the Tigris River: 1 under construction, 1 completed. All of these are large dams over 15m height.
- 5 dams on the Khabur River: 3 first priority, 1 fourth priority, 1 under construction. All of these are large dams over 15m height.
- 38 dams on the Greater Zab River: 24 first priority, 7 fourth priority, 6 under construction and 1 completed. 23 of these are large dams over 15m height.
- 36 dams on the Lesser Zab River: 19 first priority, 8 forth priority, 5 under construction, 4 completed. 33 of these are large dams over 15m height.
- 11 dams on the Sirwan River: 6 first priority, 1 fourth priority, 2 under construction and 2 completed. 10 of these are large dams over 15m height.
- 13 dams on the Basara and Awa Spi Rivers: 4 first priority, 2 second priority, 2 under construction and 5 completed. 11 of these are large dams over 15m height.

Listing the current dams under or prioritized for construction within the KRI

The following section aims to provide an overview of all thirty-five dams currently under construction or prioritized for construction by the Directorate of Dams and Water Reservoirs within the KRI as of February 2020. These are categorized according to each sub-basin: Tigris, Khabur, Greater Zab, Lesser Zab, Sirwan and Awa Spi/Basara. The final section is dedicated to three dams planned on the Greater Zab with the support of Turkey. Some of the discussed dams are currently under construction and scheduled for completion; some are infrastructure of which construction was halted; some have been planned and given first priority for construction; some have been announced but construction has yet to be planned. These projects are generally developed with public funds, through public-private partnerships or international development agencies.

In November 2019 the KRG approved a budget of IQD 33.3 billion or $27.0 million[61] to complete the construction of 11 dams across the KRI with the aim to preserve underground water sources in Kurdistan and foster agriculture.[62] This was announced in local media. The dams are Aqouban, Shawger, Banuy Talaban, Nazanin, Chamargah, Khanas, Sibnah 2, Gali Bandawah, Dewanah, Tourajar and Khornawazan. Three of these dams are located in Dohuk, five in Erbil and four in Sulaymaniyah. Construction of these 11 projects were postponed to after March 2020 due to weather conditions, while construction of one additional dam in Erbil Governorate, Gomaspan Dam, resumed in November 2019. Contracts with construction companies have been signed and these 12 dams are currently between 20 and 90 percent completed. The completed dams will be able to store up to 59 million cubic meters of water and are intended for flood control and irrigation up to 273 million square meters of land. At least nine of these are large dams (with a dam height above 15 meters). Four of these dams were included in the “Top 100 Priority Capital Investment Projects” in the 2016 World Bank/Ministry of Planning road map for the KRI: Aqouban, Chamargah, Khornawazan and Khanas. Despite the allocation of the funds, local media in December 2019 reported that some contractors fear that they will not be paid on time, since the contracts stipulate payments will be done upon availability of hard cash.[63] Akram Ahmed, Director-General of the Directorate of Dams and Water Reservoirs, confirmed in March 2019 that even though the budget was approved

Dam Development Projects KRI



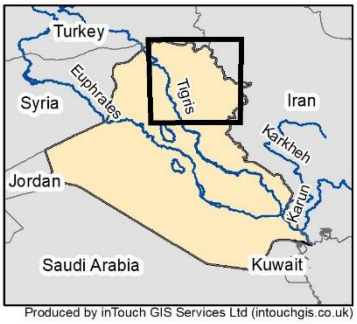
Site Locations

- Proposed by Turkey
- Energy
- Irrigation
- Irrigation and energy
- Multi-purpose
- Water Bodies
- Rivers

N

0 10 20 30 40

Kilometers



Produced by inTouch GIS Services Ltd (intouchgis.co.uk)

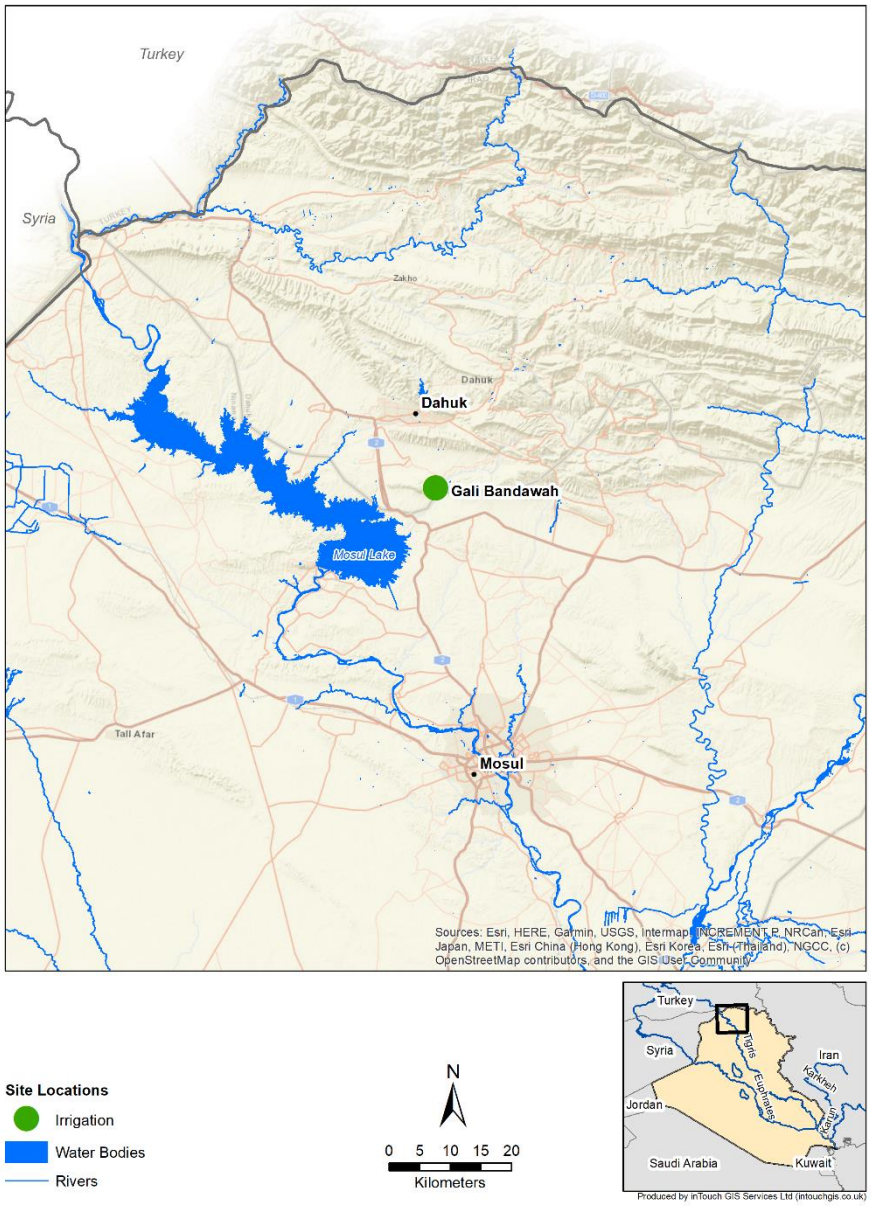
earlier, funds allocated by the KRG for the construction of these dams are still insufficient.[64]

Construction of five structures started before 2014; the Basarah, Bawanor, Surqashan, Chaq Chaq 2 and Zalan Dams. These works have been halted for various reasons: design failures (unstable locations), construction failure (dam burst), constructors retreating from the project or financial issues. Some of these dam projects have relocated to a different location or continue to remain in the pipeline. Akram Ahmed reported in December 2019 that work on these dams, which cumulatively need 500 billion IQD ($410.4 million), had not resumed yet.[65] As of March 2020, Basarah Dam resumed construction in a new location.

Ten dams are currently being constructed or planned through Public-Private Partnerships (PPPs) with various companies. The KRG has been looking to develop new dam projects through such form of financing, in which the private sector typically undertakes to build and operate a facility (be it a dam or a school) in return for the government guaranteeing an income stream. PPP contracts take various forms: some involve the construction and operation of new infrastructure, others the provision of services from existing facilities; in some, the ownership of the underlying asset is ultimately transferred to the private sector operator, in others it remains with the state. One variant is the BOT (Build, Operate, Transfer) contract, where a private sector entity finances construction and is repaid by the state, in regular payments, for the use of the buildings and services provided under a facilities management contract. The facility passes to the government when the operating contract ends, or at some other pre-specified time. With a BOO (Build, Operate, Own), the ownership remains with the private entity but the contract provides for various forms of government support during the contract period. With an LDO (Lease, Develop, Operate), an existing asset is leased from the government, with the private entity contracted to renovate and operate it. Although long promoted by the World Bank as a means of financing infrastructure, PPPs are now increasingly viewed by the International Monetary Fund and others as a highly risky form of finance that can trap countries into unsustainable levels of debt. The KRG has been actively looking for investors for these dam projects. Akram Ahmed, the Director-General of the General Directorate of Dams and Water Reservoir, in early 2019 had meeting with CGGC, a Chinese construction company. He provided them with a list of 10 proposed dams sites and requested them to put forward proposals for these.[66] Note that as of August 2012, Chinese companies or financiers were involved in at least 308 dam projects under way in 70 countries.[67] The 10 dams planned through PPPs are: Mandawa, Taq Taq, Sartik, Deraluk Reshawa, Bakerman, Base, Delga, Bardasoor, Kawlos, Khewata. Of the 10 proposed dam sites, seven are to be implemented using a BOT scheme or long-term loan finance. Excluded from this scheme are Kawlos, Base and Khewata Dams.[68]

Lastly, a number of other dams have been announced in the past decade by the KRG. None of these been announced for (or for the resumption of) construction. These are Kawlos, Chami Rokhana, Shiwashok, Razga Dwen, Rawanduz 10 and Kanarwe.

1. Dams on the Tigris

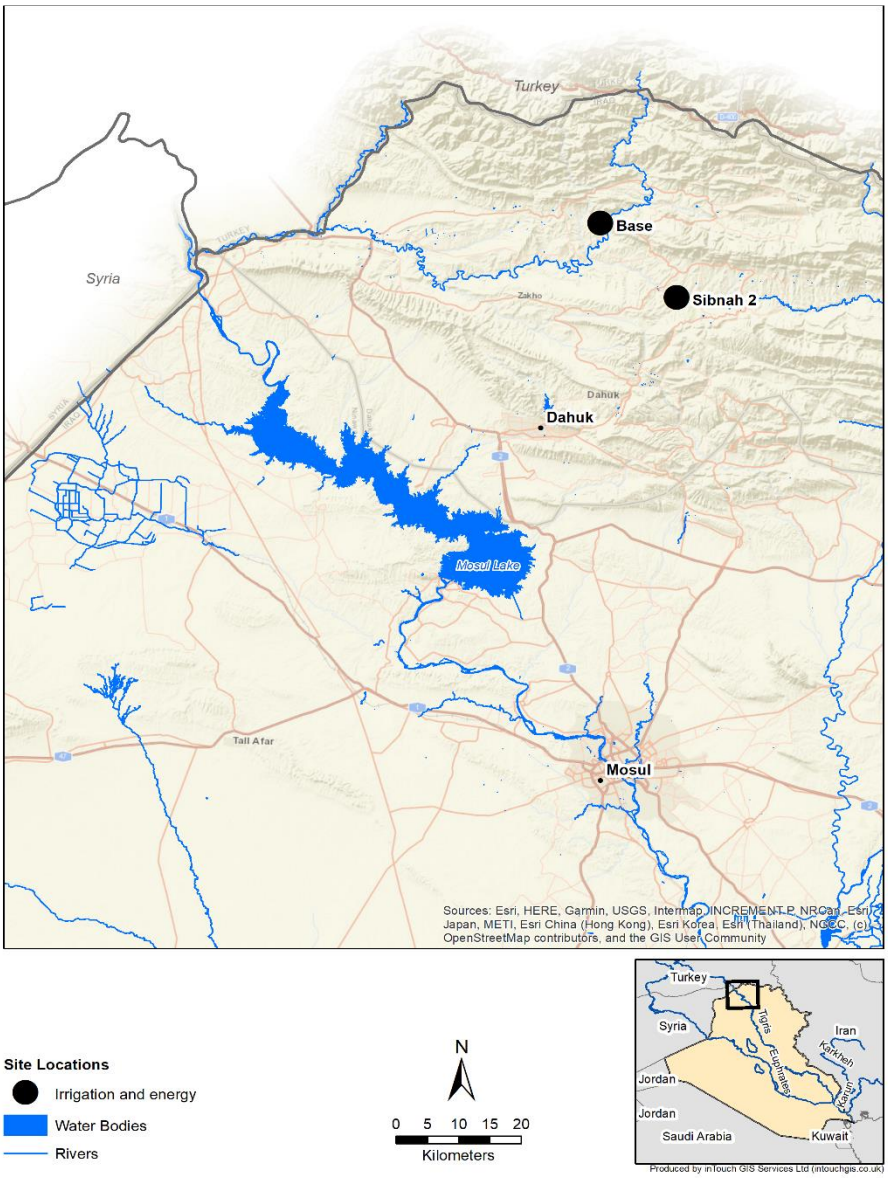


1 *Gali Bandawah (Dohuk)*

Construction of this dam started in 2013 by Zinar (a KRI company) and is currently at 38% completion. Gali Bandawah Dam is constructed on a tributary of the Tigris, 6km from the reservoir created by the Mosul Dam (located in Federal Iraq), 3km from the town of Al-Qosh. According to the website of the company, the aim of this dam is to supply water from the Tigris River to Dohuk Dam reservoir.[69] It is worth noting that previously, in 2009, the Ministry of Water Resources of Iraq (MWR) had carried out a $1 million Gali Bandawah-irrigation project to replace earth canals in Ninewa and Dohuk area through construction of seven canals connecting farm areas to springs.[70]

The Tigris River on the border of Syria and the Kurdistan Region of Iraq. (2019)

2. Dams on the Khabur



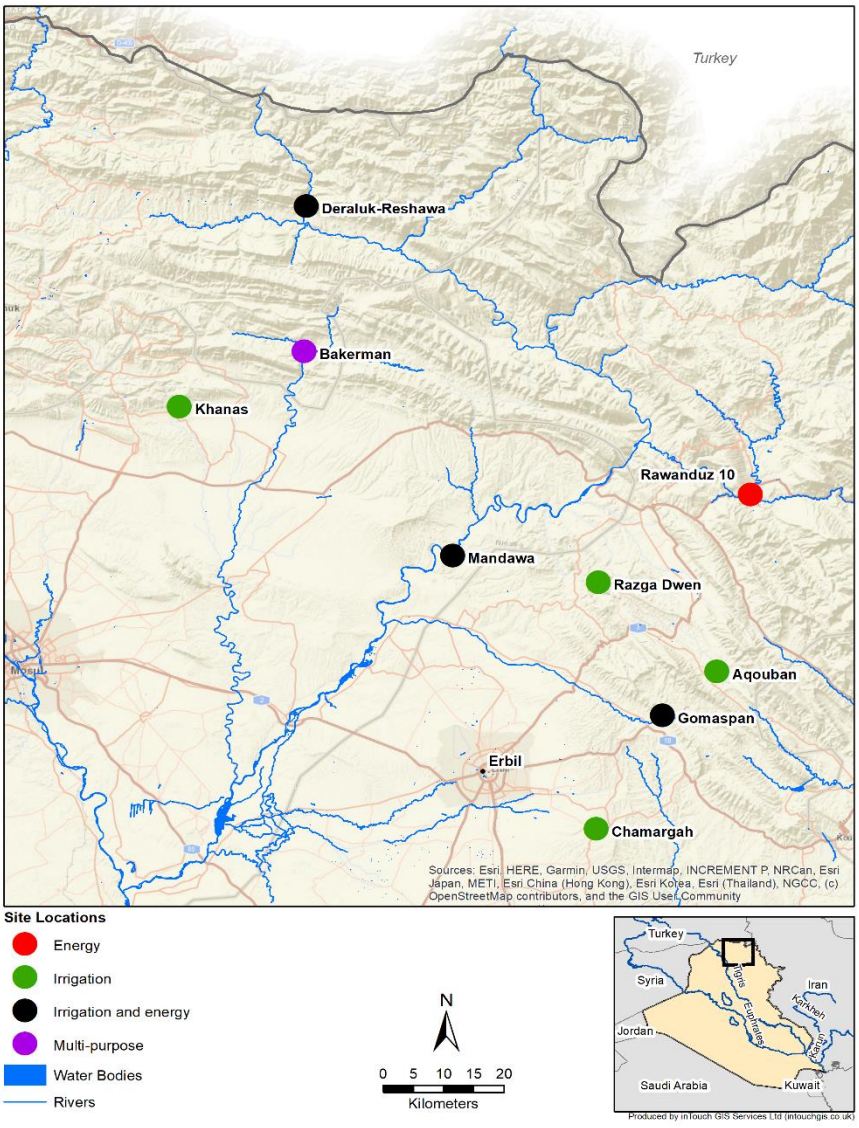
1 *Base (Dohuk)*

An arch dam on the Khabur River, near Zakho in Dohuk Governorate, for irrigation and hydropower purpose, about 30km east of the city of Zakho. The Khabur eventually joins the Tigris River at the tri-point of Iraq, Syria and Turkey. The dam is included in the investment plan 2017-2022 of the KRG Board of Investment.[71]

2 *Sibnah 2 (Dohuk)*

This dam was designed by the Turkish Deray Company, within the Setsu Engineering Group.[72] This company previously designed completed dams in the KRI such as Awa Sipi and Bedohy.[73] Construction of Sibnah 2 started in 2013 by Zinar Company. The aim of this dam on the Greater Zab is to supply water from the Tigris River to Dohuk Dam reservoir.[74] Sibnah 2 Dam is located on the Khabur river, while the first dam with the same name which lies on the Greater Zab has not been planned for construction yet.

3. Dams on the Greater Zab



1 *Bakerman (Dohuk)*

A mega dam on the Khazir, a tributary of the Greater Zab, for hydropower purposes. Bakerman Dam was designed in 2006 by El Concorde Construction from Jordan.[75] The dam is included in the investment plan 2017-2022 of the KRG Board of Investment.[76] Its constructed has started.

2 *Deraluk Reshawa (Dohuk)*

The 37 megawatts Deraluk Reshawa run-of-the-river hydropower project is the only dam discussed here which does not fall under the responsibility of the Directorate of Dams and Water Reservoirs, but under the Ministry of Electricity.[77] It is significant for being the first dam directly on the Greater Zab in the KRI. It is a prestigious project, which received considerable local media attention, including a 20-minute televised report.[78] The dam has a social media page as well.[79] The main structure of the dam includes a weir, channel, gates and a stilling basin located downstream. The water flow will be conveyed to a desilting basin through a channel, into two turbines. A powerhouse and tailrace return the water flow into the Greater Zab River.[80] This $168 project is financed by the Japan International Cooperation Agency (JICA) within the framework of a loan from Japan to the Government of Iraq,[81] and is built by Boland Payeh-Farab consortium.[82] This Iranian company constructed the well-known Milad Tower in Tehran.[83] The construction was officially to start on February 2016 but according to the website of the construction company commenced in October 2016.[84] It is scheduled to take more than three years to complete and was initially to be finalized by 2017.[85] As far back as 2008, MapCom Company from Iraq produced an EIA of Deraluk Dam.[86] According to Alex Kemman, the EIA of the dam does not mention any negative impacts on the environment.[87] Population in the area will lose their land and livelihoods and have not been offered sufficient compensation.[88] Yet according to Alex Kemman, the local populations prefer to sell their lands to the municipality for dam construction rather than other actors and they expect benefits such as hydropower, tourism and work.[89] However, despite promises of employment opportunities and local development, most of the construction of the Deraluk Reshawa Mega Dam is done by Iranian workers because of low wages.[90] Its construction is currently ongoing.

Construction site of Deraluk-Reshawa Dam. (2020)

3 *Khanas (Dohuk)*

An EIA of Khanas Dam was produced by Kar Group – Engineering and Constructions, the group who initially designed the earth dam, but was deemed inadequate by Czech experts.[91] The Dams and Water Resources Engineering Department of the University of

Salahaddin in Erbil published a hydrological study of Khanas Dam in 2010, which recommended annual cleaning of the Khanas reservoir due to highly sediment deposition from the catchment area and enlargement of the catchment area.[92] Consequently, the dam was re-designed by HEWA, which is part of the Jordanian Consolidated Consultants Group.[93] It will be located on the Gomel, a tributary of the Greater Zab in Shekhan. Construction work is ongoing. Khanas dam site contains a range of archaeological sites, and some Assyrian villages which would be submerged by the reservoir.[94]

4 *Aqouban (Erbil)*

This is an irrigation dam of 25m height on the Greater Zab River. Aqouban would be an earth dam (embankment dam) built with compacting layers of earth. It is normal for earth dams to leak to a certain extent, as water moves slowly through the dam. Measures will have to be taken to control the movement of water through the dam, otherwise it can erode the soil on which the dam is located.[95] In 2012-13, the Czech Alliance CREA-Hydro & Energy provided consultation on the construction site of Aqouban.[96] Fadhil Ali Ghaib, an assistant professor in Geology from Salahaddin University, Erbil, prepared the Environmental Impact Assessment (EIA).[97] Construction of Aqouban Dam was started by the local Chiay Ararat Company in 2014 with a budget of 7 billion IQD.[98] As of March 2020, it was 80% completed.

5 *Chamargah (Erbil)*

This is an irrigation dam on a tributary of the Greater Zab, downstream of Dukan Dam. A hydrological report on this dam was prepared by Zae Company. The July 2017 progress report of the World Bank/Ministry of Planning three-year roadmap mentions 'compensation of dam lands' for the population in the Chamargah Dam area.[99] Construction has not moved beyond the initial stage.

6 *Gomaspan (Erbil)*

The construction of Gomaspan Dam near Shaqlawa on the Bastura Chai, a tributary of the Greater Zab (seasonal stream) in a narrow gorge, was planned for construction starting in 2013, for a contract of IQD 7.2 billion by Ataç Group (Turkey) and Senk Group (KRI).[100] During 2015 its ongoing construction was promoted on social media.[101] Evident from their social media page, Gomaspan is a project of high prestige for Senk Group.[102] From November 2019, the construction of this large dam with a reservoir of 75 million cubic meters[103] was resumed on a budget of $82 million, in a Public-Private-Partnership (PPP)-arrangement with Senk Group.[104] The dam is being built for agriculture purposes and to maintain groundwater resources.[105] According to Akram Ahmed, Director-General of the Directorate of Dams and Water Reservoirs, Gomaspan Dam is significant because it is set to create a reservoir of 81 million cubic meters for the city of Erbil, and for the first time in the KRI, a roller compacted concrete (RCC) dam construction method is being used for construction, which is regarded as a more economical and practical solution for water storage projects.[106] There are nearly 500 such dams built or under construction in the world, ranging from 15 to 243 meters.[107] Economy and speed of construction are the main reasons designers selected RCC. One of the most common issues which occur in the RCC dams at the beginning of its usage is leakage between the compacted layers within the dam body and hairline cracks throughout dam. These types of cracks can start from

upstream to downstream. There are several rehabilitations options dependent on the types of cracks.[108] A risk-assessment for Gomaspan Dam should address such issues.

Construction site of Gomaspan Dam. (2020)

7 *Mandawa (Erbil)*

A mega concrete-face rockfill dam for irrigation, hydropower purpose on the Greater Zab.[109] Its main goal is to increase the power supply of the KRI. Consultancy bids for this dam were under evaluation as early as 2005.[110] The Italian Geotecna Progetti designed Mandawa Dam and its construction was awarded in 2013 to Geosonda Group from Serbia.[111] Officials of the Directorate of Dams and Water Reservoirs claimed that populations affected by Mandawa Dam have been consulted and agreed with its construction.[112] According to Alex Kemman, the EIA of Mandawa Dam fails to describe how the dam would affect the environment.[113] The number of displaced people due to Mandawa Dam would amount to 2300-3700. The EIA acknowledges displaced populations will be compensated and resettled according to a resettlement plan, but it offers no specifications.[114] Its construction has yet to start.

Proposed location of Mandawa Dam. (2020)

8 *Rawanduz 10 (Erbil)*

A hydropower dam which was originally scheduled to be constructed by 2016, about 3km from Rawanduz city. The Investment Board of the KRI together with the Directorate of Investment promoted this hydropower dam on the Greater Zab as an investment opportunity through PPP.[115] The dam is included in the investment plan 2017-2022 of the KRG Board of Investment.[116] Its construction is yet to be planned. Other dams on the

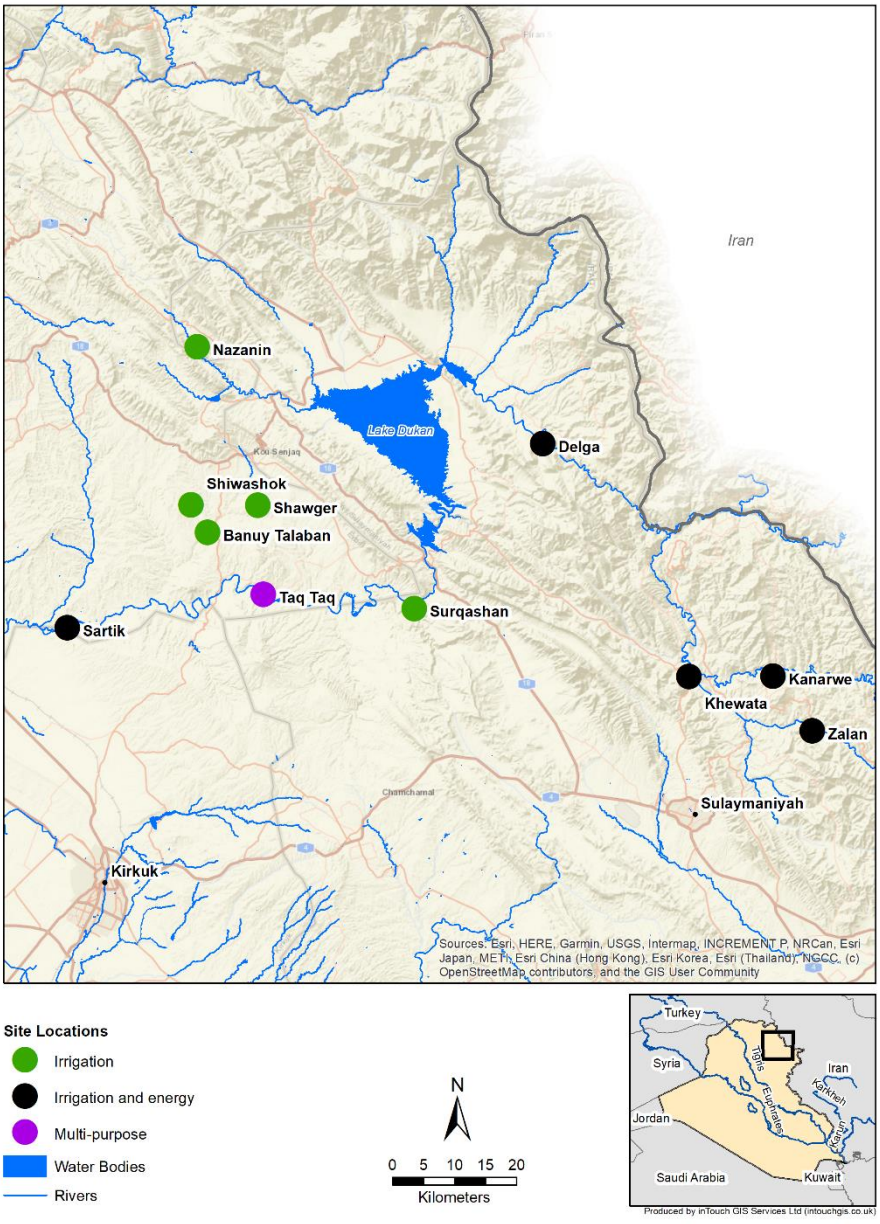
Rawanduz River, a tributary of the Greater Zab, have been explored as well by the MAWR.[117]

The Rawanduz River. (2018)

9 *Razga Dwen (Erbil)*

An EIA of this dam on the Greater Zab was prepared by Fadhil Ali Ghaib, an assistant professor in Geology from Salahaddin University, Erbil.[118] Construction of this irrigation dam was started but as of the writing of this report has yet to resume.

4. Dams on the Lesser Zab



1 *Banuy Talaban (Erbil)*

An EIA of this dam on the Lesser Zab was prepared between 2007-2010 by the Department of Geology at Salahaddin University, Erbil.[119] Constructed started in 2011 through a joint venture between PS Profi Company from the Czech Republic and Plan Company from the KRI.[120] The Czech Alliance CREA-Hydro & Energy provided consultation on the construction site of Banuy Talaban.[121] In December 2012, when construction of the dam was at 40%, the structure collapsed due to heavy rainfall. 7 billion IQD had been spent by then. According to local officials, construction did not reach the scheduled 80% due to lack of funds. According to the manager of the dam site, the construction company lost 250 million IQD.[122] Since then, construction of Banuy Talaban Dam has not been resumed.[123]

2 *Nazanin (Erbil)*

This is a dam of 20m height located in Koya area on a seasonal stream of the Lesser Zab in Nazanin Valley. Construction started in 2013 by Hidroconstructia from Romania for a contract of $6.3 million, but has not moved beyond initial excavations.[124]

3 *Sartik (Erbil)*

A mega dam which would be located near Altun Kopri, 33 km downstream from the proposed Taq Taq Dam. It would regulate the water released from the proposed Taq Taq Dam.[125] In addition, Sartik Dam would lie 56 km north of the Dibbis Dam, which was built in the 1960s to provide irrigation for Kirkuk. Together with Dukan Dam, these are two existing and two proposed dams on the Lesser Zab (excluding tributaries), which flows into the Tigris River. Its construction has not started yet.

4 *Shawger (Erbil)*

Shawger Dam was designed by Sharaza Company in Erbil.[126] It currently stands at 40% completion. This agricultural reservoir would be located on the tributary Rubar Kuy in Koya, which flows into the Lesser Zab.

5 *Shiwashok (Erbil)*

Located on the Rubar Kuy, a tributary of the Lesser Zab, an irrigation dam in the Koya area.

6 *Taq Taq (Erbil)*

A mega dam designed by London-based ITSC,[127] to be located on the Lesser Zab about 5km upstream from Taq-Taq town, for irrigation and hydropower purpose. The Taq Taq Dam reservoir would serve as a regulating reservoir for water releases from the hydropower station of the existing Dokan Dam. ITSC conducted an EIA of the dam in 2006.[128] The dam is included in the investment plan 2017-2022 of the KRG Board of Investment.[129] Its construction has not started yet.

7 *Delga (Sulaymaniyah)*

A large dam for irrigation and hydropower purpose on the Lesser Zab in Sulaymaniyah Governorate, 20km from the Dukan Dam reservoir, and 19.5km form the Iraq-Iran border. The village of Delga is located 10km southeast of the dam construction site.[130] A substantial part of its catchment area is located in Iran.[131] A first call for studies of Delga Dam was published as early as 2008,[132] and the dam was designed by London-based ITSC.[133] Delga Dam has been postponed on several occasions,[134] ranging from 2013 to 2017.[135] Due to the size of the project and the lack of funding, experts say construction is not expected to start within the next decade.[136]

8 *Kanarwe (Sulaymaniyah)*

An irrigation dam in the Penjwen area on the Kanarwe River, a tributary of the Lesser Zab.

9 *Khewata (Sulaymaniyah)*

A rock-filled dam on Qalach Walan, a tributary of the Lesser Zab, designed in 2013 by Mahsab Shargh Company from Iran.[137] This company produced the EIA of the dam.[138] A pumping station in the reservoir has been proposed for domestic water supply to the city of Sulaymaniyah. As part of a Local Area Development Programme (LADP) of the European Union (which concluded in mid-2019), a Sustainable Energy Action Plan (SEAP) was produced for Sulaymaniyah Governorate. This action plan supports the construction of Khewata Dam. It claims that in the summer the water treatment plan of Dukan and the springs of Sarchinar cover only 64% of the Sulaymaniyah city's water demand and therefore this dam is a necessity.[139] Khewata would be the location of the dam since it is regarded as the nearest and most suitable location for a reservoir.[140] Khewata Dam has not moved beyond the design stage and no field work has been done yet, since construction would require a large amount of funds which are currently not available.[141]

10 *Surqashan (Sulaymaniyah)*

Surqashan Dam is located on the Tabin River, a tributary of the Lesser Zab near the city of Dukan. The first ideas for construction of Surqashan Dam appeared in 1982.[142] Actual construction of this earth dam started in February 2011, scheduled to be completed by January 2015 through the Ardallan Joint Venture Company in collaboration with Ahenap

Construction site of Surqashan Dam. (2020)

Demarcation of Surqashan Dam. (2020)

Company.[143] The dam would be 42 meters high, with a reservoir of 42 million cubic meters. Its main purpose would be irrigation and tourism. However, the tourism potential is unclear, since the site can only be reached by a narrow dirt road going through an oil refinery, while the river below the dam site was polluted by a gravel mine created for construction of the dam.[144] This gravel mine released high levels of sediment into the Lesser Zab River.[145] In addition, Nature Iraq reported that Surqashan Dam would flood the remains of an ancient Islamic fort, in an area with a number of ancient tombs and caves. No Cultural Heritage Impact Assessment has been made of the dam.[146] No plans for fish passages are included in the dam.[147] 40 villages will be submerged by the dam reservoir,[148] and there is no compensation for farmers or communities whose farmland and/or homes will be lost.[149] Construction of Surqashan Dam has been halted since 2016; the company has withdrawn from the project due to financial issues.[150] The construction site is unguarded and in decay.

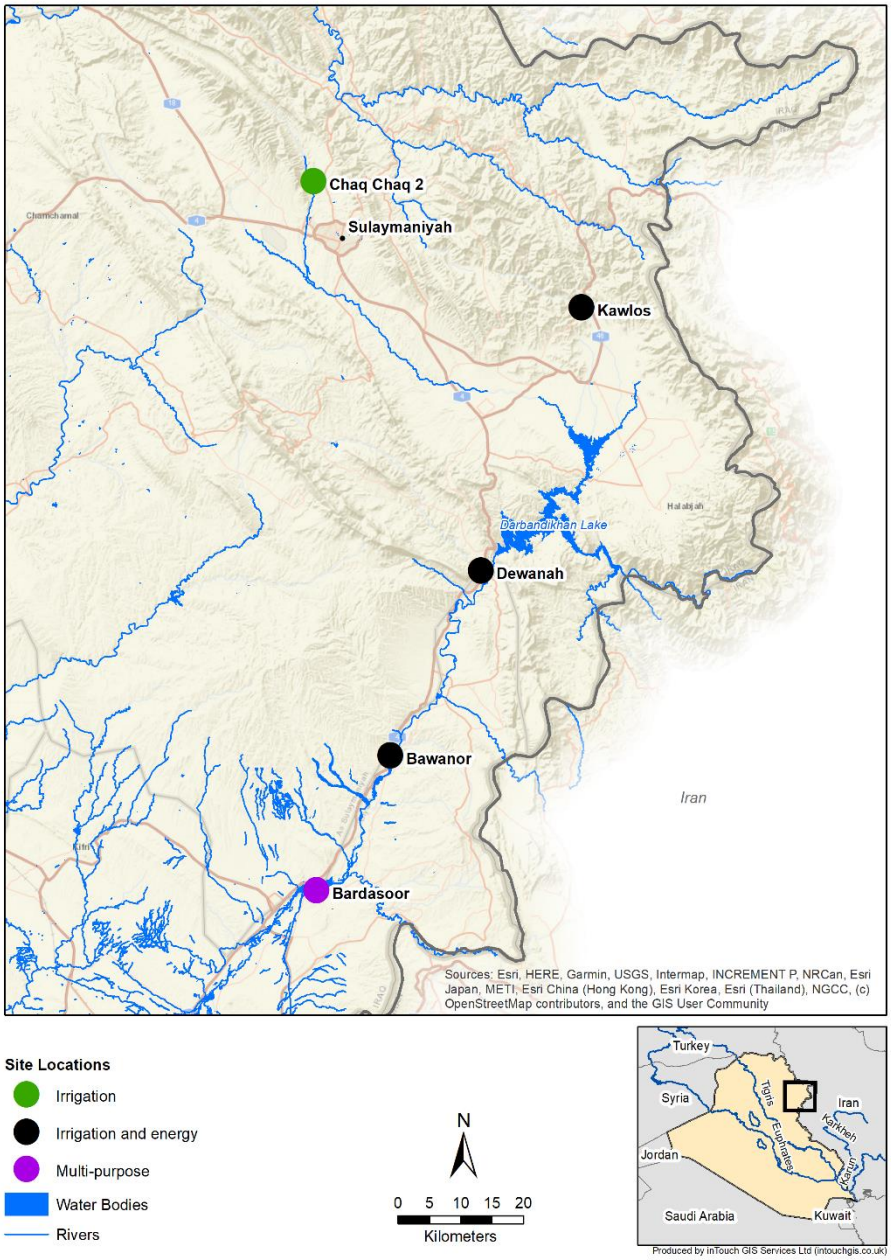
11 *Zalan (Sulaymaniyah)*

This earth dam on the Qala Chwalan (Lesser Zab tributary) was designed by the Italian company Calidonna.[151] In January 2014, a contract was concluded with EvYol and AbNiru, two Iranian companies, to build Zalan Dam.[152] These companies conducted the EIA.[153] Its cost was estimated at IQD 23.9 billion and its construction was scheduled to take three years.[154] The dam would be used mainly for irrigation purpose but also hydropower. Agricultural lands of nearby Sherhaweza village would be submerged by dam.[155] In 2017 while constructing, Zalan Dam burst due to floods and parts of the dam were destroyed. Only 2 spillways were designed in the dam, while 3 were necessary to release the pressure. The dam failure occurred during Newroz (Persian New Year) when most construction staff was on holiday. There was not sufficient staff present at the site to control the floods. Following the dam failure, EvYol filed a court case and was compensated by the MAWR.[156] Zalan Dam has not been repaired since. Currently the dam is 38% finished and waiting for allocation of funds for reparation and to resume construction. As of March 2020, construction workers are still present at the site.

Construction site of Zalan Dam. (2020)

Construction company EvYol has a history of dam construction: it constructed two dams in Sri Lanka, and a range of dams inside Iran. These include Karun-4, the largest concrete dam in Iran. Evyol did preliminary work prior to construction of Karun-4 dam, including the construction of an access road and tunnels to divert the river from the project.[157] Iran has built a large number of dams, including several on the Karun River which feed the Tigris. These have greatly decreased the water flows that reach Iraq. Paradoxically, this implies that companies responsible for hydro-infrastructure that has reduced water flows to Iraq are invited by the KRG to profit from dam construction within Iraq. It is worth mentioning that besides Evyol, subsidiary companies of Khatam-al-Anbiya (which is one of Iran's largest contractors in development projects and is owned by the Iranian Revolutionary Guard Corps and banned under US sanctions) such as Sepasad have been involved in the construction of the controversial Karun-4 dam in Iran.[158]

5. Dams on the Sirwan



1 *Bardasoor (Sulaymaniyah)*

A hydropower dam on the Sirwan River in Garmian area. Bardasoor Dam is included in the investment plan 2017-2022 of the KRG Board of Investment.[159] Muhammad Fathulla, an independent engineer, produced the EIA of Bardasoor Dam.[160] At 44 pages, it is very concise, but lacks methodology and is mostly aimed at mitigating the negative effects of a dam whose construction was already approved before the EIA was requested, as the study itself admits.[161] It claims 3 villages will be flooded by the dam.[162] Compensation for affected populations is not mentioned. Bardasoor Dam would submerge an archaeological construction from the Ottoman era.[163] Currently only topographic surveys, excavations have been conducted of this dam.

2 *Bawanor (Sulaymaniyah)*

This earth-fill dam is to be built on the Sirwan River, 32km from Kalar district, and would cost IQD 23.4 billion. The Investment Board of the KRI together with the Directorate of Investment promoted the dam as an investment opportunity through Public-Private Partnership (PPP).[164] Construction started in 2013 by Hidroconstructia from Romania, for a contract value of $195.3 million.[165] As of March 2020, construction has not yet moved beyond excavation works.[166] Bawanor Dam would provide 50MW of electricity, and provide irrigation too.[167] This large dam would have a reservoir of 70 million cubic meters.[168] An EIA of Bawanor Dam was prepared between 2007-2010 by the Department of Geology of Salahaddin University, Erbil[169]. Consequently, in 2010 another Environmental Impact Assessment (EIA) was conducted by the Czech Renewable Energy Alliance (CREA) Hydro-Energy, a cluster of companies, research institutions and universities in the Czech Republic.[170] This EIA has been published as a thesis on the website of Mendel University in Brno, Czech Republic.[171] The author acknowledges that the report does not fulfil all the aspects of the EIA, mostly because the EIA was produced while the feasibility of the dam was still being studied,[172] When detailed technical aspects of the dam are not available yet and thus its exact impact is difficult to assess. Nevertheless, the EIA outlined that the dam will have two crucial impacts: environmental and social. The microclimate and environmental flows of the river would be altered, as well as the ecosystem (otters and waterfowls have their natural habitat in the area).[173] Livelihood of surrounding populations would be lost due to the flooding of mines, henneries and farming areas. The assessment proposes to employ those people in the construction of the dam and argues that new employment opportunities will arise from the dam operation and irrigation,[174] although this is questionable since these jobs will require specific skills. Recent studies have demonstrated that the water quality of the Sirwan River is deteriorating.[175] Bawanor Dam would further exacerbate this process by increasing the salinity of the river, due to evaporation as water chemistry and temperature downstream changes.

3 *Chaq Chaq 2 (Sulaymaniyah)*

Confusingly, this is the third attempt to build a Chaq Chaq Dam on the Quilisan Stream. Nearby, towards Sarchinar district of Sulaymaniyah, lie the remains of the first Chaq Chaq dam which failed in 2006 due to floods (see further). An attempt to construct another Chaq Chaq dam further upstream was not successful: it was found that the rock slopes are unstable. Today this attempt at construction is still visible in the rocks by the riverbank.

Construction site of Chaq Chaq 2 Dam. (2020)

Further upstream, a third attempt was started to build Chaq Chaq 2 Dam, with some canals finalized. This is the current project. The cost of this dam was estimated at IQD 16 billion and would take 900 days to build.[176] The purpose of Chaq Chaq 2 would be irrigation and to protect the area from flooding.[177] The dam is located on the Quilisan, a tributary of the Tanjero River, 8km north of Sarchinar resort in Sulaymaniyah. It was designed in 2012 by Mahsab Shargh Company from Iran. This company produced the EIA as well.[178] A contract for construction was signed in December 2013 with Marwan Ahmed Alkurdi Company (Jordan).[179] Currently, works have been halted due to lack of funding.

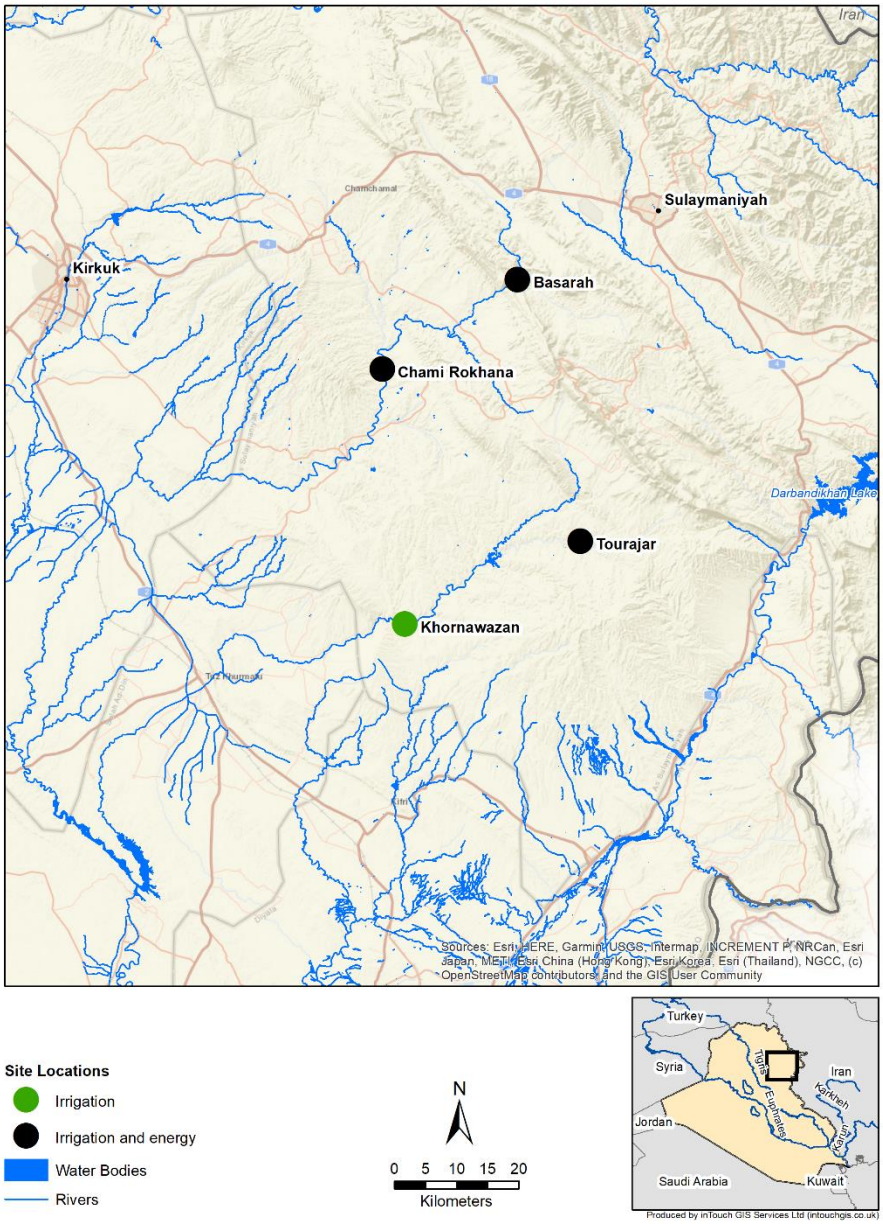
4 *Dewanah (Sulaymaniyah)*

The Dewanah is a tributary of the Sirwan River flowing between the mountains of Qaradagh and Baranan. It is surrounded by the Awa Spi and Tanjero Basins. The Dam is located nearby the city of Darbandikhan and was designed by Dler, a local company, while its construction was completed by Hovar company. The initial deadline for construction of the Dewanah Dam on the Dewanah River was May 2013.[180] Its construction was resumed again following the financial crisis, and in June 2019 it was reported that the dam is to be operational in November 2019.[181] As of March 2020, the dam has been completed and the reservoir is being filled.[182] According to Akram Ahmed, the Director-General of the General Directorate of Dams and Water Reservoir, it is the fifth largest dam in the KRI in terms of storage capacity (11 million cub meters).[183]

5 *Kawlos (Sulaymaniyah)*

A large storage dam for irrigation and energy on the Chaqan, which feeds the Sirwan River in Sulaymaniyah Governorate. First studies of this dam appeared in the early 1980s.[184]

6. Dams on the Basara/Awa Spi



1 *Basarah (Sulaymaniyah)*

This large irrigation dam on the Basarah River near Delezha village would have a height of 47m and a reservoir of 60 million cubic meters.[185] It is located south of Sulaymaniyah on a tributary of the Diyala River, Chami Basara.[186] The first studies on the Basarah Dam construction site appeared in 2009.[187] The Investment Board of the KRI together with the Directorate of Investment promoted the dam as an investment opportunity through Public-Private Partnership (PPP).[188] It was then found that the rock slopes of the dam area were unstable. A study published in 2013 concluded that stabilization of the slopes is necessary for the proposed Basarah Dam. It recommended a detailed study of modes of failure in all unstable slopes before construction of the dam.[189] That same year, a contract was signed with three companies to start construction of Basarah Dam, which was

Sign at the new construction site of Basarah Dam. (2020)

scheduled to finish within five years.[190] All three companies were Iranian: Bamra, Umrab, & Hardam.[191] Due to the financial crisis from 2014 construction was halted. Recently it was decided to move the location of Basarah Dam slightly further downstream near the village of Tilakoy. As of March 2020, a sign at the new location announced that construction will be funded by the European Union and the German development agency GIZ. The dam will be built by an Iranian-Jordanian joint venture. As of March 2020, a geophysical survey is ongoing.[192] Scars of initial construction in the rock slopes of the previous location are still visible. Researcher Osama Amin reported that Darband-i Basarah ("the Gorge of Basarah"), the dam construction site, contained archaeological artifacts including a rock relief of at least four millennia old carved on the face of an anticline: the Lulubian rock relief of Darban-I Basarah.[193] The operation of Basarah Dam would result in the flooding of such artifacts. The area has not been properly excavated, and other artifacts might be lost if the dam goes into operation. Plans for dam construction on the Basarah River have existed since the 1990s, and as early as 2002, the Directorate of Antiquities of Sulaymaniyah visited the site to make a replica of the Lulubian rock relief, which is now stored in the Slemani Museum.[194] It is an example of heritage at risk from dams. No Cultural Heritage Impact Assessment has been made of Basarah Dam. No compensation has been announced for farmers or communities whose farmland and/or homes would be flooded, contrary to the guidelines of every major multilateral development bank.[195]

2 *Chami Rokhana* (Sulaymaniyah)

A multi-purpose dam on the Basarah River near Chamchamal for irrigation and hydropower.

3 *Khornawazan (Sulaymaniyah)*

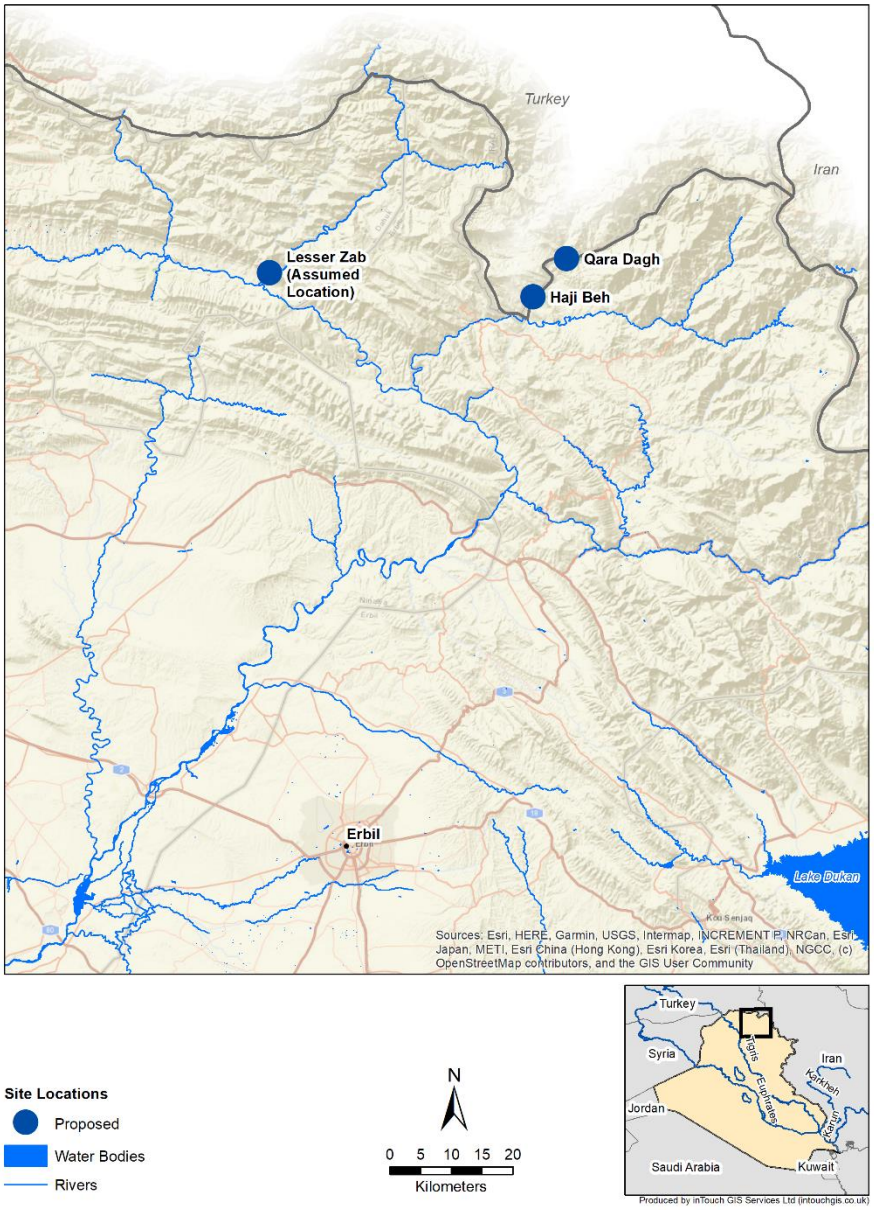
This big dam is located in Garmain on the Uthaim River (a tributary of the Awa Spi). An EIA of Khornawazan Dam was prepared between 2007-2010 by the Department of Geology of Salahaddin University, Erbil.[196] In 2012-13, the Czech Alliance CREA-Hydro & Energy provided consultation on the construction site of Khornawazan.[197] As of March 2020, construction is ongoing with 90% of the works finished.[198]


The Basarah River. (2016)

4 *Tourajar (Sulaymaniyah)*

Consolidated Consultants Group (Jordan) designed this dam, located in Garmian nearby the city of Kalar on a tributary of the Lahez. According to the designers, the construction cost would be $1.75 million. The group started preparation of a feasibility study in February 2019,[199] though the first geological studies were produced six earlier.[200] Tourajar Dam has not moved beyond the study stage yet.

7. Dams planned with the support of Turkey on the Greater Zab



There is a proposal for building three additional hydropower dams in the KRI. The dams would be located in the Greater Zab basin on two tributaries. The reservoirs formed by these dams would be on the border with Turkey in the Mergasor region of KRI. These dams are:

Haji Beh (Located on Chama River in the Sherwan sub-district in the border areas);
Qara Dagh (Located on Chama River in the Sherwan sub-district in the border areas);
Lesser Zab (built on the Balinda River in the Mzury sub-district, a tributary of the Greater Zab and not to be confused with the Lesser Zab River)

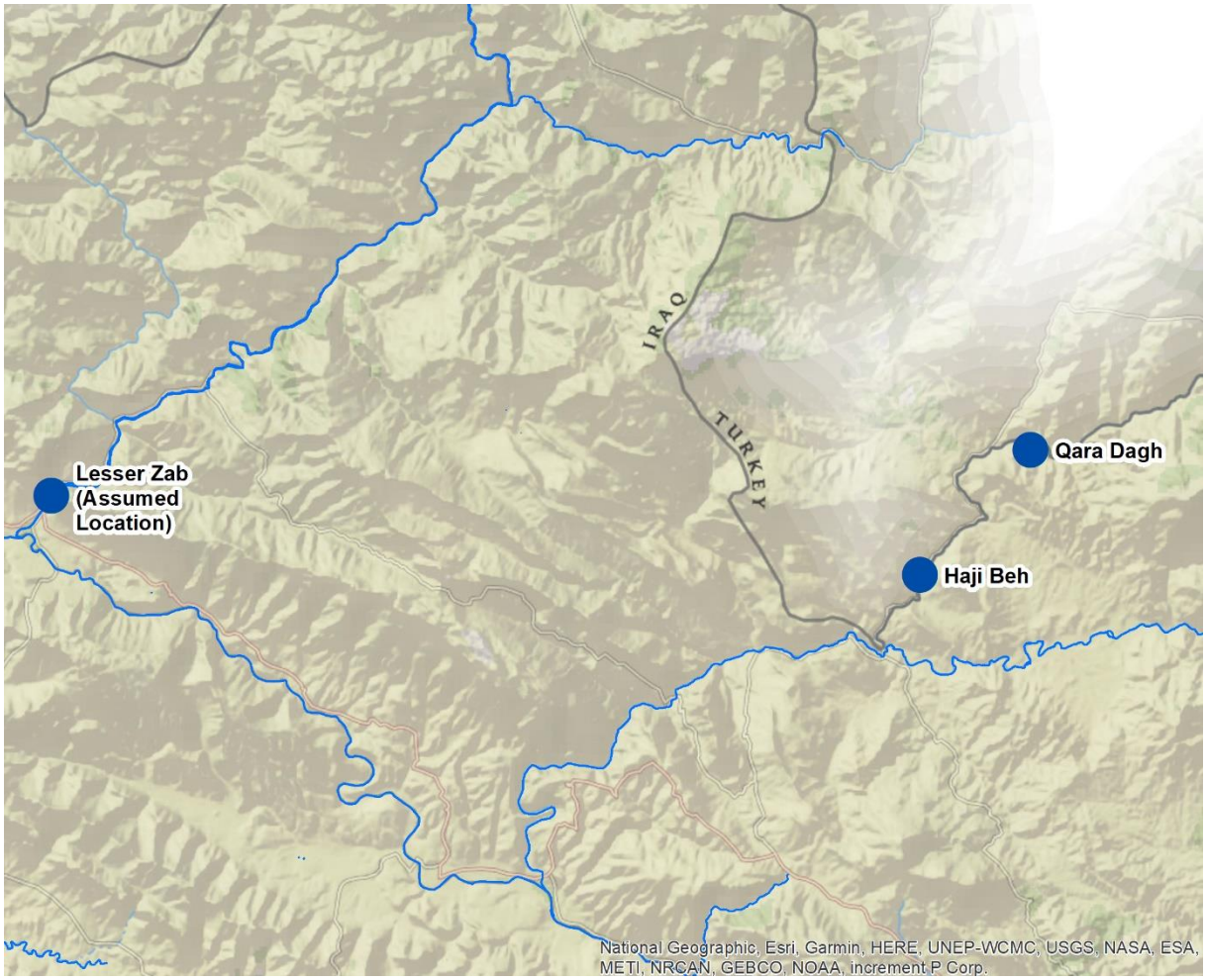
One of these dams will be large, reaching up to 180m, while the other ones are medium-sized.[201] One dam is planned to store 240 million cubic meters of water and produce 50 megawatts of electricity, according to Akram Ahmed, Director-General of the Directorate of Dams and Water Reservoirs. The second dam will have a reservoir of 670 million cubic meters and produce 80 megawatts of electricity. The third dam will contain 240 million cubic meters of water, and produce 25 megawatts of power.[202] These hydropower dams have been proposed by the government of Turkey and are to be built by Turkish companies but supply electricity for the KRI.[203]

The construction of these dams has been discussed since 2015 between the three governments of the Kurdistan Region, Iraq and Turkey. The idea was proposed by Turkey in 2015, to jointly construct the dams with the KRG and Baghdad, and the Turkish government has been calling for it since.[204] In December 2018, an Iraqi delegation visited Turkey during which the dams were agreed upon by the Government of Iraq and the KRG. Iraqi, Turkish and KRG forces were subsequently involved in the security assessment of the sites.[205] On 31 July 2019, all three governments met in Baghdad to finalize the agreement, including a 30-member Turkish delegation led by former Turkish Minister of Forestry and Water Veysel Eroglu.[206] The Directorate of Dams and Water Reservoirs of the KRG was present in this meeting.[207] A technical team was established to study development of the Greater Zab River.[208] As of March 2020 the 3 dams are currently on hold due to complications in the ongoing negotiations between Turkey and Iraq over water shares of the Tigris River,[209] but progress could resume any given time.

The Greater Zab near Barzan in the Kurdistan Region of Iraq. (2019)

According to Mohammed Amen Faris, member of the Agricultural Affairs Committee in the Iraqi Parliament, the project would provide electricity to the surrounding areas and it "would help to save water for agriculture and revive tourism."[210] However, is tourism really a goal here? The remote border regions of the KRI have been known to harbour PKK fighters. The Turkish army has been bombing the area for decades, in efforts to drive out the insurgents who use the KRI as a base to target Turkey.[211] It is likely that the three proposed dams are used to securitize the border region, by creating a reservoir which would in effect create a water barrier between Turkey and the KRI, hereby blocking access to the KRI for PKK fighters. These dams are therefore controversial and their construction

is very likely to be targeted by the PKK. Iraqi, KRG and Turkish governments have already announced a joint military force to monitor the dam construction site.[212] Justifying further military presence, the KRG and the Turkish government are preparing to open a third border crossing between the two countries in this area; the Zete-crossing would connect Mergasor with Hakari.[213]



To understand the context and implications of these three proposed dams in the KRI, we briefly need to examine the practice of securitization of dams by Turkey and how hydro-infrastructure has been consistently used in the past decades by the Turkish government to thwart Kurdish resistance, both within Turkey and vis-à-vis its downstream neighbours.

Within Turkey, the Turkish government recently completed the controversial Ilisu Dam and at the time of this report was filling its reservoir. Under the GAP project, of which Ilisu is part, 11 dams are currently operational and three are under construction.[214] These dams are considered highly controversial within Turkey, and PKK insurgents have on many occasions attacked the construction sites of these dams with the aim of prolonging the development. Ilisu Dam will submerge the ancient Kurdish heritage site of Hasankeyf, which dates back 12,000 years. Furthermore, as Ercan Ayboga of the Initiative to Keep Hasankeyf Alive confirms,[215] the dam is regarded by local populations as a tool to assimilate the Kurdish population of Turkey into Turkish society by displacing them and forcing them into cities distant from their history and culture (Note that previously in the

early 1990s, 50,000 people of a predominantly Kurdish population were resettled as a consequence of Ataturk Dam on the Euphrates River).[216]

In 2009, Turkey announced the construction of 11 additional dams in a sparsely populated area along the border of Turkey and Iraq in Hakkari and Sirnak provinces (across the border from the Mergasor area in KRI). Ercan Ayboga confirms that as of February 2020, seven of these 11 dams have been completed.[217] According to Joost Jongerden, the sole purpose of these dams is to make it impossible for PKK insurgents to penetrate Turkey's borders from the Kurdistan Region of Iraq.[218] This project replaces earlier proposals for a border wall. Some of these dams are planned on a tributary of the Greater Zab, which flows into the KRI. These include Cukurca Dam, Doganli Dam and Hakkari Dam.[219] In 2017 it was reported that 18 hydropower dams have been built or are planned for construction in Hakkari province.[220] In 2008, the State Hydraulic Works admitted that these dams are "security dams against the PKK".[221] According to researcher Alex Kemman who visited the area in 2015, the local population of Hakkari believes the dams are intended to flood the mountainous routes of the PKK while villagers will be displaced and forced to move to cities.[222] Information about these hydro-structures remains scarce, and they are highly securitized.

Syria-Turkey relations of the past three decades provide a precedent demonstrating how the Turkish government has used water politics to put pressure on its downstream neighbours in an effort to curb Kurdish resistance. In the 1980s, in the midst of a PKK insurgency, Turkey agreed with Syria to set a minimum annual flow of the Euphrates River from Turkey, while Syria in return agreed to end PKK activities within its borders in 1992 (though it enforced this policy only in 1998).[223] In the 1990s Turkey constructed the Ataturk Dam on the Euphrates River, reducing the flow rate to Syria and Iraq by 40% compared to the 1970s.[224] In 2007 Turkey and Syria held joint operations against PKK on Syrian territory.[225] Between 2006 and 2011, Syria went through a five-year drought, possibly a result of climate change. The country was going through a water crisis and in need of increased water flows from Turkey. In 2009, in a crisis summit in Ankara, Turkey, Syria and Iraq discussed the issue of drought in the region. Turkey refused to commit to increase water discharge to its downstream neighbouring countries.[226] As a response in early 2011, Turkey agreed with Syria to build a series of dams as a means to safeguard Syria's water supplies.[227] When the Syrian Civil War broke out, relations between the two countries deteriorated, and in June 2014, Turkey reduced the water flow of the Euphrates River into Syria completely, hereby reducing the water in the reservoir of Tabqa Dam and its hydropower supply. In addition, the Autonomous Administration of North and East Syria, which is regarded by the Turkish government as an affiliation of the PKK, reported on a number of occasions that Turkey cut off water flows to its region and locals reported huge drops in water volume of streams originating in Turkey.[228]

Considering the aforementioned precedents, it is clear that the three proposed Turkish-built dams in the KRI are of a political nature. They securitize hydro-structures in the Turkish counter-insurgency strategy against the PKK. Turkey has had a military presence in the Kurdistan Region for 30 years,[229] and it has been the aim of Turkey to remove the Kurdistan Region of Iraq as a potential base for the PKK. The three proposed dams fit within this narrative. The following question then poses itself: why would the KRG and the Iraqi government support the Turkish construction of dams within its own borders, especially considering the disastrous impacts of unilaterally-built Turkish dams on the

water flows to KRI and Iraq? Both the Iraqi Federal government and the KRG have concerns over the impacts of Turkish dam construction within Turkey, in particular Ilisu Dam. Officials in Iraq and KRI are aware that Turkish dam construction will lead to greatly reduced Tigris River flows. The Iraqi government has on different occasions addressed water security with Turkey, but the Turkish government has always firmly claimed it will guarantee sufficient water flows into Iraq (which include KRI) but refuses to abide by any written agreement. Turkey has not been willing to sign the Convention on the Law of Non-Navigational Uses of International Watercourses from 1997,[230] an international treaty regulating the fair use of transboundary rivers to which Iraq and Syria are signatories. In May 2019 the Iraqi Minister of Water Resources Jamal al-Adli delivered a draft of a legal agreement to Turkey on the required shares of water from the Tigris and Euphrates Rivers. In the aforementioned meeting of 31 July 2019 between the KRG, Iraq and Turkey during which the three dams on the Turkish-Iraqi border were discussed, the Iraqi government again presented the legal agreement draft. Following a meeting between technical teams on 9 September 2020, the Iraqi government reported that "the Turkish side was not prepared to pursue any serious negotiations or technical meetings."[231] Similarly, the KRI is not in a strong position either and issues of trade and oil take priority over water. Turkey is the largest external trading partner of the KRI.[232] The current trade volume between Turkey and the Kurdistan Region of Iraq stands at $2.5 billion[233] and is of vital importance to the KRG. In 2014, a memorandum between the Turkish Ministry of Forest and Water Affairs and the Iraqi Ministry of Water Resources was signed, which in 2019 was still at the ratification stage. Internationally, often the Iraqi MWR acts as the focal point on water issues for all of Iraq, including KRI. The memorandum does not mention any water shares between the riparian countries, nor does it mention the 1997 convention on international watercourses, which came into force the same year the memorandum was signed. Instead, it proposes further development of the Tigris River and its tributaries within the KRI and Iraq. Article 2(a) of the Memorandum emphasizes "cooperation on joint projects on the water resources management in the Euphrates and Tigris shall further be developed."[234] Turkey has often proposed for Iraq and the KRI to build its own dams for water storage, as a response to water scarcity. The memorandum further says that Turkish companies will be invited to take part in construction works related to water resources management. Clearly, Turkish companies want to have a share of the Iraqi water market. The memorandum does not mention any of the dams constructed within Turkey, which basically endanger Iraqi water security. Instead, Turkey has convinced Iraq and the KRI that they need dams of their own.

The Greater Zab River south of Mergasor in the Kurdistan Region of Iraq. (2019)

Chapter 4: Fundamental considerations on dam construction in the KRI

In 2013, upon the signing of the contract for the construction of Basarah Dam, KRI Minister of Agriculture and Water Resources Sirwan Baban committed that "the Ministry is determined to follow the standards of quality, competition and transparency in the implementation of the projects."[235] Has this been the case? The aim of this chapter is to address how problematic dam schemes have been fostered by structural gaps in the water and dam policies of the KRG. It describes 14 considerations, which this report argues are important to be included in any assessment of the region's dam policies and practices.

Dams displace populations

Population displacement is the most obvious consequence of dam construction. An estimated 80 million people have been displaced by dams worldwide.[236] Besides the flooding of the reservoir, other water infrastructure such as irrigation channels as well as decreased flows downstream may induce displacement as well. Displacement often leads to resettlement in which people move to another location. This should be accompanied by compensation for their loss or assistance to relocate and rebuild their livelihoods. This is by no means always the case: displacement often leaves populations impoverished and marginalized.[237] The World Commission on Dams (WCD) studied a large number of dams across the world and reported that in case compensation was provided, it was often inadequate, and those who were resettled rarely had their livelihoods restored.[238] For people living downstream of the reservoir, the effects of the dam on their livelihoods only become apparent when operation starts. The downstream impacts for farmers who rely on seasonal floods can be severe.

Local fishermen in the Basarah River. (2016)

Upstream in Turkey, Ilisu Dam will displace up to 78,000 people.[239] Within the KRI, there are many such examples as well: The Bekhme Dam on the Greater Zab, which is currently not scheduled for completion, would according to the most conservative estimates displace up to 7000 people.[240] Bardasoor Dam would flood three villages,[241] Mandawa Dam would displace up to 3700 people,[242] more than 100 families would lose land due to Deraluk-Reshawa Dam,[243] Surqashan Dam would flood 40 villages,[244] while Basarah Dam and Zalan Dam would flood agricultural lands of local farmers.[245] Affected populations in the areas of Basarah Dam, Deraluk-Reshawa Dam and Mandawa Dam reported that they will receive no compensation despite the loss of homes or agricultural land. Some EIAs of these dams acknowledge compensation and resettlement for displaced populations according to a resettlement plan, but offer no specifics.[246] Certain villages which would be affected by the Bekhme Dam are not aware they could be displaced.[247] The period between the design of a dam project and its construction often exceeds a decade and dam construction has often been delayed in the KRI due to lack of finance. During this period, affected areas are often devoid of any investments and the population can suffer from psychological stress due to living in a possible dam reservoir. The Independent Human Rights Commission (IHRC) of the KRI says they have not received any complaints from dam-affected populations although it claims that people are aware the IHRC could assist them. Sabir Abdullah, Director of the Sulaimani branch of the IHRC, recommends displaced populations to address grievances with the MAWR or the Provincial Council directly.[248] He claims that the MAWR always has a plan for resettlement and compensation, and negotiates with affected populations before construction.[249] As a result of flooding of the dam reservoir, populations lose their livelihood without the possibility of new employment opportunities. According to Sabir Abdullah of the IHRC, dam-affected populations often welcome dam construction for economic development, and accept displacement in return for benefits such as agriculture and tourism opportunities. He says land prices around dam areas rise because of increased value for agriculture and business.[250] Dam-affected populations of Chaq Chaq 2 Dam, Aqouban, Banuy Talaban confirmed they welcome the construction of such water infrastructure, which is regarded as a new source of income. During the dam construction period, skilled and unskilled workers are required, which could be drawn from affected areas or the labour market of the KRI. However, in the cases of Zalan Dam or Deraluk-Reshawa Dam, the construction work is done by Iranian workers instead of locals.[251]

The WCD recommended mutually agreed and legally enforceable agreements to ensure mitigation, implementation of resettlement and development entitlements for dam-affected populations.[252] In 2012, the MAWR developed a roadmap, which established a priority for protection of human rights and even water rights.[253] However, most of the dam projects are not adequately scrutinized for human rights violations. A human rights framework should be included in any dam-assessment and provide clear information and assistance for dam-affected populations. The KRG Environmental Protection and Improvement Board (EPIB) and the IHRC of the KRG could oversee such process. The IHRC is currently not involved in any dam assessments, due to the lack of dialogue between the IHRC and the MAWR.

Deterioration of water quality in dam reservoirs

The alteration of a free-flowing river into an artificial reservoir can have great impact on aquatic and riparian ecosystems. Dams can indirectly deplete water nutrients and dissolved oxygen, due to algae formation and changes in temperatures of the water in the

reservoir.[254] The water quality would lose its auto-regulation and self-purification. A dam holds back sediments that would naturally replenish downstream ecosystems.[255] A decrease in riverflows can cause growth in pollutant concentrations, while massive evaporation in the dam reservoir increases salinity levels of the river.[256] These impacts are accumulated when several dams are constructed on a single river, as is generally the case in the KRI. Water quality can be impacted hundreds of kilometers further downstream and could be regarded as environmental degradation, destroying ecosystems downstream.[257] Following the construction of a dam, mitigation of water quality impacts depends on management actions related to its specific context.[258]

Generally, in Iraqi and KRG law, declines in water quality and contamination caused by dams is not regarded as pollution. However, policymakers should consider this. Relevant in this regard is the Federal Iraqi Law no.2 for Water System Protection (2001) which mostly deals with discharge of waste into public waters. It mentions that the Environment Protection and Improvement Directorate (EPID, now part of the Iraqi Ministry of Environment) should issue environmental rules for the physical, chemical or biological quality of common waters.[259] It authorizes the EPID to issue environmental restrictions in order to maintain the quality of public water. Unfortunately lack of pre-dam data on river chemistry and ecology makes it a challenge to quantify such impacts objectively. In the KRI, the resources of the Environmental Protection and Improvement Board are limited; it is not able to undertake large data collection, and data-sharing between different government ministries and agencies is lacking.[260]

The first attempt at constructing the Chaq Chaq 2 Dam was unsuccessful; it was found that the rock slopes were unstable. The scars in the rocks are still visible. (2020)

Lack of quality Environmental Impact Assessments for dams

An Environmental Impact Assessment (EIA) assesses the unintended impacts of a development project, with the aim to mitigate the negative consequences. They should facilitate the decision-making process and increase accountability for decision-makers of dams and other projects. According to David Jensen and Steve Lonergan, application of an EIA-process can yield four benefits: it can help weed our poorly performing companies

bidding for development projects who are not willing or able to submit an EIA, it can increase transparency and confidence in authorities, it can foster opportunities for cooperation between different stakeholders over the management of the rivers in question, and it will prevent conflict as a consequence of environmental degradation.[261] EIAs for dam projects, though required by laws in the KRI, are not always common. In fact, a report by the KRG Ministry of Planning and UNDP from 2012 confirmed that EIAs are generally neglected.[262] Two laws are applicable to industrial and infrastructural projects such as dam construction. On the federal level the 1997 Law no.3 for the Improvement and Protection of Environment is relevant.[263] A similar law was adopted by the KRG in 2008 (Law no.8 of 2008 for Environmental Protection and Improvement in Kurdistan Region – Iraq).[264] Both of these laws include directives on sanctions and the obligation to conduct an EIA on large projects such as dams. Article 18 of the Federal Iraqi Law no.3 says that an EIA has to be part of any project proposal, and is to be conducted by the entity proposing and constructing the project. Article 12 of the KRG Law no.8 requests an EIA of any project that impacts the environment. Article 13 the KRG commits to a system of evaluation for EIAs. The EIA laws further include paragraphs on consultation, informing, and compensation. No detailed requirements are mentioned in Law no.3 for a proposal; it does not mention the length of the EIA process or those authorized to conduct the EIA.[265] The quality of the EIA therefore depends mostly on the requesting authority.

EIAs are often conducted by dam proponents that underestimate the social and environmental impacts, while overestimating socio-economic benefits, as they are mostly concerned with demonstrating the viability of the project and the alternative of no project is not taken into account. This is especially the case with large investment projects when the stakes are high. In some cases, EIAs have been requested when dam construction was already approved (i.e. Bardasoor Dam).[266] In the EIA of Bawanor Dam, the author acknowledges that the report does not fulfil all the aspects of the EIA, mostly because the EIA was produced while the feasibility of the dam was still being studied without all technical details of the dam available.[267] Some EIAs lack essential information, such as methodology description (this is the case for the EIA of Jali Dam), or are too limited in scope (the Khanas Dam EIA is only 12 pages while the Deraluk Dam EIS contains 122 pages).[268] Some EIAs are not produced in the required form by law (e.g. Razga Dwen Dam). Some EIAs contain factual errors (e.g. Deraluk, Jali and Razga Dwen Dam mention the occurrence of species which do not exist in the region) while different EIAs contain the same chapters.[269] According to Stepan Kriegler, some EIAs correspond to a Strategic Environmental Assessment (SEA) instead of an actual EIA. An SEA would be an essential tool yet to be used in hydropower planning in thr KRI, but it does not substitute for subsequent detailed EIA. A SEA is supposed to be conducted at a very early stage of the decision-making process.[270] This could imply that in some cases no actual EIA was done (Bawanoor Dam) but an SEA instead. In addition, laws are not always enforced and some dams are being built without an EIA.[271] In the cases where EIAs are made, they are generally not publicly available and there is no process that allows the public to comment on or a third party to verify these assessments. An exception is the EIA of Bawanor Dam, which was produced by a researcher from Mendel University in Brno (Czech Republic). This EIA was not released by the KRG but Mendel University published it on their website as a thesis.[272]

In theory the Environmental Protection and Improvement Board (EPIB) of the KRG is responsible for the proper supervision of laws and procedures related to the

environment. It has competencies similar to a Ministry. In practice, however, the MAWR supervises all EIAs of dams and the EPIB is not involved in any of these.[273] The EPIB maintains no relationship with the MAWR. It has limited resources, and is chronically understaffed, with only 4% of its staff having a background in environmental science.[274] Its weight is therefore limited: mitigation of environmental impacts of dams depends completely on the MAWR. Hallo Askari, the head of the EPIB, confirms the lack of environmental consciousness in the KRI and advocates for policymakers to set the right example by implementing environmentally sound policies.[275]

Considering the number of large and complex dam projects proposed within the KRI, a SEA would be a valuable tool for comparison of various water management options and their impacts, assessing available alternative development scenarios, available designs. It should evaluate the effects of dam construction policies and plans. It should have a basin-wide approach which takes into account the cumulative impacts of all dams on each river. The WCD recommended basin-wide assessments of the river eco-system for each proposed dam.[276] A SEA could include conflict analysis, especially in the Tigris basin where dams have the potential to create conflict on water resources between upstream and downstream countries, regions and communities. This is especially urgent considering the fact that most of the EIAs of dams proposed or under construction in the KRI do not take into account its impact on Federal Iraq. Ideally, a SEA would be required by legislation as is the case in more than 60 countries.[277]

Lack of Heritage Impact Assessments for dams

A large portion of the KRI and Federal Iraq population resides in low-lying areas downsteam of large dams. No Heritage Impact Assessments (HIA) have been made of any of the dams in the KRI. A HIA would determine the impact of proposed dam construction on the cultural heritage value of the area proposed to develop and recommend approaches to the conservation of the heritage. They are not required under local legislation. Dams such as Khanas, Bardasoor, Basarah or Surqashan would submerge

The Marshlands of Southern Iraq are threatened by upstream dam construction. (2018)

important archaeological heritage such as ancient rock reliefs, a centuries-old fort, and Ottoman-era buildings. The archaeological sites of the Sapna Valley, which would be flooded by Bekhme Dam (not scheduled for completion), still have not been thoroughly studied even though the dam would erase many important archaeological sites, according to Ralph Solecki in 2005.[278] Impact of water infrastructure projects on cultural heritage should be assessed in the earliest stages of planning. Any HIA of dams located in the KRI on tributaries of the Tigris River should include an assessment of the impacts on Federal Iraq. Dams in the KRI will gravely impact the water flows that are necessary to sustain the Ahwar of Iraq, a UNESCO World Heritage site consisting of marshlands in Southern Iraq, fed by the Tigris River. In its Decision 40 COM 7 (2016), the UNESCO World Heritage Committee says it "considers that the construction of dams with large reservoirs within the boundaries of World Heritage properties is incompatible with their World Heritage status, and urges States Parties to ensure that the impacts from dams that could affect properties located upstream or downstream within the same river basin are rigorously assessed in order to avoid impacts on the Outstanding Universal Value (OUV)."[279] In 2018, the UNESCO World Heritage Convention acknowledged that World Heritage is threatened by "large-scale development projects including dams, […], located both inside and outside their boundaries" and requested that these "are assessed through strategic environmental assessments (seas) at an early stage in the development of the overall project, before locations/routes have been fixed and prior to any approvals being given" (Decision 42 COM 7).[280] The KRI therefore has a duty to assess the impact of its dam construction on the Ahwar World Heritage Site in Southern Iraq.

Understand and prepare for dam failure

Dams are always prone to dam failure and other disasters. The KRI has witnessed several such cases in recent times. In February 2006, Chaq Chaq Dam, a kilometer northwest of Sulaymaniyah on the Quilisan River, collapsed due to overtopping caused by design problems – no victims were reported. The dam was constructed from 2002-2004 by the Bulgarian company Akrokomplekt,[281] contracted by a Swedish NGO with aid from the Swedish International Development Agency (SIDA). In December 2012, Banuy Talaban Dam collapsed as a consequence heavy rainfall when construction was at 40%. According to the dam management the failure was a result of the lack of funds.[282] In March 2017, the Zalan Dam, which was still under construction in Sulaymaniyah Governorate, burst due to flooding as a result of design errors and lack of staff at the site.[283] In November 2017, the KRI was rocked by a 7.3 magnitude earthquake, which damaged Darbandikhan Dam and Dukan Dam though without serious consequences reported. Damages were assessed by a World Bank team and determined extensive repair was required. The reservoir of the Dukan Dam reached its highest level in 31 years in 2019, following weeks of heavy rainfall. The ability of the dam to withstand such pressure was questioned,[284] and areas south of the dam were at the risk of flooding which could have caused large population displacement. As the water reached the streets of Dukan city, Dukan Municipality reported that they lost the ability to control how much water was flowing downstream from the dam.[285] That same year, Smaquli Dam reservoir in Erbil Governorate caused the flooding of a road connecting the cities of Erbil and Sulaymaniyah due to rising water levels.[286]

The spillway of the Dukan Dam in Iraq in April 2019, when the reservoir reached its highest level in 31 years. (2019)

Additionally, the KRI is located in a volatile region; water infrastructure has repeatedly been targeted by armed groups. In Central and Southern Iraq, Daesh (ISIS) took control of dams to either flood areas or instigate water scarcity. Mosul Dam, located only 5km from the KRI, was located on the frontline of the conflict with Daesh with a high risk of failure. In Southeast Turkey, on 13 December 2018, one of the spillway gates of the Dicle Dam on the Tigris River broke. As a consequence, a big area along the riverbanks was flooded, affecting hundreds of settlements, local agriculture and a the Hevsel Gardens of Diyabakir (a UNESCO World Heritage Site).[287] Such events raise the question whether the Directorate of Dams and Water Reservoirs has learned from previous dam failures, and whether KRG has a disaster plan ready in case of extraordinary events and ultimately dam failure. In case of potential dam failure or emergency water releases, are there any emergency alert systems in place for downstream populations? Dam failures can be fundamentally attributed to physical and human factors which often precede dam failure by years. Professor Abdulla H.A. Bilbas of the University of Salahaddin, who holds a PhD in the Ecosystem Health Assessment of Dukan Lake, finds the (ongoing) construction of dams "catastrophic" and believes maintenance management, especially of dams, is non-existent in the region.[288] Cases of dam failure in the KRI discussed here have been attributed to lack of funds, lack of human resources, design errors and unexpected weather conditions. There is evidence that experts in the KRI have studied past incidents: In 2014 , the University of Sulaimani enacted a simulation of the Chaq Chaq Dam 2006 breach flood for research purposes.[289] Beyond design and construction, some important organizational practices could be: availability of sufficient budget and resources so that dam management will be resilient; continuous training and learn from past dam failures for dam personnel; identification of potential modes of failure and development of emergency action plans; establishment of an early warning system for failure through monitoring; sharing of information across the dam management.

The Chaq Chaq Dam collapsed in 2006. (2016)

Dam are to be constructed through risky financial mechanisms such as PPPs

The MAWR in its 2012 roadmap committed to encouraging private sector investment as a strategic priority for agriculture and water in the region.[290] Across the world, many dams have proven to be very costly and having taken too long to build to deliver a positive return.[291] The KRG has therefore taken different approaches to finance dams. In March 2013, media reported that the KRG Council of Ministers was in the process of borrowing long-term loans from foreign companies in order to continue its dam projects: "The amount of dams we want to build is too many and the budget we have cannot handle finishing them off, with this step we will be able to complete them within the time frame we want," the council stated.[292] In 2015, the KRG Ministry of Planning released the "Kurdistan Region of Iraq 2020: A Vision for the Future" policy document, a framework of five-year policy priorities for KRG government officials, often neo-liberal in its character. One of the overarching policy priorities recommended in the document is to foster private-sector participation in infrastructure provision, in particular public-private partnerships (PPP) in case of "a national interest for the government to be involved or if the private sector alone is unable to provide services".[293] Previously, the KRG Ministry of Planning together with UNDP had concluded in a joint report from 2012 that 20% of all investments in the KRI between 2013 and 2020 could be secured through public-private partnerships (PPP), in particular for power generation, which includes hydropower.[294] From 2016, the World Bank assisted the KRG with financial reform packages, as the KRI endured a financial crisis that started two year earlier. To diversify its economy, the KRG and the World Bank published a joint roadmap aimed to foster agriculture (which include irrigation dams) among other sectors, through investment opportunities for private investment while decreasing the share of the public sector.[295] A 2017 report by the Ministry of Planning on Economic Reform, supported by the World Bank, confirms the MAWR is seeking to privatize parts of the public sector in order to save public funds. Part of this plan was to encourage private sector investment in the agricultural sector through 62 projects, which include a number of dam projects.[296] Regardless of obstacles such as political instability, cancelled tenders and risks associated with payments,[297] PPPs are regarded by the KRG as a tool to increase private investment, with the assistance of the World Bank. However, they are highly questionable deals for the government. Particularly large dams, through cost overruns and construction delays, have often left

countries buried in public debt. The Coca Codo Sinclair hydropower dam in Ecuador is such an example.[298]

The International Monetary Fund (IMF) now views PPPs as carrying "sizeable" financial risk.[299] The IMF warns: "While in the short term, PPPs may appear cheaper than traditional public investment, over time they can turn out to be more expensive and undermine fiscal sustainability."[300] In the UK, the National Audit Office recently estimated that PFI school and hospital contracts cost 40%-70% more than if they were financed by government borrowing.[301] [302]Indeed, in 2010, Britain's then Chancellor of the Exchequer described the UK's PPP programme (known as the Private Finance Initiative) as "totally discredited".[303] The IMF cautions that "with the increasing use of PPPs by countries, the size of associated risks is likely to grow."[304] A prime source of such risk are the contractually-binding guaranteed income streams that governments provide to PPP partners – a defining feature of PPP contracts. Such guarantees typically include:

- Guaranteed profits – generally 15-20%.
- Guaranteed Debt repayments – whatever project-related loans have been takken out by the private sector partner get repaid by the government if the PPP company cannot service them.
- Minimum Revenue guarantees – if a dam fails to provide the contracted levels of water, for example, the government makes up any loss of revenue.
- Financial and economic equilibrium clauses - these entitle a PPP company to compensation for changes in laws or regulations that adversely affect a project's revenues or its market value. So if the legal minimum wage for workers is increased, undermining the returns on, say, a PPP-funded irrigation project, then the government would have to make up the difference.

In effect, the private takes most of the gains, while the public takes all the risk. One consequence of such guarantees is that they build up often large "off balance" sheet liabilities for the government, storing up potential debt crises for future generations. Portugal alone has clocked up PPP liabilities equivalent to 5 per cent of GDP,[305] while Peru's were estimated at $6.5 billion in 2012.[306] In the UK, over the lifetime of PFI contracts, "the public will end up paying up to 12 times the initial cost of the hospitals." [307] It is highly questionable whether the KRG could afford to service such "hidden" costs were it to fund dam construction through PPPs.

PPP contracts can – and have – often lead to consumers paying much more for their water and electricity than if projects are funded through conventional public borrowing. To guarantee their income streams, private sector developers typically require governments to enter into "take or pay" contracts, under which the government is unconditionally obliged to pay for contracted services (the provision of electricity or water, for example) regardless of whether or not they are delivered or taken. An example is the Yuvacik Dam near Izmit in Turkey, which was constructed by Thames Water under a BOT agreement. The contract stipulated that the water would be purchased at an agreed price by specified industrial users and neighbouring municipalities. However, the water proved very expensive and the contracted buyers refused to buy, leaving the Turkish Government paying "over the odds for water which is too expensive for its intended customers."[308] In the energy sector, Take or Pay contracts in the form of Power Purchasing Agreements (PPAs) similarly bind power distributors, usually state-owned entities, to buy the power from a PPP power generator, often at inflated prices. The PPA for the controversial Nam

Theun 2 Hydropower Project in Laos – the world's largest private sector cross-border power project – binds EGAT, the state-owned Thai electricity generating company, to buying electricity at a price higher than that from other available sources in Thailand, which already has a surplus of generating capacity.[309]

Public Services International Research Unit (PSIRU) concluded that the public sector faces real risks from PPPs such as incomplete contracts or public liability in case of bankruptcy of the company involved. It also said that there are high legal and accountancy costs to PPP contracts. Additionally, PSIRU concluded that capital is cheaper for non-PPP projects because governments can borrow cheaper than private companies, while construction costs in PPP projects are higher since financiers require a turnkey contract (which constructed so that it can be sold as a completed product).[310] It is evident that PPPs mostly give private investors high returns with low risks at the expense of the public.

The World Bank has promoted dams

The World Bank is arguably the most influential global financial institution. Since the financial crisis of 2014, the KRG has turned to the institution for assistance including loans in exchange for economic and financial reform. At the request of the KRG, the World Bank reported ways to improve and restructure the KRI economy, focusing on private sector growth in the region.[311] It has continuously supported dam construction in the KRI within the problematic framework of PPPs,[312] even if they are relatively low-return and environmentally destructive. The World Bank does recognize the need to sustain the environmental flows of rivers.[313] It also recognizes the KRI is vulnerable to dam construction of upstream riparian neighbours and the loss of large quantities of water due to evaporation as a result of mismanagement. Yet the World Bank still recommended that the KRG implement proposed dams, [314] regardless of the fact that they would obstruct environmental flows, cause more evaporation than natural surface water and increase conflict over water resources with Federal Iraq. "The policy is to increase storage capacity in Kurdistan Region by building small (ponds) and large dams,"[315] the three-year roadmap of the World Bank and the Ministry of Planning for the KRI says. The World Bank justifies the construction of dams as a response to Turkish and Iranian dam construction, while

Canals of the Gomaspan Dam under construction. (2020)

omitting the impact it would have on Federal Iraq.[316] It recommends trans-boundary water agreements between Erbil and Baghdad without referring to the complexity additional dams would bring to the negotiation table. The World Bank has also admitted that large dam projects are vulnerable to precipitation and flow patterns due to climate change and reliance on hydropower for projects will increase uncertainty.[317]

Dam construction is not an effective climate adaptation measure

Sustainable and equitable management of water resources is a challenge for many countries. Climate change will make this even harder, putting the KRG at risk of climate-fragility.[318] In the past decade the region suffered from droughts, which lead to water shortage in 2015 with further negative impacts on agricultural lands, but in 2013 and 2019 the rain exceeded its normal average levels for the past 10 years, in some cases causing floods.[319] In the plains precipitation is reduced as a consequence of climate change, while in the mountainous areas water is insufficiently stored. As a result, exploitation of groundwater resources is increasing at an unsustainable rate.[320] According to the MAWR, currently over 70% of farmers in the KRI rely on shallow wells for irrigation, which are used to extract the groundwater. The KRG has acknowledged climate change could impact the water resources of the region: in 2019, the Director of the Directorate of Dams and Water Reservoirs Akram Ahmed warned about the water resources in the KRI decreasing to crisis levels in the near future.[321] The KRG has therefore aimed to include climate adaptation into its water and agricultural policies.[322] It regards climate fragility as a reason to rapidly develop its surface water resources. In 2013, the Minister of Agriculture and Water Resources Serwan Baban expressed his view that the construction of dams is a concrete measure against climate change in the region.[323] Storing surface water in dam reservoirs, mostly for agricultural irrigation, is regarded by the KRG as the most effective climate adaptation measure to mitigate water shortages.

The unfinished Bekhme Dam. (2020)

However, academics have argued that water shortages are caused by over-consumption and poor management rather than water scarcity. The KRI contains many small storage and water harvesting dams (no data exists on the exact number),[324] but rainwater is not sufficiently harvested.[325] This could be done through smaller-scale ponds. In addition, farmers use large quantities of water for flood irrigation. Though drip and sprinkler methods are much more efficient and productive, they are uncommon. Experts have suggested for the MAWR to subsidize sustainable and efficient irrigation and water harvesting systems, instead of subsidizing mostly the production of wheat.[326] Some Iraqi academics have argued for amendments in the current agricultural production system. These include agricultural diversification to cope with temperature stress, and enhanced crop management practices whereby essential crop growth stages avoid harsh climatic conditions by changing the growing period.[327] To counter overexploitation of

groundwater resources, policies could be implemented which allow the replenishing of shallow wells. All of these are different climate adaptation measures which do not require the construction of dams.

Dams themselves can lead to unintended negative consequences which have the opposite effect of climate adaptation. Large quantities of water could be lost due to evaporation in dam reservoirs. The reservoir of Bekhme, which would have been the largest dam in the KRI, would evaporate 480 million m3 of water annually, which is more than the water use of the three largest cities in the Kurdistan Region combined.[328] Dams themselves are vulnerable to climate change as they might be rendered useless during times of drought or extreme rainfall. A dam constructed on the Alwand River in Khanaqin, a predominantly Kurdish town located in the disputed territories between Baghdad and Erbil, was unable to provide sufficient water storage during the summer season. This problem was exacerbated due to upstream dam construction on the Alwand in Iran.[329] In Venezuela in 2016, the hydropower of Guri dam faltered as water levels in the reservoir reached record lows.[330] In Zambia in 2015, water levels behind the Kariba dam dropped and the country experienced a power shortage problem.[331] Extreme rainfall can cause catastrophic flood releases or even dam failure. The KRI experienced such rainfall in 2019, when the reservoir of the Dukan Dam reached its highest level in 30 years.[332] Climate change will impact precipitation and river-flow patterns, making dams uneconomic. The impacts of climate change are not taken into account by large dam developers. If they did, according to International Rivers, "dams would need much greater capacities to safely pass high floods, and projections of power generation for hydropower projects would have to allow for the probability of new extremes of droughts."[333] This would increase the costs and reduce the benefits of dam construction. Reduced dam capacity due to climate change has in some countries accelerated dam construction, rather than delayed and increased investments in other projects and energy sources.[334] Similar analogies can be drawn with the DMP of the KRI.

Destruction of the river as a consequence of gravel mining, behind the Zalan Dam in-construction (on the right side). (2020)

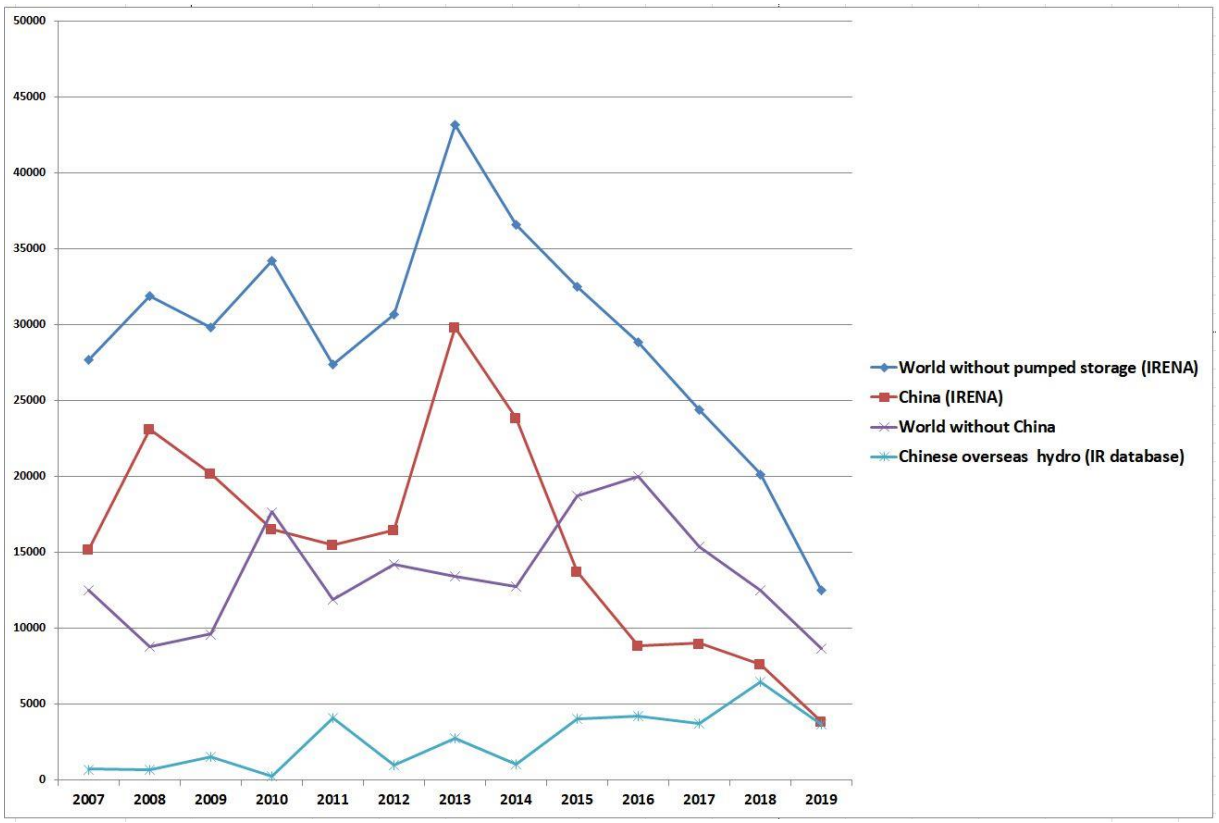
The broader impacts of dams in the Kurdistan Region could be increased environmental degradation and loss of biodiversity in the KRI, while in Federal Iraq its impacts could be disruption of access to water resources and livelihoods. This is exacerbated by the lack of a basin-wide approach and the cumulative impacts of dams. It would undermine economic and political stability, as well as human security in the region. It is therefore possible that current efforts to reduce vulnerability to climate change inadvertently exacerbate conflicts. Lack of coordination across borders and lack of conflict sensitive

policies instigate such impacts.[335] Climate adaptation must be linked to long-term peacebuilding efforts with Federal Iraq. While food security is an essential strategy, intelligent climate adaptation policies need to measure their success against multiple objectives, not just the one target of increased water storage or agricultural output as is common in KRG policy documents.

Hydropower infrastructure is not actually green, nor is it economically viable

Before 1990, the electricity demand of Iraq exceeded the supply. 90% of Iraq's power generating and distribution systems were destroyed during the first Gulf War.[336] Since 2004, Iraq has had to import electricity from its neighbours.[337] It is estimated that currently less than 5% of Iraq's electricity is generated from hydropower, of which two major dams are located in the KRI (Dukan and Darbandikhan Dam).[338] Together they constitute 649 MW or 25% of Iraq's total hydropower capacity.[339] Local experts and academics have often called for the KRG to rapidly develop its hydropower potential,[340] and many dams have been proposed for the purpose of electricity provision. The KRI is constructing a number of hydropower dams on its major rivers, such as Bawanor Dam, Deraluk-Reshawa Dam, Zalan Dam or Delga Dam. The International Energy Agency (IEA) found that Iraq has some of the highest electricity network losses in the world and recommends to improve the efficiency of the grid supply which could increase capacity by one-third.[341] It did not include hydropower energy in its medium-strategy for Iraq, published in April 2019.[342] Possible reasons for the IEA ignoring hydropower are its decreasing economic viability and lack of sustainability due to environmental and social impacts. On the economic side, hydropower is the only major renewable energy source for which costs of installation and costs for unit of generation and of energy production (Levelized Cost of Energy or LCOE) increased over the past decade. In the same decade such costs for solar and wind power plants decreased manifold. As a consequence since 2013 the amount of hydropower capacity added to the grid annually decreased by 55% according to IRENA global statistics. The graph below also shows that hydropower additions in China - the country that has the greatest global share - have been also falling sharply, which is why Chinese hydroengineering firms are seeking opportunities to participate in overseas projects.

Deraluk Reshawa Dam under construction. (2020)



Capacity of hydropower added annually in MW (Rivers Without Boundaries graph based on IRENA 2019 Statistics, see http://www.transrivers.org/2020/3046/).

As they loose economic appeal, hydropower dams are now often presented as a green and clean source of energy, as was the case at the 2019 World Hydropower Congress. The KRG generally ascribes to this discourse. The hydropower industry sees access to climate-related funding as the main condition for its survival, and it is eager to capitalize on the expanding market for climate-certified energy projects. However, hydropower infrastructure irreparably harms the environment: dam reservoirs destroy forests (which act as carbon sinks) and are responsible for the emission of greenhouse gases.[343] Dam reservoirs emit methane, a significant contributor to the climate crisis.[344] Such methane emissions from dams are the highest in the first years of operation, at a time when the world is aiming to reduce greenhouse gas emissions to mitigate the impacts of climate change. Hydropower dams require large reservoirs which requires the submerging of land. Such flooding of habitats and associated construction of supporting roads and resource extraction as huge impact on biodiversity. The negative impacts caused by hydropower are far larger than wind or solar power plants, according to academics who have analysed comparisons of these three renewable energy sources. Comparing hydro, solar and wind energy, Gibson, Wilman and Laurance consider hydropower to be the "most dangerous in terms of its potential impacts on terrestrial and aquatic species, native habitats and greenhouse gas emissions."[345] According to their research, wind energy is considered to have the lowest footprint.[346] Efficiency of solar and wind production is increasing while the costs are dropping.[347] If the KRG would like to increase low-emission energy sources for electricity provision, it cannot harm the environment. Instead, the KRI has great potential for solar energy, wind power generation and biomass sources as studies from the region have demonstrated.[348] The IEA has also called for Iraq to develop its solar energy potential,[349] and a diversification of its energy sources would provide genuine a path to sustainable electricity grid.

Dam construction is accompanied with land development and resource extraction

Dam construction has typically been accompanied by secondary activities which constitute land use change. These often take place without prior consultation or consent from local dam-affected communities. In the KRI such activities have been the construction of access roads, deforestation and mostly gravel mining. Access roads have been constructed often permanently to allow transportation of construction materials and equipment to the dam construction site. Access roads stimulate further deforestation as people and investments are able to access previously inaccessible parts of the forest. The areas around the access roads can attract migrants and farmers. Deforested lands could be used for agriculture, logging or mining. As a consequence, the effect of deforestation could be a reduction in precipitation, independently from climate change impacts. Dam projects also require the construction of housing for construction workers at the site itself. Most of these are temporary, but some are not are left abandoned. The construction site of Bekhme Dam to this day still contains abandoned concrete houses from the 1980s for construction workers. The workers' houses at the site of Surqashan Dam have been in decay since construction was halted.

The housing of construction workers at the Bekhme Dam site has been abandoned since 30 years. (2019)

The housing of construction workers at the Surqashan Dam has been abandoned. (2020)

In-stream gravel mining is very common in the KRI near dam construction sites. The Lesser Zab in particular has been damaged by such mining to extract building materials (quarries, sand and gravel). Sand and gravel can be used as construction aggregate for rockfill dams, but also roads or concrete. Waterkeepers Iraq conducted a threat assessment of the Lesser Zab and published a case study in 2016 on the gravel mining phenomenon in the Kurdistan Region.[350] Machines remove gravel and sediments from the riverbed and adjacent gravel bars within the floodplains of the river. The sorting of the gravel is usually done in an upland area nearby the river, using water pumped from the river. Mining causes the formation of gravel hills and trenches, thereby changing the composition of rivers and degrading the water quality, which has an effect on biodiversity (in particular fish), agriculture and even groundwater in the adjacent areas. Rivers affected by gravel mining should be allowed to maintain stable geomorphic conditions with minimum impact on ecology. Degradation occurs when extraction exceeds replenishment.[351] Gravel mining sites in the KRI are regulated by the Geology Division of the MAWR. However, Waterkeepers Iraq reported that it is common for mining to take place beyond designated areas, and affected land and river areas are not restored post-mining.[352] The Environmental Protection and Improvement Board (EPIB) in Erbil is responsible for monitoring the sites but lacks the resources.

Gravel Mining near Zalan Dam in Sulaymaniyah Governorate. (2020)

Consider free-flowing rivers for tourism instead of dams

Generally, dams are regarded as potential tourism hotspots by the KRG. The 2013 Tourism Strategic Plan for the Kurdistan Region of the Ministry of Municipalities and Tourism recommended within the framework of tourism infrastructure development to "take advantage of the artificial lakes behind the dams to build tourism facilities and link them via transport networks and infrastructure services."[353] The KRG Board of Investment released a development plan for 2020 which said that "the tourism sector could also benefit from manmade lakes."[354] The Independent Human Rights Commission of the KRI underscores the livelihood opportunities in tourism for dam-affected populations.[355] Some affected populations have confirmed they regard dams as a source of income for tourism.[356] Outdoor picnicking is a popular activity in the KRI, especially in areas close to rivers and lakes. However, tourism development does not require disruption of rivers, the creation of artificial lakes or annihilation of biodiversity. Consider that free-flowing rivers instead constitute an equally high if not higher potential for outdoor tourism.

The site of the Bekhal Waterfall nea the town of Rawanduz was developed for tourism. (2018)

Universities and experts should discuss the negative impacts of dams

Over the past decades, construction of large dams has become a controversial issue. Academics in the West are increasingly critical of large dams and there is a substantial global civil society movement and network of dam-affected people, grassroots organizations, environmentalists, activists opposing the construction of large dams across the world. The World Commission on Dams (WCD), which acted as a global environmental forum bringing together supporters and opponents of large dams, in its report from 2000 developed best practice guidelines for dam construction and management based on stakeholder consultations. The WCD concluded that while "dams have made an important and significant contribution to human development," in "too many cases an unacceptable and often unnecessary price has been paid to secure those benefits, especially in social and environmental terms, by people displaced, by communities downstream, by taxpayers and by the natural environment."[357] The WCD recommended that water development needs and goals should be discussed in an open and participatory process, in particular stakeholder fora on large dams to foster participation in the decision-making processes.[358] Civil society, universities and experts have an essential role to play in this process.

The KRG has long been called on to raise awareness of water shortages and to rationalize its water use. Dams are seen as the path forward to the extent that Kurdish water experts continue to downplay the current construction of small dams in the KRI as 'small projects' and instead push for the construction of large dams instead which are regarded as essential to achieve water security.[359] Indeed, the MAWR maintains a close relationship with research centers and water resources/engineering faculties in the region, where the general consensus is that the Kurdistan Region should build more dams. In particular large dams, in order to store water as a response to Turkish and Iranian dam construction on rivers flowing to KRI. Universities in the KRI have repeatedly warned of a water crisis and have called upon the KRG to safeguard water storage for a growing population.[360] Experts from local universities have pushed for dam construction in order to collect rainwater.[361] Local engineers have suggested building dams on particular rivers and seasonal streams, which provide the bulk of water resources in the KRI.[362] The discourse on dams within the KRI lack a basin-wade approach and cumulative impacts of dams are not taken into account. There is no information presented or debate in the KRI on the negative impacts of dams, even though they are promoted in such large numbers. The educational system encourages this siloed thinking due to the lack of interdisciplinary studies. Engineering students are not taught anything about the biological or social systems that they are manipulating and therefore cannot predict how these systems will respond to manipulation. But academics and other experts have the duty to instigate such a debate in academic literature and local media. Until then the KRI remains absent from the global debate on the development effectiveness of dams.

Dams will have a negative impact on the water security of Federal Iraq

Even though concerns about climate change and upstream dam construction in neighbouring countries are justified, damming the rivers of the KRI and diverting transboundary waterflows can create a policy backlash. The Greater and Lesser Zab Rivers contribute to approximately 50% of the Tigris River flow downstream in Baghdad.[363] Cumulative dams will increase water insecurity further downstream, in Federal Iraq. In particular, the long-term future of the Marshes in Southern Iraq is threatened by the impact of Kurdish dams on current and future flows to the marshlands.

The Kurdish dams securitize water as assets, as the KRG aims to 'protect' the waters within its own borders. Akram Ahmed, Director-General of the Directorate of Dams and Water Reservoirs, in 2016 expressed: "Baghdad does not agree with the construction of additional dams in the KRI, but the KRG has been forced to build new dams, as it wants to have complete control over its own water resources. The KRI has been ignored in past decades by Baghdad and should be compensated, as KRG officials and locals have repeatedly suggested. We cannot be at the mercy of Baghdad. Former Iraqi governments have erected large development projects in the whole of Iraq, except in the KRI."[364] KRG officials have argued that the KRI has obtained approval from Baghdad for each dam constructed. KRG officials have also expressed that they could halt water flows to the rest of Iraq in the event of a political or financial conflict with Baghdad.[365] In 2014, former Iraqi Prime Minister Nouri Al-Maliki decreased the KRG share of the Central Government's budget. As a response, several Kurdish politicians suggested to reduce the water inflow from the Sirwan River and Lesser Zab to Federal Iraq.[366] In 2017 the KRG reduced water flows of the Lesser Zab to the rest of Iraq due to decreased flows from Iran.[367] In 2020 a former Kurdish presidential advisor proposed build additional dam reservoirs to store and withhold water from Federal Iraq, in order pressure the Central

The Tigris River in Baghdad. (2013)

Government in Baghdad in a row over budget cuts.[368] The Ministry of Environment of Iraq acknowledged in a 2010 report for the Convention on Biological Diversity[369] that planned dams upstream will have a significant impact on biodiversity, including Mandawa Dam on the Greater Zab and Taq Taq Dam on the Lesser Zab in the KRI. The Ministry of Environment claims these dams are 'promoted by the MWR [Ministry of Water Resources]'.[370] In addition, sources indicate the data about the number of small dams in the Kurdistan Region is not precise. There are many dams which are not registered by the Iraqi Minister of Water Resources.[371] As for the current proposed dams of the KRI, the Dams Master Plan from 2014, which includes projections for up to 2030, is based on the presumption that water intake from flows outside of the KRI border will remain unmodified until 2030.[372] Such a plan is therefore set to exacerbate social and political issues with downstream Federal Iraq.

The Strategy for Water and Land Resources in Iraq (SWLRI), that was prepared for the Iraqi Ministry of Water Resources in 2015 and adopted by the Iraqi government, states unambiguously that "no new large dams are required to assist Iraq in achieving its 2035 objectives." The SWLRI recommends no further dams should be built in Iraq until agreements have been reached with upstream states on downstream flows.[373] The KRG

was consulted but does not intend to comply with it. The SWLRI was to be updated in the course of 2019 but it is not clear whether the KRG has been involved in this process. The MAWR of the KRI did commit to "strengthen the role of the KRG in planning and decision-making in Iraq, regionally and globally" in its 2012 roadmap.[374] On 9 February 2020 a delegation of the KRG, lead by Agriculture and Water Resources Minister Begard Talabani, visited Baghdad, seeking funds from the federal government to build five dams in Kurdistan and renovate two existing dams.[375] The KRG is actively looking for funds to continue the construction of its proposed dams and is therefore proposing to store up to 20% of the common water resources for Southern Iraq in dam reservoirs of the KRI.[376] The dams are framed as beneficial for the development of agriculture and strategically necessary to protect Iraq's water resources.[377] During the visit, the KRG delegation also raised the issue of unpaid subsidies from Baghdad to Kurdish farmers. In this case, the proposed dams might be used by the KRG as political leverage vis-à-vis Baghdad to pay past subsidies.

The KRG will have to integrate the many policies that play a role in water security-linkages. Improvements in transboundary water management across the region could have a positive impact on water security and cooperation across borders. This is especially important considering the structural political vulnerabilities of the region. Demand for water will grow in the Tigris-Euphrates basin, as will the impact of climate change and water scarcity. In the absence of cooperation on transboundary rivers, tension could arise, especially if the KRG unilaterally changes water flows as it is likely to do through dam construction. The Tigris-Euphrates basin has a history of armed conflict and interstate tensions, and water management is often eclipsed by political considerations.[378] New dams will impact the power balance in the basin in a very short period of time. Dams may be used for political purpose by the KRI and increase tensions with Federal Iraq. The KRG has on previous occasions threatened to cut off water flows to Southern Iraq and could do so again in times of instability.[379] Consider that instead of implementing policies that aggravate water security for its downstream neighbour, the KRI could side with Baghdad and negotiate with Turkey and Iran for fair water shares in the Tigris basin. Iraq as a whole will be affected by upstream dams in neighbouring countries and therefore the KRG and the Federal Iraqi Government could potentially join forces to gain a stronger clout in the Tigris-Euphrates basin.

Re-consider the role of upstream neighbours

Across the border, the Turkish government has completed Ilisu Dam and, as of the writing of this report, is filling its reservoir. This dam is part of the GAP-project, under which 11 dams are currently operational and at least three more are under construction.[380] These dams will allow Turkey to exercise direct control over the water flows to Iraq. The KRG is not able to fully address this issue with Ankara due to the political imbalance. It should however be careful considering that Turkey has a history of using water security as political leverage. In particular, the KRI should consider whether the promotion and construction of dams by Turkey within its own borders (see previous pages) is a welcome development, and who benefits from these hydro-infrastructure projects. The Iraqi MWR in 2014 signed a memorandum with Turkey, which did not mention any agreements on water shares or references to international law. Instead, it promotes the share with Turkish companies of the Iraqi water market and specifically water infrastructure. Similarly, Iranian companies are constructing several dams within the KRI. Some of these have been directly or indirectly involved in the construction of large dams on Tigris River

tributaries within Iran. Iran's large-scale dam construction politics have diverted and diminished water flows to KRI. Again, the KRG should consider whether it is now acceptable to have the same companies constructing destructive hydro-infrastructure in the KRI and who in the region benefits the most from dam construction.

The Sirwan River in Iran, near the border with the Kurdistan Region of Iraq. (2017)

Conclusion

According to UNDP, the water discharge of the Tigris-Euphrates basin is set to decrease by 50% within the next decade. Some of the most important tributary rivers feeding the Tigris flow through the Kurdistan Region of Iraq. To tackle the issues of climate change, upstream dam construction and mismanagement, the strategic goal of the Kurdistan Region of Iraq is to construct a large number of dams across its territory, with the aim of storing water for irrigation and hydropower. 245 dams have been proposed by the KRG masterplan, of which thirty-five have currently been prioritized. These dams have been discussed in this report. This should give a grasp of the magnitude of the KRI's plans for dam construction on the rivers feeding the Tigris. The KRG aims to construct these dams on the Khabur, Greater Zab, Lesser Zab, Sirwan and Awa Spi/Basara as well as the Tigris itself. Some of the discussed dams are currently under construction and scheduled for completion; some are infrastructure of which construction was halted; some have been planned and given first priority for construction; some have been announced but construction has yet to be planned. These projects are generally developed with public funds, through public-private partnerships or international development agencies. Three dams on the Greater Zab are to be constructed with the support of Turkey. These dam schemes are problematic and often the product of structural gaps in the water and dam policies of the KRG. Abandoned, failed or poorly designed dam projects are a testimony to these policies. This report described 14 considerations which should be included in any assessment of the region's dam-building practices. Much has been said about the social and economic benefits of dams, but the costs for humans and environment is high. Proponents that dam projects are a way to meet energy and agricultural demands, but they are neither clean or harmless. There is little or no debate in the Kurdistan Region about the destructive impacts of its proposed dams on free-flowing rivers, biodiversity, water quality, cultural heritage, livelihoods and homes of populations, and the water security of downstream Federal Iraq. 50% of the Tigris river flow in Baghdad depends on the Greater and Lesser Zab rivers which flow through the Kurdistan Region. Dams decrease water quality and destroy riverine ecosystems on which plants and animals depend. Dams also cause population displacement and the loss of prime agricultural lands and cultural heritage that are submerged under dam reservoirs. The Kurdistan Region contains many examples of dam failure.

In the Mesopotamian region, the general paradigm is that dams are beneficial for development. They continue to be promoted by policymakers, companies but also academics and experts. The official discourse in the KRI is largely uncritical of dams, despite growing skepticism as to their benefits in the wider international community. This report aims to correct this one-sided view by examining how dams can also lead to negative environmental and socio-economic consequences, which are not considered by the KRG because of structural gaps in its water and dam policies and practices. It is therefore important that data on river and water management is shared with civil society and made public. Transparency is important in this regard, on the specifications of dams being constructed, their funding mechanisms, the firms involved and their environmental and socio-economic impacts. This report aimed to contribute to the available discourse. Most water shortages in the region are caused by internal dysfunctional water management, competition and overconsumption. It is true that the KRI is located downstream of Turkey and Iran, and is therefore affected by upstream dam construction. However, it is not possible to blame water scarcity on neighbouring countries only.

Building more dams within the territory of the KRI creates its own conflicts with downstream Iraq. Management of the Tigris-Euphrates rivers requires a basin-wide approach, and dam constructors in the KRI need to take into account basin-wide and cumulative impacts of water infrastructure.

As an alternative to dam construction, consider the following recommendations:

- Establish a framework for holistic dam management in the KRG which includes all relevant ministries and departments: Ministry of Agriculture and Water Resources, Environmental Protection and Improvement Board, Ministry of Electricity (for hydropower dams) and General Directorate of Meteorology and Seismology (forecasting natural hazards such as earthquakes and floods, to prevent dam failure). This will require integrated planning across Ministries. The KRI Parliament should play an active role through water and dams-related committees. They should maintain dialogue with civil society and affected populations.
- Policymakers of the KRG should use a conflict-sensitive approach to climate change-adaptation measures (including dams).
- Dams should be comprehensively managed across the river basin, with a focus on biodiversity conservation, natural ecosystem, services and sustainable development. KRG policies should aim for basin-wide management, in particular of the Tigris River and its tributaries flowing through the KRI but also in cooperation with upstream neighbors and downstream Federal Iraq.
- Engineering departments at academic institutions in the KRI should initiate interdisciplinary study programs in cooperation with biology, social studies, and other departments to train future engineering graduates in the environmental, public policy and cultural impacts of and mitigation methods for large-scale infrastructure projects (including dam construction).
- Review the debt and other implications of PPP-financing, in line with the recommendations of the IMF. Make public the proposed PPP-contracts for parliamentary scrutiny in order to review the guarantees offered and their social and financial implications.
- Prior to decisions to any further development of water infrastructure, the KRG should undertake a basin-wide Strategic Environment Assessment (SEA) of all current and planned dams in the Kurdistan Region, which take into account the cumulative impacts of all dams on the environment, local communities and cultural heritage across region. Key Biodiversity Areas should be protected from any water infrastructure development.
- Provide compensation and resettlement to all populations that have been affected and will be as a consequence of dam construction, according to a well-defined and transparent resettlement plan.
- Consider adding hydropower capacity only through modernization of existing dams and focus on truly sustainable energy such as wind, solar and biomass.
- In order to maintain water supplies in the KRI, invest in the harvesting of rainwater, mainly for re-use in irrigation, and for all newly constructed buildings and small ponds. Construct additional water-recycling plants and re-use of discharged wastewater.
- Modernize irrigation techniques in order to rationalize water consumption in the agricultural sector.

- Recognize the intrinsic value of rivers, particularly free-flowing rivers, and the critical role they play in sustaining life. Develop conservation and water management programs to protect remaining free-flowing rivers.
- Dam removal should be considered an option for dam infrastucture that is harming natural areas and destructing rivers, in particular if they are inefficient or unfinished. Alternatives in water management and energy do exist.

If the KRI can create vision for water security that entails cooperation across different institutions and responsible management of water resources, dams would be the last rather than first option for bettering the lives of KRI citizens. Instead, free-flowing rivers would be highly valued for their existing biological, aesthetic, recreational and cultural assets.

List of Dams

The following list provides further details on the dams discussed in this report in sections 1-6 of chapter 3.

Tigris

No.	Site name	Governorate	District	River order stream	Latitude	Longitude	Main purpose	Type of project	Catchment area (km2)	Dam height/head (m)	Storage capacity (million mc)
1	Gali Bandawah	Duhok	Semeel	Bahindawa	36.75	43.03	Irrigation	Agriculture, reservoir	111.88	30	5.4

Khabur

No.	Site name	Governorate	District	River order stream	Latitude	Longitude	Main purpose	Type of project	Catchment area (km2)	Dam height/head (m)	Storage capacity (million mc)
1	Base	Duhok	Zakho	Khabur	37.17	43.09	Irrig/energy	Multi-purpose dam	1962	75	101
2	Sibnah 2	Duhok	Dohuk	Sibnah	37.06	43.23	Irrig/energy	Agriculture, reservoir	138.42	38	5.95

Greater Zab

No.	Site name	Governorate	District	River order stream	Latitude	Longitude	Main purpose	Type of project	Catchment area (km2)	Dam height/head (m)	Storage capacity (million mc)
1	Bakerman	Duhok	Akre / Chamanke	Khazir	36.85	43.66	Multi-purpouse	Lage storage dam	724.42	55	205
2	Deraluk-Reshawa	Duhok	Amedi	Greater Zab	37.08	43.66	Irrig/energy	Run-of-river multi-purpose	5671	138.00	390.00
3	Khanas	Duhok	Shekhan	Gomel	36.76	43.43	Irrigation	Agriculture, reservoir	536.28	30	4.7
4	Aqouban	Erbil	Shaqlawa	Mawaran	36.35	44.43	Irrigation	Agriculture, reservoir	24.4	28	2.62
5	Chamargah	Erbil	Erbil	Kurdarah	36.10	44.21	Irrigation	Agriculture, reservoir	26.27	18	1.5
6	Gomaspan	Erbil	Shaqlawa	Bastora	36.28	44.33	Irrig/energy	Large storage dam	131.52	61	80.8
7	Mandawa	Duhok/Erbil	Khabat / Shaqlawa / Agra	Greater Zab	36.53	43.94	Irrig/energy	Large storage dam	16999.69	56	476
8	Rawanduz 10	Erbil	Rawanduz	Rawanduz	36.63	44.49	Energy	Run-of-river hydropower	1457.94	64	22.88
9	Razga Dwen	Erbil	Shaqlawa	Mawaran	36.49	44.21	Irrigation	Agriulture, reservoir	178.41	32	2.71

Lesser Zab

No.	Site name	Governorate	District	River order stream	Latitude	Longitude	Main purpose	Type of project	Catchment area (km2)	Dam height/head (m)	Storage capacity (million mc)
1	Banuy Talaban	Erbil	Koya	Rubar Kuy	35.97	44.57	Irrigation	Agriculture, reservoir	256.50	21.00	2.75
2	Nazanin	Erbil	Koya	Nazanin	36.24	44.55	Irrigation	Agriculture, reservoir	73.47	22.00	1.90

3	Sartik	Erbil	Koya	Lesser Zab	35.83	44.32	Irrig/energy	Run-of-river multi purpose	14125.46	45.00	489.15
4	Shawger	Erbil	Koya	Rubar Kuy	36.01	44.66	Irrigation	Agriculture, reservoir	23.33	23	1.08
5	Shiwashok	Erbil	Koya	Tributary of Rubar Kuy	36.01	44.54	Irrigation	Agriculture, reservoir	14.65	20.00	1.06
6	Taq Taq	Erbil	Koya	Lesser Zab	35.88	44.67	Multi-purpose	Large Storage dam	13352.09	93.00	2900.00
7	Delga	Sulaymaniyah	Pshdar	Lesser Zab	36.10	45.17	Irrig/energy	Multi-purpose dam, limited storage	7939.98	58.00	100.00
8	Kanarwe	Sulaymaniyah	Sharbazher	Siway	35.76	45.58	Irrig/energy	Agriculture, reservoir	1509.85	23	11
9	Khewata	Sulaymaniyah	Sharbazher	Qala Chwalan	35.76	45.43	Irrig/energy	Large Storage dam	2425.75	56.00	300.00
10	Surqashan	Sulaymaniyah	Dokan	Cham-i-Sarzi	35.86	44.94	Irrigation	Agriculture, reservoir	548.00	41.00	3.50
11	Zalan	Sulaymaniyah	Sharbazher	Qala Chwalan	35.68	45.65	Irrig/energy	Multi-purpose dam, limited storage	313.60	25.00	1.45

Sirwan

No.	Site name	Governorate	District	River order stream	Latitude	Longitude	Main purpose	Type of project	Catchment area (km2)	Dam height/head (m)	Storage capacity (million mc)
1	Bardasoor	Sulaymaniyah	Kalar	Sirwan	34.64	45.39	Multi-purpose	Large storage dam	21590.01	28.00	168.00
2	Bawanor	Sulaymaniyah	Kalar	Sirwan	34.83	45.52	Irrig/energy	Regular and hydropower plant	20149.89	20.00	29.79
3	Chaq Chaq 2	Sulaymaniyah	Sulaymaniyah	Tanjero (Chami Qilyasan)	35.64	45.39	Irrigation	Agriculture, reservoir	99.71	20.00	4.00
4	Dewanah	Sulaymaniyah	Darbandikhan	Dewana	35.09	45.68	Irrig/energy	Multi-purpose dam, limited storage	603.23	42.00	19.20
5	Kawlos	Sulaymaniyah	Sharbazher	Chaqan	35.46	45.86	Irrig/energy	Large storage dam	266.16	55.00	58.00

Basasra/Awa Spi

No.	Site name	Governorate	District	River order stream	Latitude	Longitude	Main purpose	Type of project	Catchment area (km2)	Dam height/head (m)	Storage capacity (million mc)
1	Basarah	Sulaymaniah	Sulaymaniah	Basara	35.46	45.19	Irrig/energy	Large storage dam	576.67	67.00	41.70
2	Chami Rokhana	Sulaymaniah	Chamchamal	Basara	35.33	44.95	Irrig/energy	Multi-purpose dam, limited storage	1604.17	31.00	22.00
3	Khornawazan	Sulaymaniah	Chamchamal	Uthaim (Awa Spi)	34.96	44.99	Irrigation	Agriculture, reservoir	1223.63	24.00	7.00
4	Tourajar	Sulaymaniah	Chamchamal	Tributary of Lahez	35.08	45.30	Irrig/energy	Multi-purpose dam, limited storage	215.56	39.00	26.00

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