Water Scarcity and Development

A case study of the Euphrates water shortages and their implications on northern Syria.

LUNDS UNIVERSITET

Department of Human Geography
MSs in Development Studies
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Supervisor: Mirek Dymitrow
By Yazan Najy

Abstract

In yet another alarming development in Syria, the waters of the Euphrates River have declined to critically low levels in 2021. The unprecedented low water levels of the Euphrates put nearly 5.5 million Syrians at risk as they depend on the Euphrates basin for drinking water and agricultural production. This study examines the phenomenon of water shortages in the Euphrates River whilst utilising the theoretical lenses of political ecology and the Water, Energy and Food (WEF) Nexus approach. The study aims to analyse 1: the implications of water scarcity on development in northern Syria, and 2: the achievability of SDGs 1, 2, 3, 6, 7 and 15 in the same geographical location. The case of the Euphrates River water shortages is studied following the Fundamental Qualitative Description methodology and analysed in accordance with the Miles & Huberman (1994) framework. The data in this study are presented in the form of SDGs assessments and then further discussed against the concepts of water, energy and food security that are drawn from the WEF Nexus theoretical approach. This research demonstrates distressing results regarding the development of northern Syria. Water scarcity from the Euphrates basin has affected the core aspects of development such as poverty, hunger, energy, health, and nature preservation. The conclusion of this study suggests that water scarcity in north Syria hinders the process of development by causing water, energy and food insecurity. Moreover, the data strongly conclude that with the current trends in water availability, north Syria will not achieve any of the selected SDGs by 2030.

Keywords: Water Scarcity; Euphrates River; Sustainable Development Goals (SDGs); Northern Syria; Water, Energy and Food Nexus (WEF).

Word count: 19,551

List of abbreviations

FAO	Food and Agriculture Organisation
GAP	Southeastern Anatolia Project (Güneydoğu Anadolu Projesi)
ICIMOD	International Centre for Integrated Mountain Development
IDP	Internally Displaced People
IWMI	International Water Management Institute
MENA	Middle East and North Africa
MPI	Multidimensional Poverty Index
NTU	Nephelometric Turbidity Units
OCHA	Office for the Coordination of Humanitarian Affairs
PKK	Kurdistan Workers' Party (Partiya Karkerên Kurdistan)
SDG	Sustainable Development Goals
UN	United Nations
UNICEF	United Nations Children's Fund
WEF	Water, Energy and Food Nexus
WPF	World Food Programme
WHO	World Health Organisation
WoS	Whole of Syria

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1. Introduction

1.1 Water as a resource

Water as a natural resource is an essential element for the survival of every living being on the planet. It plays a vital role in the structure of the environment around us, and it affects many aspects of humans. In comparison to all other natural resources, water is the most widely distributed substance on the planet, although in different amounts and accessibility (Shiklomanov, 1998, p.2). Water as a natural resource exists in three forms, liquid, solid and invisible vapour, as a liquid, it forms oceans, seas, rivers and lakes. It can also be found in underground water basins in layers of the Earth's crust. It also exists in polar and alpine regions mainly as a solid state in the form of snow or ice. Moreover, water could also be contained in the air as vapour, ice crystals or water droplets (ibid, p.4). In these three forms, the earth's hydrosphere contains a large amount of water with an estimation of 1.386 million cubic kilometres (km3). However, it is important to note that only 2.5 per cent of that number represents fresh water, while the rest (97.5 per cent) is saline water (Shiklomanov, 2000). Out of the 2.5 per cent available fresh water, 68.7 per cent of that water is in the form of permanent snow covering the Arctic, Antarctic, and other mountainous regions. Furthermore, 29.9 per cent of the fresh water resources is groundwater which requires special strategies to reach, leaving 0.26 per cent of the total amount of fresh water found in lakes, reservoirs, and rivers (ibid).

Humans have always thought to control the development of water resources, which includes techniques for storing, cleaning, and redirecting fresh water in an attempt to combat the unpredictability of rainfalls and river flows (Gleick, 2000). Controlling water resources often has the goal of accessing one of the two types of

fresh water resources. The two types are static water storage and renewable water resources. Static storage refers to fresh water resources that require many years or even decades for full renewal. This storage type includes but is not exclusive to lakes, groundwater and glaciers. Intensive interventions in static storage result in irreversible ecological consequences (Shiklomanov, 2000). Moreover, interference with these storages means a human intervention in the natural equilibrium, such an equilibrium that has been established for centuries (ibid). However, in contrast, renewable water refers to fresh water that replenishes yearly. Unless overexploited, renewable water replenishes itself with the natural hydrological cycle (ibid). Early agricultural civilisations were formed in places where rainfall and river waters were reliable. The formations of cities were only possible with the advance in hydrological techniques that allowed water supplies to be accessed. Similarly, modern industrial societies were heavily reliant on access to water, even when such access was manufactured and interfered with the natural hydrological cycle. The dramatic modification in the hydrological cycle in modern industrial societies took the form of unprecedented and monumental engineering constructions in water supply control, hydropower, and irrigation (Gleick, 2000).

The last decades of population growth and unrelenting economic development only placed a higher demand on water resources. The concept of water scarcity emerged with the recent pressures on water resources, a concept that generally refers to the situation where the demand for water by all sectors, cannot be met fully due to water shortages or poor quality of water (Liu et al, 2017). According to the United Nations World Water Development Report (WWDR) of 2012, a population is “water-stressed” when the annual water supply drops below 1700 cubic metres per person. Furthermore, a population can be considered to suffer from “water scarcity” if the supply drops below 1000 cubic metres per person, and finally, a population could be considered to suffer from “absolute scarcity” if the water supply drops below 500 cubic metres per person (UN-Water, 2012). The concept of water scarcity is both a relative and dynamic concept, it can occur at the supply or the demand level, but most importantly, it could also be a social

construct. The causes of such scarcity can vary over time due to the unpredictability of the hydrological cycle, but evidently, other causes for water scarcity can interfere with the water cycle, including human interventions in nature in the shape of economic policies and water management strategies (FAO, 2012). Indeed, according to the Global Risks (2015) report, global shortages for supply are the top high-impact risk in our lifetime, with water scarcity becoming a highly debated issue since the late 1980s with an evident increase in publications on water assessments (ibid).

Studies conducted by the International Water Management Institute (IWMI) in the 1990s predicted that water scarcity would become the single greatest threat to human health and natural ecosystems. One IWMI study (1999) further predicted that nearly 1.4 billion people will face severe water scarcity by 2025 (Seckler et al, 1999). The predictions of the IWMI in the 1990s are now confirmed to be a reality with the United Nations World Water Development Report (2020) confirming that 2.2 billion people are currently suffering from a lack of access to clean drinking water, and 4.2 billion people (approximating 55 per cent of the population) are experiencing water-related sanitation issues (UN-Water, 2020). On an annual basis, there exists enough fresh water globally for the world population and increasing economic development. However, the existence of fresh water varies in time and space, leading to large spatial and temporal variations in water availability as well as demands. Consequently, water scarcity becomes more severe in several specific parts of the world during specific times (Mekonnen & Hoekstra, 2016).

The dynamics of water scarcity and climate change remain complex and highly debated, there are undeniable scientific findings that show that climate change is leading to further water shortages (UN-Water, 2020). But to what extent is climate change responsible for the current water scarcity? This is a scholarly contested question. Nonetheless, as stated in the United Nations Water Development Report (2020), climate change will have a direct effect on the availability, quantity, and

quality of freshwater. Different natural phenomena such as heatwaves, unpredicted rainfall patterns and storm surge events are all expected to be extreme manifestations of climate change. Moreover, climate change will affect forests and wetlands with degradation patterns away from the natural equilibrium. This consequently affects water-related ecosystem functions such as carbon capture and storage, flood protection, and water purification (ibid). Furthermore, the overall quality of water will be dramatically affected by the higher temperatures. Temperature rises are expected to reduce the dissolved oxygen and as such contribute to a reduction in the capacity of freshwater bodies to self-purify (ibid).

1.2 Water in the arid Middle East

While water scarcity is placed as a global challenge, there remains an important geographical element in such a scarcity that must be acknowledged. The arid region of the Middle East and North Africa (MENA) possesses only 1 per cent of the world's renewable water resources while having approximate 5 per cent of the total planet's population (Dubreuil et al, 2013). The current average available water in the MENA region is approximately an average of 1200 cubic metres per person, which is six times less than the world average of 7000 cubic metres per person. Further projections for the MENA region predict the average of the entire region to fall under 1000 cubic metres per person by 2050 (Bozorg-Haddad et al, 2020). The situation is most alarming within the geographical limitations of the Arab countries, with the 2010 report of the Arab Forum for Environment and Development (AFED) showing that Arab countries suffer the most severe water scarcity issues in the region and the world: an estimated 70 per cent of the Arab lands are dry, and rainfall is poorly distributed in the region (El-Ashry et al, 2010). The report also states that thirteen Arab countries are amongst the world's nineteen countries with the highest water scarcity, with eight Arab countries below 200 cubic metres per capita, and six countries even dropping below 100 cubic metres per capita, keeping in mind that the flow of even 500 cubic metres of water per capita is still considered absolute scarcity (ibid). This is to show that the

MENA region as a whole is reported to be the most water-scarce region in the world (UNICEF, 2021). Nearly 70 per cent of the region's economic activities are conducted in areas of high or very high-water stress, three times the global average of just 22 per cent (ibid).

While climate change could be a factor in causing water scarcities in the region, there are other important factors specific to the MENA region which contribute directly to the creation of water scarcity. Conflict in many shapes including territorial disputes and civil wars has disturbed the process of water management in many countries of the MENA region. The conflicts in the region have also had a direct link to the deterioration of water infrastructure (UNICEF, 2021). A discussion paper by the Food and Agriculture Organisation (FAO) and The United Nations World Bank Group (2018) used the term "fragile" to describe systems and political processes in the Middle East. The concept of fragility is used to describe many contemporary challenges in the MENA region, including armed conflict, economic and political instability, migration, and natural resources pressures. The FAO and the World Bank discussion describe how water could both be the cause and the effect of fragility. While fragility creates weak institutional performance and results in damaged water infrastructure, it is also essential to point out that the arid nature of the region and the lack of surface water could also lead to rising tensions and conflicts, ergo further fragility (FAO & World Bank, 2018). Nonetheless, and despite the many reasons for scarcity issues in the region, water is still undervalued. Political policies on the water in the region have led to artificially low costs of water. Low tariffs and GDP allocation on subsidising water have undervalued water as a resource and led to further water waste (UNICEF, 2021).

40 per cent of the world population lives on shared water basins (UN-Water, 2008), which adds another aspect of complexity to an already complex region. Understanding the dynamics of water allocations in shared rivers and aquifers is essential to the MENA region. The Tigris-Euphrates, the Niles and the Jordan are

the region's main transboundary rivers that provide fresh water. The rivers are used for agricultural, industrial and domestic use, all in unsustainable volumes and through the exploitation of aquifers (Golmohammadi, 2021).

1.3 Transboundary water of the Euphrates River

The arid nature of the Middle East and Northern Africa has historically created a sense of unity and a common purpose to survive the nature of the region, this is shown through centuries of sharing water resources in-between the communities of the region. The notion of sharing is best understood as a survival method, as it is done out of necessity rather than idealism (UN-ESCWA and BGR, 2013, p.13). However, the 20th century began with an evident emphasis on the importance of nation-states and with that emphasis, the lines were drawn in the region separating communities and areas with well-defined political borders. With this separation, issues of freshwater availability became a national issue rather than a regional one. Moreover, technological transformations started to become prominent in the second half of the 20th century and resource extraction was being conducted on a scale that the region has never witnessed before. The early state-building process was heavily dependent on resources for developmental needs and thus, water management became a strong political tool (ibid, p.14). The development process meant that countries were keen on maximising profits from natural resources, and for water management, this meant that countries with upstream geographical locations began building large scale infrastructure on their rivers. This indeed became the norm in the region as upstream countries built dams on major rivers to generate hydropower and expand irrigation. Consequently, countries with the misfortune of being downstream had to adapt and make use of whatever water was allowed to flow into their end of the river (ibid). This recent development of upstream and downstream dynamics is most evident in the Euphrates River basin.

The Euphrates River has its starting source in eastern Turkey, and it ends in the Persian/Arabian Gulf. The Euphrates is the longest river in Southwest Asia (2,700 km). The river flows from Turkey through Northern Syria and then to Iraq. The nature of its water comes from melting snow and therefore maximum flows are usually witnessed in April/May while minimum flows are experienced in September/October (Kolars & Mitchell, 1991, pp. 3-4.). The Euphrates River begins in Turkey and flows in mountainous areas with canyon-like valleys that are suitable for the construction of many dams. The river flows inside Syria in undulatory plains forming distinct river terraces (Sissakian & Al-Ansari, 2019). The geographical location of the river means that Turkey as an upstream country contributes most to the Euphrates River. Indeed, Turkey's contribution to the Euphrates' water is as high as 90 per cent of the total water of the river. Geography in this situation plays an important role in advantaging Turkey over its riparian neighbour Syria. Turkey can and does dictate water policies that have effects not only inside of its territorial borders but also inside that of Syria. Such phenomena can be observed with Turkey's vast national project titled the Southeastern Anatolia Project, also known as GAP. The GAP project includes the building of over 22 dams, with Ataturk Dam being the largest dam on the Euphrates River (Feitelson & Tubi, 2017).

Figure 1. Syrian Map showing the Euphrates River and provinces surrounding it (adapted by the author).

According to the Ministry of Industry and Technology in Turkey, the GAP project is the largest infrastructure project in the modern history of Turkey, and one of the largest development programmes developed in the region. The GAP projects cover over 10 per cent of Turkey in population terms as well as geographically as the project area covers 9 Turkish provinces (Ministry of Industry and Technology, 2015). The GAP is marketed as a key project to improve the living standards of the local population by eliminating economic disparities that exist between the GAP covered area and the rest of the country. This is said to be done by providing further employment opportunities and by improving stability and productivity for the local population. (ibid). The GAP consists of 22 dams, 19 hydraulic power plants and expansive irrigation projects that cover 1.8 million hectares of the land adjacent to the Euphrates River (ibid). The magnitude of the project size is also reflected in its impact; as of 2010, two-thirds of Turkey's potential hydropower is being exploited in the hydro-production process (Yuksel, 2012). The project

directly interferes with the natural equilibrium of the Euphrates River, this being especially true considering the large dam has a capacity of 48.7 billion cubic metres, making it the sixth-largest volume dam in the world (ibid).

The transformation of the GAP project from a hydroelectric project to a large-scale regional development programme created increasing tension between the upstream country Turkey and the downstream country of Syria. The tension was not only a concern from the downstream country regarding the quantity of water but also the quality of the allowed flowing water into Syria (Çarkoğlu & Eder, 2001). Water management issues were a significant reason for the serious diplomatic tension between Syria and Turkey in 1998. At the time, Syria claimed that the country-state was not receiving its due share of water from the Euphrates River, while Turkey accused Syria of supporting the separatist Kurdish group the PKK, and further accused Syria of using the Kurds as an ethnic card in the negotiations. The water tension of 1998 brought the two sides to the brink of war (ibid).

It is important to note that certain attempts were made to avoid such tensions with transboundary collaboration between Syria and Turkey being discussed in the protocol agreement of 1987 (Feitelson & Tubi, 2017). The two countries have agreed on the allowance of 500 m3/s from Turkey to Syria. This agreement was especially important for the Syrian side as the Euphrates water accounts for 85 per cent of the total flow of Syria's rivers (ibid). Although this protocol was agreed on, Turkey never signed the 1997 "UN Convention on the Law of the Non-navigational Uses of International Watercourses", leading to accountability struggles and making transboundary water-related conflicts more likely in the region (Zagonari and Rossi, 2014, p.66).

1.4. Research question and aims

The importance of the research questions comes from the recent development in the Euphrates River. Reports from 2021 have shown that the Euphrates River in Syria is running dry to levels never witnessed before (WFP, 2021b). The World Food Programme has reported that as of May 2021, the Euphrates River in Syria has reached a critical level of low water flow (ibid). While geographic dry spells are not uncommon in the region, the recent development in the Euphrates River points toward man-made interventions that are disturbing the flow of water, specifically the Turkish policies regarding how much water is allowed to flow into Syria. In May 2021 the Tishreen Dam in Syria was only receiving 180 m3/s from the Euphrates, in comparison to the promised minimum of 500 m3/s as outlined in the 1987 protocol between Turkey and Syria. Over the same period, the Tabqa Dam also witnessed an 80 per cent reduction in water flow. This recent development puts nearly 5.5 million Syrians at risk as they depend on the Euphrates basin for drinking water as well as agricultural activities. Moreover, the recent decrease in water also affects the water-powered generators from the Tishreen Dam, meaning that approximately 3 million Syrians could be left without electricity (ibid). Understanding the magnitude of importance that the Euphrates water in Syria represents, specifically in northern Syria, this paper examines the questions:

- ***What are the implications of water scarcity on development in northern Syria?***

- ***What role does water scarcity play in the process of achieving the Sustainable Development Goals (SDGs) in northern Syria? Specifically, SDGs 1,2,3,6,7 and 15?***

These questions will be answered within the field of development studies. Answering such questions will help add to the knowledge on water scarcity and development, especially for largely agricultural regions. The 2021 water scarcity on the Euphrates River is a new development in the region that is overshadowed by a decade of conflict in Syria. Therefore, this study aims to investigate development in northern Syria specifically concerning water scarcity and not with a focus on the armed conflict. Moreover, adding knowledge on the progress of the SDGs in northern Syria is also important, especially since as of the time of writing this study, no SDGs report was conducted on that geographical location. Such location is important to examine as northern Syria is not currently ruled by the Syrian government, and therefore, the development process in that particular region is separated from the rest of Syria and requires a separate study.

1.5 Outline

The outline of this study is divided into 6 chapters. Following the introductory chapter, this study will begin with a literature review in Chapter 2. This chapter will explore the conceptualisation complexity of the term “scarcity” in regard to water resources, while also providing an overview of recent water policies in Syria. Chapter 3 discusses the theoretical roots of this study, political ecology, realism and the Water, Energy, and Food Nexus (WEF). These are all incorporated in this study to further examine water scarcity and development. Chapter 4 introduces the methodological framework that the study will adhere to, while Chapter 5 titled analysis will present the results and then discuss the results data with regard to the theoretical background of the study. Finally, Chapter 6 will organise the findings of the study into a clear and concise conclusion section that answers the research questions.

2. Literature review

The literature covered in this section will focus on the conceptualisation of the central issue of water scarcity (On both the supply and the demand levels). Moreover, this section will cover the literature on previous water-related struggles in Syria, more specifically on droughts in Syria and what they mean to water scarcity. Finally, the literature on water nationalism will be introduced to cover the Turkish perspective and their role as a hydro-hegemon.

2.1 Water quality and quantity (Supply problem)

In his paper "Water scarcity: Fact or fiction?", Rijsberman (2006) attempts to conceptualise the real meaning behind water scarcity. Rijsberman distinguishes between water scarcity in a physical sense (Supply problem) and water scarcity in the shape of available water's mismanagement (Demand problem). For instance, one region can experience water scarcity even though the region often suffers from floods. To complicate the issue further, it's even possible for the same region to also experience droughts. Floods and droughts could happen in the same year in the same region, in such a scenario, for instance, the annual average water availability becomes a meaningless measurement tool for water scarcity. This complexity means that assessment should go further than looking for simple statistics of water availability; for instance, infrastructure such as dams could be essential in combating water scarcity in the region with floods and droughts. Moreover, water quality is another aspect that must be considered when assessing water scarcity, fresh water could become polluted as it flows downstream, meaning that water is indeed available, but it is unsafe to use at best, or completely unusable (Rijsberman, 2006).

Falkenmark et al, (1989) in a study on semi-arid regions, argue that development thinking has largely underestimated the limitations of natural resources and the role of climate while simultaneously overestimating the importance of large-scale projects and technologies. From a hydrological perspective, Falkenmark et al argue that there is a need to abandon the "natural phenomenon" argument when it comes to water scarcity and that the question should not be how much water do we need; but instead to ask how much water there is and how can we best use it? (Falkenmark et al, 1989). Indeed, the focus is on the supply aspect and the annual water resources in the physical sense, and how to best utilise that available water. Falkenmark et al's influential study was the basis to quantify water scarcity as they attach different scarcity values to cubic metres per capita for what is now known as the Falkenmark index (ibid). A similar understanding of water scarcity was shared by Seckler et al (1998) who conducted a study projecting water demand and supply in the world between 1990 and 2025. The study was done under the direction of the International Water Management Institute (IWMI) and its findings are now referred to as the IWMI indicators. The study concluded that many countries will be facing water-related struggles by the year 2025 however, manmade solutions such as increasing irrigation effectiveness and developing infrastructure can mean meeting a large proportion of the global water demand (Seckler et al, 1998). What's important to note is that these two early influential studies on water conceptualisation had a specific line of thinking that effectively discussed water scarcity exclusively in terms of water quantity.

Recent studies on water scarcity began to acknowledge the conceptualising error in only observing the quantity of available water, instead recent papers have been published to also examine the quality of the available water. For instance, Zeng et al (2013) argue that water quality is not often observed as a factor for water scarcity, consequentially underestimating the magnitude of water scarcity in many regions. Therefore, Zeng et al create a methodological approach to include water quality in the assessment of water scarcity. They do so by creating a water scarcity index that follows this formula I = Iblue + Igrey. The formula relies on the water

footprint approach that distinguishes three types of water, blue water which is fresh water from lakes, rivers and aquifers; green water which is water that does not participate in the runoff process or recharge the groundwater but is instead stored in the soil, and grey water as polluted water. The water scarcity index (I) is meant to be a tool to measure both the quantity and the quality of the water by summing the blue water scarcity index Iblue and the grey water scarcity index Igrey. Important to note that the grey water footprint is measured by stating the amount of fresh water it takes to dilute pollutant water back to a usable water quality standard (Zeng et al, 2013). A similar study and building on Zeng et al work is the study of Liu et al (2016). This study also acknowledges the historic lack of discussion on the quality of water and as a response introduces an indicator that covers both the quality and the quantity of water with the addition of environmental flow requirements (EFR). EFR refers to the timing, quantity, and quality of water flow required to sustain freshwater. The study by Liu et al adds the Quality, Quantity and EFR approach (QQE) to the discussion on water-related struggles and concludes that the QQE indicator provides a comprehensive tool for understanding water scarcity (Liu et al, 2016).

Whether the discussion is focused on the water quantity, quality or both, there remains a general focus on the supply-related struggle regarding water. In other words, all the previous studies put a strong emphasis on water in the physical sense and utilised supply-oriented metrics to guide their studies.

2.2 Water shortages in Syria (Demand problem)

Syria is not a stranger to the discussion on water shortages, from 1900 to 2005, Syria suffered from six significant droughts that reduced the rainfall season to one-third of the normal rates. These droughts often lasted one season only, with only one drought lasting for two. However, in 2006 an extreme drought hit Syria

and lasted for multi-seasons and made its way into 2011 (Gleick, 2014). The 2006-2011 drought was described by Femia and Werrell (2012) as *"the worst long-term drought and most severe set of crop failures since agricultural civilizations began in the Fertile Crescent many millennia ago"*. Indeed, the drought reached up to 60 per cent of Syria's land and the effects were felt across the nation. However, the northern region was the home to the most vulnerable group of Syrians who were dependent on agriculture for their livelihood. For instance, in the northeast, Al-Hasakah reported 75 per cent of total crop failure. And the northeast region herders have reported losing 85 per cent of their livestock, economically affecting 1.3 million people (Femia & Werrell, 2012). By 2009 the economic costs of the drought were enormous, with over 800,000 Syrians reportedly losing their entire livelihood, and by 2011 around one million Syrians were food insecure as a direct consequence of the drought (ibid).

Climate change is an important aspect when discussing the droughts in Syria. Skaf and Mathbout (2010) in their study on droughts have argued that global warming is likely to alter the hydrological cycle in Syria. The semi-arid environment of Syria means it is more likely for global warming to affect soil moisture and water resources effectively leading to the distribution of the ecosystem and the communities that live in them. Droughts are expected to rise in intensity and frequency in the region. However, drought impacts must be seen as a multidimensional natural phenomenon that has interactions between both the supply and the demand aspects. Human interference in the ecosystems can and does significantly exacerbate the impacts of droughts, this is especially true in the case of unsustainable use of natural resources (Skaf & Mathbout, 2010). Similarly argued by Hoerling et al (2012) that climate change is indeed increasing the frequency of droughts in the Mediterranean region. However, their study concludes that the sensitivity of the Mediterranean region to time-evolving external radiative forcing is only part of the explanation, while other processes are likely to also contribute to the drying of the area. In other words, while climate

change is indeed playing a part in decreasing the availability of fresh water, it still does not provide a full explanation for water scarcity (Hoerling et al, 2012).

While climate change and increased population have increased the pressure on the water in semi-arid Syria. There is a scholarly consensus that Syria's water scarcity transcends the supply aspect and is a demand-oriented scarcity. Barnes (2009) argues that water scarcity in Syria is a construction of the ruling Ba'ath party in Syria. Constructing scarcity is material (the infrastructure that is tapping groundwater resources faster than they can be replenished), and social (the policies and political processes that led to physical water shortages). In Syria, it was reported that 90 per cent of the country's water is used for agriculture while only 8 per cent accounts for domestic use and 2 per cent for industry (Barnes, 2009). The mismanagement of the water resources springs from the ultimate goal of achieving food security. The state-maintained control over seven strategic crops (Wheat, barley, sugar beet, tobacco, chickpeas, cotton and lentils) to which the government decided their prices and quantities. Moreover, to incentivise the production of strategic crops, the government set the price to be above that of the world markets. For instance, the government would buy wheat at a value 60 per cent higher than the value set by the world market. Another example is the enlargement of land area cultivated with cotton during the 1990s, making cotton to be Syria's second-largest export after oil. It's important to highlight that these strategic crops are highly water-intensive. Moreover, it is also essential to highlight that excessive usage of water for irrigating industrial crops like cotton has increased the salinity of farmlands and consequently exacerbated the current rural water scarcity (ibid). The term strategic crops were intentionally utilised to indoctrinate the farmers in the ideology of the Ba'ath Party. Working with strategic crops meant that farms were not merely producing for profits but were soldiers producing for the nation (ibid).

In a similar study, Saleeby (2012) also disregards what she referred to as the "Malthusian anxieties" and suggests that the Syrian water shortages are the results

of deliberate, top-down decisions. While also referring to the strategic crops agenda and the excessive use of water for agricultural production, Saleeby argues that there have been recent policies aimed at modernising irrigation techniques and technology. However, historic dependency on subsidies and lack of loans and support for farmers, actively meant that even when new technologies were available, farmers could simply not afford them. The poor decision-making was on many levels, for instance even when the government attempted to assist in the form of subsidising feed to herders, it instead created a movement where it encouraged herders to maintain larger herds than the environment of the region can sustain, resulting in further exacerbating desertification and land degradation, creating further water struggles. (Saleeby, 2012). Similarly argues Salman and Mualla (2003) that groundwater is being overexploited in most basins of the country based on the extremely subsidised rate of groundwater costs that do not reflect their real value (Salman & Mualla, 2003).

2.3 Water and Nationalism

To further understand the central issue of the current water shortages in Syria, Turkey the upstream country and the hydro-hegemon must be included in the discussion. Today Turkey has complete decision-power over the flow of the Euphrates River into Syria. Meaning that any discussion on water scarcity in Syria, and especially in the northern part, is incomplete without understanding the Turkish perspective. Turkey's attitude toward its riparian neighbour Syria is best explained by the literature on water nationalism. Water nationalism was first introduced by Allouche (2005) and later linked to Turkey by Conker (2018). The literature on water nationalism provides a comprehensive framework to understand the Turkish-Syrian dynamic and their transboundary water tension. Conker (2018) presents the core idea behind water nationalism by drawing parallels between the value of water and the value of land. The argument behind the idea of water nationalism is that water is valued as highly as land in the nation-making process. Meaning that water is not to be treated as a sharable

resource, but instead as a vital part of the nation. This is best explained by three principles: (1) territorialism over resources, (2) water resources and state-building, and (3) water resources and nation-building (Conker, 2018).

The first principle of territorialism over resources refers to the strong attachment to established political boundaries such as national borders. such attachment varies to concepts such as loyalty to the native people of the land as well as to the land's natural resources. territorialism effectively means that anything within the political borders of a state becomes of high value to the nation's identity. Consequently, other commonalities such as religion, language and ideologies become secondary in the process of nation-building. Physical space in that sense becomes a core part of the identity of the "homeland" (Conker, 2018). Such understanding of the physical sphere and territory is also reflected in natural resources and in the creation of "my water" mentality as Allouche termed it (Allouche, 2005).

The second principle of water resources and state-building refers to the concept of power in the state. The process of state-building in this principle is understood to be done through emphasis on economic development, military strength and institutional capacities. Water is especially important for state-building as there are direct links between water and the state's economic development (Conker, 2018). In Turkey's case, the GAP project is an example of how water is used to boost economic development. The GAP project generated 45-50 per cent of Turkey's annual hydropower between the period of 1995 and 2008 while simultaneously covering 20 per cent of Turkey's electricity needs. Moreover, based on an estimation from 2017, GAP's monetary value is US$ 26.63 billion, in comparison to US$ 3.47 billion in 1993 (Williams, 2021).

Lastly, the third principle of water resources and nation-building. Nation-building refers to the process of creating a common identity that is loyal to the nation-state. Water in this process is used to showcase the power and pride of the nation, this is

often done through large water dams. The dam's importance is beyond its utility, dams are symbols of the nation's progress toward modernity. The dams' names are often inspired by national figures to further establish a sense of nationalism when discussing water. In Turkey, the symbolism is very clear with the Ataturk Dam, the largest dam in the Euphrates basin being named after the founding father of modern Turkey (Conker, 2018).

Water nationalism literature provides a comprehensive view of the issue of transboundary water between Turkey and Syria. The role of Turkey as a hydro-hegemon in the region provides the country with enough freedom to practise its water nationalism disregarding the downstream countries. This dynamic expands beyond the upstream nature of Turkey and its geographical location. Zeitoun & Warner (2006) use the term “Power play” to explain that power is a deciding factor in which country gets to utilise a shared water resource (Zeitoun & Warner, 2006). Turkey as a hydro-hegemon can exercise its water nationalism and power play to define the rules of the game for riparian countries such as Syria. This power dynamic also means that Turkey can instrumentally use its control over shared water resources as a negotiation technique to further advance the nation’s agenda (Warner et al, 2017). Such a dynamic was observed in the Syrian conflict, where the Turkish state used water as a pressure tool on the Syrian government to cut ties with the Kurdish militia PKK. This also explains that shared water does not exclusively create conflict but instead could be utilised in already existing conflicts (ibid).

2.4 Literature summary

The literature covered in this section highlights the conceptualisation complexity of water scarcity. Population increase and climate change have an evident effect on creating water struggles, however, on both the supply and the demand level there seems to be an academic agreement that man's interference with nature is the driver of creating water struggles. This is true for both the quantity and the quality

of water. In the case of Syria, even with its semi-arid nature, previous water struggles and scarcity have been a direct effect of national and regional policies. Moreover, this section was not designed to pinpoint the origins of water scarcity in Syria, but instead to highlight the importance of understanding water scarcity in relation to political interference rather than just the plain geographical explanation.

3. Theory

3.1 Political ecology

The field of political ecology studies the relationship of power and the distribution of environmental resources between different categories of humans. Political ecology emphasises human agency in constructing environmental struggles. This is for instance explained with an image of a hydrological cycle that exists regardless of human existence, with the cycle serving a fundamental role in regulating the climate of the planet. However, placing human agency into the equation has led to the possible disruption in the hydrological cycle with canals, dams and various other human interventions that serve irrigation and other sectors, all to the benefit of some part of the population and the disadvantage of others (Labajos & Alier, 2015). The insertion of human action into the natural cycle is referred to as the "hydrosocial" cycle which occurs in different historical and sociocultural contexts (ibid). Indeed, countries with similar geographical locations, rainfall patterns, human population and livestock numbers could differ significantly in the quality of wildlife, this is mainly due to human activity that is linked along the axes of control, influence, and money, in other words, power (Robbins, 2019, pp.9-10).

Political ecology does not disregard the discourse on climate change and the biophysical nature of water shortages, in fact, political ecology acknowledges the severity of climate change and recognises that billions of people suffer from a lack of access to clean water, however, the argument here relates to human agency and human economic development that has the greater impact on the quality and the quantity of water. This is reflected in the fact that in the span of the last five decades of economic development and urbanisation there followed a trend of consumption that amounted to half of the world's wetlands while also significantly polluting half of the world's lakes. Moreover, scarcity as a relative

term also goes against the population increase argument. This is not to deny that an increased population requires greater water availability, but to explain that active changes in water use behaviour and investment in technology could decrease the total water consumption (Johnston, 2003). Environmental change and ecological conditions are to a larger extent a product of different political processes (Robbins, 2019, p.16). Water scarcity is then understood as a relative construct influenced by biophysical conditions, human actions and political processes. Scarcity as such does not only reflect a biophysical lack of water but could also be the inability to pay for available water or could be an aspect of social relations while a certain group withholds the existing water from other groups. Human action embodied in the political process significantly influences water supply and demand aspects (Johnston, 2003).

Political ecology provides a fitting framework to study the case of the Euphrates in northern Syria, a region undergoing heavy political processes and continuous conflict. Moreover, the water shortages in the northern part of Syria have also been attributed to various human actions, most noticeably the construction of dams by the riparian country Turkey and the hydro-politics conducted by the upstream country. Theoretically, the case study subscribes to the core understanding of power and political ecology, this is that groups with more power use said power to control natural resources. Conflict, in this case, is over which groups can take advantage of environmental resources. From a political ecology perspective, environmental conflicts are bound to occur especially in the form of conflict over large infrastructures such as dams (Labajos & Alier, 2015). Ecological functions are turned into monetary values and internal conflict arises between the utility of water as a public good and human right or as a profitable commodity (Johnston, 2003). Dams are especially utilised to turn water into a commodity as large dams are typically associated with economic progress (Labajos & Alier, 2015).

Moreover, and on the national level, the degradation and marginalisation thesis within the field of political ecology fits the historic use of water in Syria. The thesis argues that overexploitation of natural resources can occur as a response to certain state interventions and as a result of certain regional or global market dynamics. Governmental interference with production, even when it is advertised as production improvements (also incentives), leads to a contradictorily reactive process of decreasing the sustainability practices of local people (Robbins, 2019, pp.159-160). This case is especially true for marginalised local communities in regions where economic exploitation is allowed. The most marginal individuals and groups are in a cycle of overexploitation and further marginalisation. The more marginalised certain groups get, the more they overexploit natural resources to survive. This process places a greater demand on the ecosystem and leads to irreversible damage (ibid, pp.160-161). Historically, Syria can be seen through the scope of this thesis. This is indeed true as the Syrian government has repeatedly interfered in agriculture production and incentivised the exploitation of resources, especially water. The overexploitation was incentivised through extreme subsidies on water that amounted to the resource losing its real value. Moreover, with the focus on cotton and other "strategic crops", the Syrian government has encouraged agricultural attitudes that lead to soil degradation (Barnes, 2009; Saleeby, 2012; Salman & Mualla, 2003). The cotton production of Syria is related to what Robbins (2019) describe as "soil mining", as cotton production in developing countries and the exploitation often attached to it leads to depleted soil quality and increased pests problems (Robbins, 2019, p.161)

The ontology of political ecology is an important addition to this study. The geographical semi-arid nature of Syria could in many cases be examined through the theoretical lenses of environmental determinism and the ontology of water shortages could be understood entirely in that sense. This is to argue that environmental determinists would view the case of Syria with disregard for the organisational process such as local political decision-making, power, and regional political dynamics. The determinist lenses would view the organisations

to be completely subordinate to the environment (Gopalakrishnan & Dugal, 1998). However, as seen from previous literature reviewed, human agency has been at the core of the environmental issues in Syria. Moreover, and specifically, when discussing transboundary river basins, Mirumachi (2015) argues for the importance of including politics when discussing transboundary river basins in developing countries. Mirumachi utilises the term "wicked problem" to describe transboundary water management, mainly because a shared river basin between different sovereign countries causes any decision-making process to be more complex (Mirumachi, 2015, pp.1-2). Therefore, it is safe to argue that a region as politically heavy as north Syria, must then be examined through the lenses of political ecology rather than environmental determinism. This study does not aim to pinpoint the exact origin of water scarcities, but instead to examine the consequences of such scarcities. However, it is still important to conceptualise where such scarcity approximately originates from (environmental or man-made), to drive actions and further studies based on the finding of this one.

3.2 Realism

The realist school of thought provides a conceptual framework for how countries behave in cooperation with transboundary water. Realism proposes that international relations are fundamentally anarchical in nature and countries are driven first and foremost by their interest. States in this understanding are considered rational actors and their behaviour reflect natural human behaviour. In that sense, international relations are viewed as a constant struggle for power and gains, consequently, cooperation is an anomaly. In other words, cooperation only emerged as the powerful actor initiates such cooperation and often is the case that the formulated cooperative regime favours the powerful actor (the hegemon). Cooperation can however still exist where agreements favour all the participant actors equally, but that is considered an exception (Baranyai, 2020). A central realist approach then views nation-states as actors driven by self-interest to maximise their power and minimise threats to their security. This indeed includes

pursuing self-interest above all other claims such as universalism, human rights, or any ideological moral concerns (Joseph, 2014).

Leb (2009) while attempting to utilise neo-liberal institutionalism lenses in viewing transboundary water issues, still acknowledges that in certain scenarios countries act following the realist approach. For instance, by applying the prisoner's dilemma approach, it was observed that information deficits and asymmetries lead to non-cooperative results, such non-cooperativeness is the rational outcome in these scenarios. With the lack of international water regimes that facilitate information exchange, countries are prone to a prisoner's dilemma situation when they behave rationally and utilise water for their national interest, often to the detriment of the interest of the other riparian states (Leb, 2009).

Realism and political ecology draw a similar narrative of the importance of human agency. In both fields, there is an emphasis on power and its role in shaping international and regional dynamics. Actors with more power are understood to use said power to formulate an agenda that favours them first and foremost. And in both fields, actors are understood to behave by disregarding human rights and moral values if such disregard would provide benefits to the actors.

3.3 The Water, Energy and Food Nexus

Water, energy and food could be argued to be at the core of sustainable development. These three sectors are prominent factors in the Sustainable Development Goals (SDGs) and they directly or indirectly affect every single SDG. Therefore, the theory of Water, Energy and Food Nexus (WEF) has been selected for this study to understand water shortages interlinks with other development necessities such as food and energy and the overall process of development.

An emerging development paradigm began to profile water, energy, and food as a nexus in recent years. At the core of the nexus is the concept of natural resource scarcity. More specifically, the recognition that the three concepts within the nexus, water, energy, and food are interlinked in a complex web of relations. Tension, synergies, and trade-offs are possible within the nexus on different spital and temporal scales (Leck et al, 2015). Water, energy and food are inextricably linked, and the successful management of these resources underpins development progress (ibid). In other words, given the interconnectedness across sectors, an impactful reduction of negative conditions of externalities can in turn increase the overall resource use efficiency (Hoff, 2011). The nexus approach is in principle a holistic approach that examines the system from the outset. However, it is often the case in the WEF that the thinking begins from one perspective and then integrates the others (Leck et al, 2015). This is evident in the example from Hoff 2011 that begins with water and is similar to the design of this study that considers water at the centre of the nexus. This understanding of water as the centre of the nexus is not uncommon, for instance, the World Economic Forum (2011) strongly linked water to the process of development and placed water at the centre of the nexus:

> "Water lies at the heart of a nexus of social, economic and political issues - agriculture, energy, cities, trade, finance, national security and human lives, rich and poor, water is not only an indispensable ingredient for human life, seen by many as a right, but also indisputably an economic and social good unlike any other. It is a commodity in its own right... but it is also a crucial connector between humans, our environment and all aspects of our economic system." (World Economic Forum 2011, p.3).

The World Economic Forum acknowledged that water scarcity risks the process of development. especially in what the forum described as regions with "bubbles" of agricultural productivity that cannot be sustainable in the long term. This bubble is the product of weak trade regimes and the mismanagement of tariffs and

subsidies and does indeed affect the two other sectors in the nexus (Allouche et al, 2014). The process of development can also be undermined by external factors on a transboundary river basin scale where competition for water between upstream and downstream countries for water can have an immense impact on the nexus (ibid). Indeed, water as a resource can have an impact on the security aspects of all the three components of the nexus. Table 1 shows what Bizikova et al (2013) display as the WEF Security Nexus, which is a review of what constitutes water, food and energy security (Bizikova et al, 2013). Table 1 will be heavily utilised in the discussion section of this study, with each element of security examined against the collected data. The careful examination of security elements for water, food and energy should provide a framework to further assess the process of development.

Table 1. Review of WEF Security Nexus (Source: Bizikova et al, 2013)

Food security	The elements of food security are: (1) **food availability**: influenced by production, distribution and exchange of food; (2) **access to food**: including affordability, allocation and preference; (3) **utilization**: nutritional value, social value and food safety (4) **food stability** over time (see e.g., Ericksen, 2008; Schumidhuber & Tubiello, 2007).
Water security	The elements of water security are: (1) **water access**; (2) **water safety**; and (3) **water affordability** so that every person can lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced (Global Water Partnership, 2000).
Energy security	The elements of energy security are: (1) **continuity** of energy supplies relative to **demand**; **(2) physical availability of supplies**; and (3) **supply sufficient to satisfy demand at a given price** (Department of Energy & Climate Change [DECC], 2009; International Energy Agency [IEA], 2001).

The nexus framework does not only provide an academic framework to better understand the interactions between the sectors, but it could also serve as an important tool for future policies. Bazilian et al (2011) conclude that single-sector policymaking can bring temporary and short-term benefits, however, in an overall view, the single-sector policy is likely to conflict with other sectors, making the process of development unsustainable (Bazilian et al, 2011). Pittock et al (2013) similarly argue against single-sector policymaking and advocate for the use of cross-sectoral frameworks such as the WEF nexus. This is mainly to navigate what Pittock et al refer to as the "difficult but unavoidable" trade-offs, benefits, and possible synergies between sectors (Pittock et al, 2013). Indeed, the WEF nexus framework argues instead for a system perspective on policy making, such

a holistic approach is more complex and requires further resource planning tools and expertise. However, accepting to deal with such complexity is rewarded by finding the optimal allocation of resources, increasing economic productivity, reducing the negative environmental impacts on human health and overall, the optimisation of human welfare (Bazilian et al, 2011; Pittock et al, 2013).

The WEF nexus has developed many frameworks since its emergence, the most prominent frameworks are the Bonn (2011) Nexus Conference, the World Economic Forum (2011), and the International Center for Integrated Mountain Development (ICIMOD) (2012). These different frameworks within WEF differ in what they recognise as the centre of the nexus. For instance, the Bonn 2011 Nexus Conference and the World Economic Forum 2011 recognise water shortages as the central concept, while the ICIMOD sees the whole nexus as a system rather than focusing on one specific component (Bizikova et al, 2013). However, all frameworks share key elements. Such as the promotion of security and the inclusion of different domains such as society (changing human behaviour), economy (creating different economic approaches), and environment (promoting ecosystem services). Moreover, all the frameworks within WEF also aim to promote action by reducing trade-offs and exploring synergies between the three elements of the nexus (ibid).

The WEF nexus framework aims at providing a comprehensive image of the SDGs. Similar to the SDGs the overarching goal of the WEF nexus is to promote sustainable and efficient resource use, this also includes ensuring resources access to the most vulnerable. Moreover, the WEF nexus framework advocates maintaining a well-functioning and productive ecosystem (Hoff, 2011). Weitz (2014) argues that a WEF nexus framework is needed to understand the complex interactions of the SDGs. For instance, Weitz recognises three main types of interactions between Sustainable Development Goals. The first interaction could be described as *interdependency,* meaning that one target has to be achieved for the other to be viable. Other interactions could be in the form of *imposing*

conditions, meaning that a target can set a condition on how other targets must be dealt with. The last interaction could be in targets *reinforcing* each other, this interaction highlights possible synergies, for instance increasing water efficiency could also mean increasing agricultural productivity (See Figure 2) (Weitz, 2014).

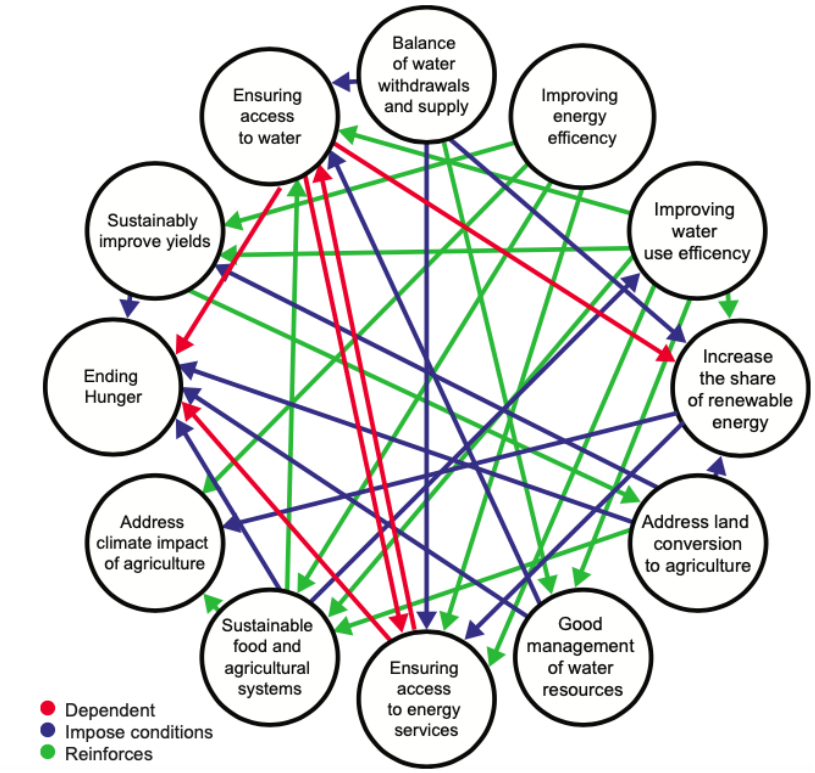

Figure 2. Sustainable Development Goals (SDGs) interactions (Source: Weitz, 2014)

What is interesting to highlight in Figure 2, is that the bubble with "ensuring access to water" is the one with a prominent dependency interaction type. Ending hunger, ensuring access to energy services, and increasing the share of renewable energy, all show dependency on access to water. This dependency is reflected more on the water target than any other target in Figure 2.

3.4 A theoretically comprehensive picture

The three previous sections on political ecology, realism and the WEF nexus approach are meant to provide a theoretically comprehensive picture of the current situation of water shortages in northern Syria. Political ecology and realism are utilised for their ontology of water scarcity and human behaviour. Both political ecology and realism emphasise concepts such as power and human agency in the discussion on water scarcities. Moreover, both concepts provide an overview of the water transboundary dynamics between Turkey and Syria and help find appropriate solutions to the findings of this paper. As for the WEF nexus approach, it is used to guide this study in understanding the complexity of development and how water is to be understood in the discussion on development, SDGs, and water scarcity.

4. Methodology

4.1 Research design

This study will follow the design of a qualitative single case study. The research design is meant to utilise existing theories in explaining the chosen single case study. Thus, this thesis will not aim at developing new theories but will instead make use of already established ones (Gustavsson, 2019). The study is designed to explore the case of water scarcity in northern Syria and to explain how water shortages affect the development of the region. For this case study, qualitative research was chosen to utilise text as empirical material as opposed to quantitative numerical data. Miles & Huberman (1994) argue that qualitative research could be appropriate when the analysis is meant to be done with words that can be assembled and sub clustered into semiotic segments. Moreover, qualitative research can be utilised to permit the researcher to compare, analyse or identify patterns within the empirical text material (Miles & Huberman, 1994, p.7).

The geographical scope of this study is limited to the northern part of Syria, this is motivated by the recent events of critical water scarcities in the Euphrates River basin that has threatened the lives of people around it. Different regions in Syria utilise different water basins, therefore this study only includes the northern part which depends completely on the Euphrates basin. Moreover, the political space of northern Syria is occupied by rebel groups and Kurdish forces, meaning that policymaking and decision-making are separated from the rest of Syria which is ruled by the Ba'ath government. Therefore, northern Syria needs to be studied separately. In this text, north of Syria refers to both the north and the northeast regions, including the 5 provinces, Idlib, Aleppo, Deir ez-Zor, Raqqa and Al-Hasakah. As for the time aspect, this study aims to explore the 2021 critical water shortages in the Euphrates, therefore an appropriate timeframe would be a data approximate to that of 2021. This study utilises the Sustainable Development

Goals (SDGs) as a framework to assess the process of development in the north. The SDGs will be examined in relation to water scarcities in the Euphrates River. Collecting and analysing data on the SDGs in northern Syria will help answer the first research question on water scarcity and development. Moreover, the collected data will answer the second question on the possibility of reaching the sustainable development goals in the northern part of Syria. The choice to focus on specific SDGs 1, 2, 3, 6, 7 and 15, is mainly due to these SDGs' direct relationship with water availability. While it could be argued that each of the 17 SDGs has some dynamic relating to water, to include all of the SDGs in the analysis would be beyond the scope of this study. Moreover, the chosen SDGs are at the heart of the water, energy, and food nexus, and getting a comprehensive picture of the chosen SDGs helps better understand the development process of the region from the WEF nexus perspective. Especially relating to water, energy and food security.

4.1.1 Case Study

A case study follows the idea that a certain unit of analysis will be studied in detail, to fully understand that unit (the case). Under qualitative research design, a case study aims to provide an in-depth understanding of a case in its natural setting, while recognising its context (Punch, 2005, p.144). The case study collects information about the unit of analysis that the research is trying to study. Units of analysis can be anything from individuals, places, decisions, periods or as used in this study, phenomena (De-Vaus, 2001, p.220). Therefore, this study makes use of Rashid et al (2019) definition of a case study:

"a research methodology that helps in exploration of a phenomenon within some particular context through various data sources, and it undertakes the exploration through variety of lenses in order to reveal multiple facets of the phenomenon" (Rashid et al, 2019).

Similarly, Yin (1994) defines a case study as the gathering of empirical material to examine present-day phenomena in a bounded environment. Moreover, Yin

recognised that a case study could be utilised to examine processes and relationships (Yin, 1994). A case study is then best suited for research areas with a focus on a contemporary phenomenon in a real-life context, such a context that the researcher often has little control over (ibid).

Creswell et al (2007) highlight an important aspect of case study and that is, case study research examines an issue through one (or more) cases within a bounded system (Creswell et al, 2007). This is important as this thesis has a unit of analysis to be the phenomenon of *water scarcity in the Euphrates River* and this unit is explored through the case of SDGs in northern Syria. Meaning that this case study will aim to explain the impact of water scarcities in the Euphrates River (unit of analysis) with data on the SDGs in northern Syria. Water shortages in the Euphrates River are a unique phenomenon to that specific river and location, and to study such shortages concerning development makes this case study more specific. Stake (1995) argues that a case study does not have to be about a general problem, instead, it could be about a particular event in a specific setting, that case study is referred to as an intrinsic case study (Stake, 1995, p.3). A unique or an understudied phenomenon fits the qualitative nature of an in-depth case study; such case studies that cover specific phenomena are valuable regardless of their lack of generalisability (Punch, 2005, p.147). The case of water shortages in the Euphrates River is indeed unique and the recent situation in the river is understudied, therefore the case study in this thesis follows the definition of an intrinsic case study.

4.1.2 Fundamental Qualitative Description

In addition to the case study guidelines, a fundamental qualitative description will guide the discussion on the central issue of water shortages in the Euphrates River. The word “fundamental” is used to separate this method from the more interpretive designs such as ground theory, ethnography, or narrative study. Sandelowski (2000) argues that fundamental qualitative description is an

appropriate and valuable method for low-inference studies. That is, such a method does not require researchers to move from the original data to a new set of integrative ones (Sandelowski, 2000). In such a design, language is a means of communicating facts, and language itself is not an imperative structure that must be read and analysed (ibid). Utilising this design helps to offer a comprehensive understanding of an event in everyday terms. Moreover, while other designs might be interested in creating thematic patterns or content analysis of the facts, qualitative description is more focused on the facts as such (ibid). The nature of this thesis's central issue requires such a design to focus on the facts, rather than how the facts are formulated. For instance, data input from a news article that shows a decrease in agricultural productivity caused by water shortage, is exactly that, rather than attempting to analyse media language or narrative. This is to avoid what Sandelowski dubbed "methodological acrobatics" (ibid). Indeed, a qualitative descriptive study is based on a naturalistic inquiry, that is to study an event in its unique environment. Exploratory by nature, such design aims to provide an accurate description of a certain event and important subjects to that event (Holly, 2014, p.70).

4.2 Data collection

This thesis aims to collect data on how water shortages and scarcities interact with the development process and the SDGs. For instance, for SDG 1, the data collection attempts to find data inputs that link water scarcity from the Euphrates River to poverty and economic living conditions of people in northern Syria. The same process will be applied to all the selected SDGs. Data collection for most issues in the northern part of Syria is particularly difficult, as the Syrian Association for Studies and Consultations (SÇDD) report (2021) highlights, that the northern part of Syria has been in a constant state of political unrest in the past decade with different military groups and government exchange control over different cities (SÇDD, 2021). The volatility of the situation meant limited access

by scholars and knowledge producers. Moreover, the water scarcity issue of the Euphrates River has emerged as a critical issue in the second part of 2021, meaning there has been a lack of academic analysis in the area. Therefore, for this thesis, all the data could be categorised as secondary sources, that is materials that are not generated by the author of the thesis but instead collected from multiple different sources (Bryman, 2012; Creswell, 2014).

The Research Design of qualitative description and intrinsic case study, both make use of document review as a valuable source for data collection (Holly, 2014, p.77). The data will be collected in multiple textual forms. For instance, reports from the United Nations (UN) and branches such as the World Food Programme (WFP), Office for the Coordination of Humanitarian Affairs (OCHA), Whole of Syria (WoS), and United Nations Children's Fund (UNICEF). Furthermore, reports from international humanitarian initiatives such as PAX for Peace and REACH will also contribute to the analysis section. The World Bank and the Multidimensional Poverty Index (MPI) will also be utilised in assessing data. The background diversity of the different international organisations means a diverse set of data collection that covers the core aspects of each selected SDG about water shortages. Nevertheless, news articles are also part of the data collection process. For this specific type of data, Google search was used using keywords such as “water scarcity In the Euphrates” and “water scarcity in northern Syria” and similar terms, to find data regarding different components of the SDGs and water scarcity in northern Syria.

4.3 Limitations

The limitations of this study are related to the availability of data. The Arab Sustainable Development Report 2020, a report by the United Nations on the SDGs in the Arab countries has acknowledged that data gathering in the Arab region has issues regarding the quality and the quantity of data. This issue is described as a “serious blind spot” in the region (ESCWA, 2020). Indeed, this

issue of data availability is a serious challenge for any study on Syria. The volatility of the conflict means that only a few organisations are allowed in the country, and even then, their data is constrained by many political factors. Government national data is almost non-existent, for this study, there was not a single report by government institutions on the situation and the conditions of the northern population and water scarcity. This issue of data is even more complicated in the north part of Syria as the region is administered by different governments that are actively in conflict with each other. Such limitations are inescapable when studying a country as volatile as Syria, however, these limitations should not hinder any academic efforts to conduct further studies in Syria even when data is challenging to acquire. Instead, as this study aims to do, academics should make use of quality data inputs that are produced through respected organisations (regardless of the quantity of such data).

4.4 Data analysis

4.4.1 Miles & Huberman, 1994

The data analysis of this thesis will rely on the framework of Miles & Huberman (1994). Punch (2005) describes the Miles & Huberman framework as a "comprehensive sourcebook, describing analysis which is directed at tracing out lawful and stable relationships among social phenomena, based on the regularities and sequences that link these phenomena" (Punch, 2005, p.197). The framework is applied with three main components: data reduction, data display, and drawing and verifying conclusions (Miles & Huberman, 1994, p.10).

Data reduction as the name might suggest is the process of selecting, transforming and overall reduction of the collected material. This process occurs continuously in qualitative research and dictates what data makes it to the research. Data reduction also occurs in an anticipatory manner when choosing the research

question, the conceptual framework, and the case. A noteworthy aspect of data reduction is that reduction does not always refer to the quantification of the data, but also reduction can occur qualitatively through summaries, rephrases and most importantly coding (Miles & Huberman, 1994, pp.10-11). For this study, the data reduction method was done by coding different words and concepts to a certain SDG (more on this in section 4.4.2 on coding). This meant that the overall data was reduced to qualitative data that fits the geographical location of northern Syria, and to concepts that are relating to development and the SDGs.

"You are what you display" argues Miles & Huberman to emphasise the importance of the data display stage. This stage aims at organising and compressing data in an assembly of information that guides the study toward the conclusion. Extended text is the standard and most common method of displaying qualitative data, however, using only extended text without a proper structure could lead to hasty and unfounded conclusions. This is the case as humans are wired to reduce complex information into simplified configurations (ibid, p.11.). Displaying the data appropriately is essential for analysing the data (ibid). For this study, data display will be done in chronological order of the SDGs. Starting with SDG 1 displaying all the collected data on how the Euphrates water scarcities are affecting the core component of that SDG, and the same process for all the selected SDGs. Each displayed SDG provides an analysis of water scarcity effects on a particular aspect of development (Economic poverty, hunger, health, energy etc.).

The third aspect of the Miles & Huberman data analysis framework is the conclusion drawing and verification. Both stages of reducing and displaying the data are meant to assist in conclusion drawing. However, it is possible that a conclusion can be noted early in the data display stage, in the form of possible configurations, casual flows and propositions. Still, such early conclusions are often vague and require further structuring (ibid, pp.10-11). This study will conclude after collecting and discussing relevant data on water and all the selected

SDGs. Understanding the value of water, early conclusions could already be predicted about the implications of water scarcity on development. Regardless, a systematic analysis must first be conducted for a better-structured conclusion.

4.4.2 Coding

Coding is the process of creating tags, names, or labels that can be placed against data inputs. The data input can be words, phrases, or small to large chunks of data. The coding process aims at attaching meaning to pieces of data. Under the research design of this study, descriptive codes are used. Description codes refer to codes that require low interference beyond the data itself. These codes are useful in attributing data pieces into different larger categories. Furthermore, an important requirement of this coding process is that there must be clear links between the selected data and the categories that the data is coded into (Punch, 2005, pp.199-201).

In this study, coding will be done by labelling pieces of collected data into 6 codes. Each code will be in the form of one of the selected SDGs. This process will help both in the data reduction process and the data display. In the data reduction process, coding will be central to creating a rich and relevant database that will inform the analysis. This means while examining scholarly work, international reports, and all forms of textual data, codes will be created in the process. For instance, while reading a text on the Euphrates River water shortages in northern Syria the coding process will find relevant data to the selected SDGs and create codes to label that data with the SDG it could represent. A piece of data on economic poverty will be for example coded into SDG 1 No Poverty. More examples for instance if there is data on food insecurity it will be coded into SDG 2 Zero Hunger and so on. In the data display process, which will be the core analysis of the central issue, codes will be presented first and then unpacked. For instance, the data display begins with a section on SDG 1 and that section will include all the collected data on water shortages concerning the components of

that SDG. Possible overlaps might occur in the coding process such as the example of agricultural productivity that could be understood both in terms of SDG 1 goal of tackling poverty or SDG 2 ending hunger, such overlaps are inevitable as part of the complex nature of the SDGs dynamics. Then, an overlap in coding could be solved by either including the same data in two different codes or choosing the most relevant code.

4.5 Methodological synergies

For the data to be selected, displayed, and concluded properly, a methodological form of synergy must exist. Therefore, the methodologies chosen in this study were carefully selected to complement each other and to provide a comprehensive framework for dealing with dense data. An intrinsic case study focuses on a specific unique case and attempts to explain it. Qualitative description avoids overcomplicating and overinterpreting data, as it also attempts at creating a clear picture of certain events. The Miles and Huberman 1994 framework fits right into this methodology as a descriptive analysis that examines stable relationships among phenomena. Moreover, the coding in this framework is done by the low-interference principle that the research design of qualitative description follows. This methodological synergy is formulated carefully to analyse the textual data in its natural setting. The data analysis with the aid of the theoretical understanding of water scarcities should indeed provide a comprehensive study of the current water and development situation in northern Syria.

5. Analysis

5.1 Presentation of results

5.1.1 SDG 1: End Poverty in all its forms everywhere

Goal 1 in the Sustainable Development Goals (SDGs) focuses on eradicating poverty for all people. The UN's first development goal is meant to combat all dimensions of poverty but with emphasis on severe poverty and poverty amongst the vulnerable (United Nations, 2022b).

In Syria, the situation regarding poverty has changed immensely since the beginning of the 2011 revolution. As demonstrated in Figure 3, the World Bank has estimated that Syria's GDP dropped by more than half between 2010 and 2019.

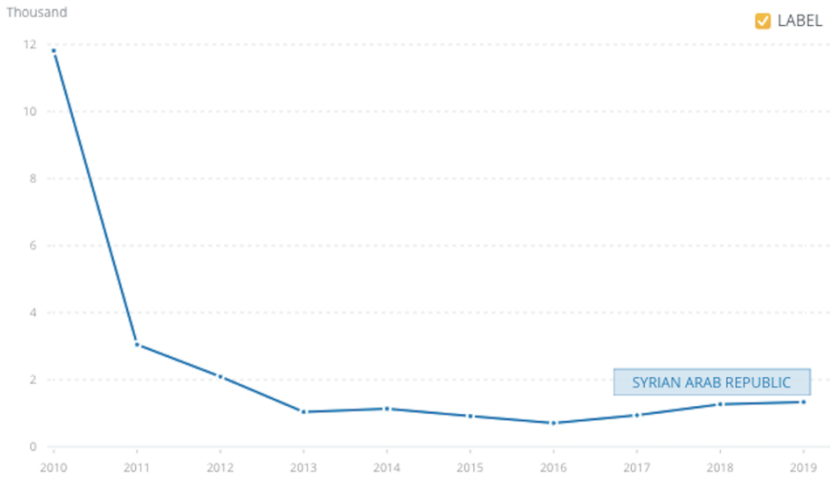

Figure 3. GDP per capita (current US$) - Syrian Arab Republic (Source: World Bank)

While extreme poverty did not exist in Syria before the conflict, it is now affecting more than 50 per cent of the population (The World Bank, 2022). It is currently difficult to estimate exactly how many of that 50 per cent living in

extreme poverty are in northern Syria, however, the latest data available from the Multidimensional Poverty Index (MPI) shows that Syrian cities in the north are most affected by severe poverty (Table 2).

Region	MPI	*H*	*A*	Vulnerable	Severe Poverty	Population Share
Al-Hasakah	0.037	9.2%	39.8%	11.8%	1.4%	8.0%
As-Suwayda	0.004	1.0%	35.9%	1.1%	0.1%	2.3%
Damascus	0.008	2.3%	33.8%	3.3%	0.0%	8.6%
Daraa	0.018	5.1%	36.4%	9.4%	0.4%	4.4%
Deir ez-Zor	0.075	18.5%	40.5%	17.6%	3.7%	4.8%
Halab	0.049	12.6%	39.0%	6.7%	2.4%	22.4%
Hama	0.016	4.6%	35.6%	5.2%	0.4%	7.2%
Homs	0.014	3.7%	36.7%	5.9%	0.5%	8.0%
Idlib	0.032	8.6%	37.4%	6.1%	1.2%	7.0%
Latakia	0.005	1.4%	37.4%	1.3%	0.1%	6.2%
Quneitra	0.022	6.1%	35.8%	7.4%	0.0%	0.4%
Raqa	0.049	12.2%	39.9%	11.1%	2.7%	4.7%
Rif Dimashq	0.021	4.9%	42.1%	15.0%	0.8%	12.2%
Tartus	0.001	0.2%	33.3%	1.0%	0.0%	3.9%

Table 2. Global MPI in Syria by Subnational Region with provinces in the north highlighted in Yellow. (Source: OPHI, 2021, with yellow highlights by the author)

The MPI report of 2021 data shows the provinces of Al-Hasakah to have 1.4% of its population in severe poverty, 3.7% in Deir ez-Zor, 2.4% in Halab, and 1.2% in Idlib and 2.7% in Raqqa (OPHI, 2021). The mean of these percentages is 2.28 per cent of the population in the north living in severe poverty. These numbers are important, especially when taking the mean of severe poverty for all the other provinces in Syria, which is 0.255 % of the population (ibid). The data reflect evident vulnerability in the northern part of Syria, especially under target 1.1 on severe poverty in SDG 1. While the MPI data is not directly a linkage between water scarcity and poverty, it is still relevant to highlight that the northern provinces in Syria proportionally suffer from more extreme poverty than any other region in the country. Yet, by 2021, the northern region experienced water scarcity on an unprecedented scale, and the population of north Syria sank further into poverty as the situation unfolded. Farmers, for instance, have registered drops in crop yields amounting to 90 per cent, and some farmers reported a 100 per cent drop in crop yields, meaning they were producing nothing at all (PAX, 2022). Income loss due to water scarcities is estimated to affect 72 per cent of the farmers

in northern Syria, with women being the most affected as they represent 70 per cent of the farming workforce as well as being affected as female-headed households (OCHA, 2021). PAX further investigated the effects of the 2021 drought on northern Syria illustrated in Figure 4.

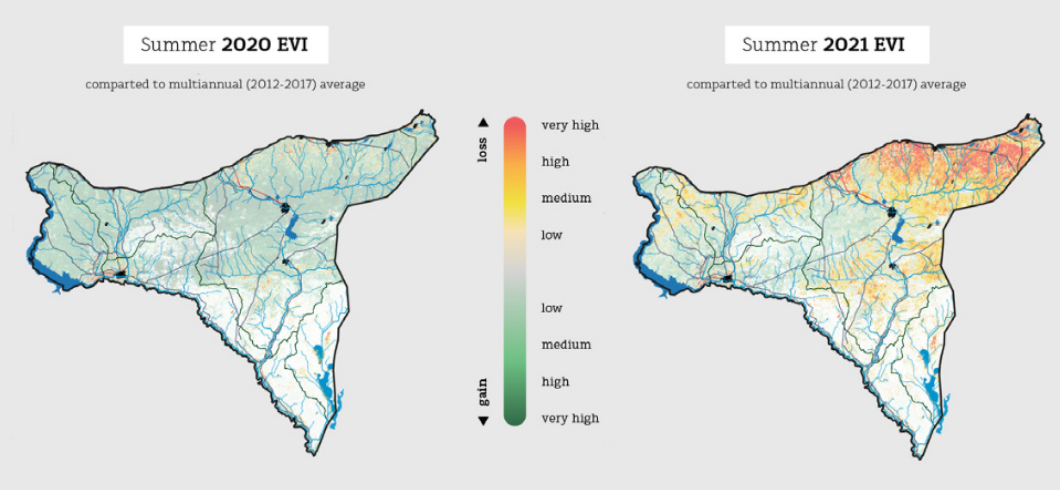

Figure 4. Remote sensing overview of crop land decline. (Source, PAX, 2022)

The study examined the change in vegetation growth for the same period between the summer of 2020 and the summer of 2021 when the water shortages became more prominent in the northern region. As shown in the figure, in the region around the Euphrates River basin, especially the northeast region, the vegetation loss has severely affected the area. Consequently, with minimal greenery and little vegetation due to water shortages in the northern region, farmers have reported producing less wheat and chaff and other agricultural products to sell, leading to a further worsening of their economic situation (PAX, 2022).

Moreover, provinces located in the north are amongst the most reliant on water trucks. For instance, in the province of Idlib, 52 per cent of the total available water comes from water trucks, with similarly high numbers in Deir ez-Zor 34 per cent, Al-Hasakah at 23.2 per cent, Aleppo at 21,7 per cent and Raqqa at 9.9 per cent (WASH, 2021). While the national average of water truck reliance is 17.5 per cent in Syria, this does not reflect the reality of scarcity in the north compared to the rest of the country. For instance, the mean for water coming from trucks is

28.16 per cent according to the data from the five provinces in the north mentioned above. However, the mean for water coming from trucks for the rest of the country (9 provinces) is 5 per cent. This large difference is important to take into consideration as water trucking vendors are operated privately meaning that with water shortages intensifying in the country, the five provinces of the north are forced into purchasing water to meet their needs (ibid).

In sites of the internally displaced people (IDP) in the north, 74 per cent of the households reported using water trucking as their main water provider. Furthermore, IDP site households have also reported spending more than five per cent of their income on purchasing water only (WASH, 2021). The WoS WASH report of 2021 further shows that many IDP sites in the north only receive 20-30 litres of water per capita which is significantly lower than the WHO recommended amount for basic needs and survival, that is 50-100 litres of water per capita (ibid). Water pumping from fossil-fuel-powered generators is another coping technique in the northern region to battle the recent shortages of river water. However, with the fuel prices tripling in Syria since the beginning of 2021 and the already existing severe poverty in the region, water pumping becomes an expensive process. These dynamics are worth examining, for instance, expensive water pumping consequently means that any agricultural process becomes far more costly, ergo prices for crops and necessary goods are inflated beyond the purchase ability of the poverty-ridden communities (Pawson, 2021).

Concerning water scarcity, Sulivan (2002) argues that water is linked to economic and social progress, suggesting that development is directly influenced by how water resources are managed (Sulivan, 2002). On a similar note, Barker et al (2000) argue that irrigation has had a central role in poverty reduction. However, water and poverty are not exclusively linked through irrigation, other activities such as fishing, harvesting of aquatic plants and industries such as brickmaking, are heavily dependent on the availability of water (Barker et al, 2000). Indeed, in a natural setting, the communities in the north region of Syria depended exclusively

on the Euphrates water for irrigation and agricultural production. This means that the water shortages in the Euphrates had a direct impact on the community's main source of economic income, agriculture (Souleiman & Hackman, 2021). For instance, barley production in the north has dropped by 1.2 million tonnes, leading to fewer economic opportunities for barley sales as well as contributing to the scarcity of animal feed (ibid). All the above data suggest that in the northern region of Syria, water is essential for economic stability and growth, especially given the importance of agriculture in the region.

5.1.2 SDG 2: Zero Hunger

The second sustainable development goal focuses on ending world hunger by 2030. To achieve such an ambitious goal, 8 targets must be met in the process. By only focusing on the first 4 targets, we can already formulate a conclusion on whether the area of north Syria will be able to achieve SDG 2 by 2030.

- 2.1 by 2030, end hunger and ensure access by all people to safe, nutritious food all year round.
- 2.2 by 2030, end all forms of malnutrition.
- 2.3 by 2030, double agricultural productivity and income generated from small-scale agricultural producers. This includes ensuring safe and equal access to land and the needed resources.
- 2.4 by 2030, ensuring sustainable strategies for food production. And build resiliency to maintain ecosystems and adapt to climate change and shock events.

(United Nations, 2022c)

The World Food Programme Annual Country Report on Syria 2021 shows that Syria has reached its lowest access to sufficient nutritious food since the last ten years of the conflict. Food prices are witnessing a steep increase, while the population's economic standards are rapidly decreasing, as well as the recent

water scarcity in the north that spread to the entire country. This has left three out of five Syrians suffering from food insecurity. By the end of 2021, the measurement of a food basket that is sufficient to feed a family for a month has reached the price of USD 88 (official exchange rate of SYP 2,500/USD). Whilst the highest-paid official government monthly salary is USD 44, this meant that a food basket at the national level exceeded the highest-paid salary by 96 per cent (WFP, 2021a).

As mentioned earlier, 5,5 million people in Syria rely on the Euphrates River for drinking water and agricultural irrigation, with that population residing mainly in the country's north region (WFP, 2021b) In the north, the provinces of Al-Hasakah, Raqqa, Aleppo, and Deir ez-Zor account for 80 per cent of the entire country's annual wheat and barley production. With the recent water shortages in 2021, these areas have been badly affected, which is reflected in the fact that in June 2021, authorities in the northern cities reported acquiring just 200,000 tons of wheat from the annual harvest, a number that is significantly lower than the annual need of 600,000 tons to cover the north region. While all the north is directly impacted by the reduction in wheat harvest, it is important to highlight that the entirety of Syria relies on wheat production from the northern region, meaning that the impacts of the water shortages on food security spread from the north to the entire country (OCHA, 2021). The economic aspect of poor yields affects farmers' ability to obtain necessary resources for the sowing season in November, meaning that a bad harvest season in 2021 would, and does affect the harvest season of 2022 (ibid). Moreover, the water shortages related circumstances have resulted in over 85 per cent of the agricultural land now suffering soil erosion, with even further damage being done to agricultural land by bombardments such as the dozens of hectares of wheat and barley burnt in Aleppo (WFP, 2021b).

SDG 1 and the discussion on poverty are directly linked to SDG 2. For instance, income livelihood lost due to crop yield failure and damaged agricultural

production, combined with high household expenses for food and water (trucking and pumping), have negatively affected an already high food insecure population. The UN's food security and agriculture sector partners have estimated that 3.36 million Syrians are affected by the recent reduction of water flow from the Euphrates River (OCHA, 2021). This is especially alarming as 68 per cent of the population in the northern provinces were already considered to suffer from food insecurity at the beginning of 2021 and before the critical water crisis emerged (ibid). According to data gathered from the World Food Programme in a VAM food security analysis, the provenance of Raqqa shows the highest numbers (60%) of inadequate food consumption reported in the six months before May 2021, with Aleppo being the second-highest 48% and Deir ez-Zor the third 46% and Al-Hasakah 45% sharing the 4th place with the provenance of Hama (No data was collected in Idlib for this report). The top 4 provinces reporting inadequate food consumption were all located in the northern region in the area with the Euphrates water shortages (WFP, 2021b).

5.1.3 SDG 3 and 6: Good Health and Well-Being and Clean Water and Sanitation

While all the sustainable development goals can overlap, goals three and six are particularly hard to discuss individually in relation to water scarcities. SDG 3 emphasises the importance of a healthy life and the promotion of well-being for everyone. While SDG 6 advocates increasing access to clean drinking water and sanitation for everyone, it emphasises the most vulnerable who lack access to basic water services (United Nations, 2022d; United Nations 2022e). An example of how both goals interact could be seen in northern Syria and the wells related problems. The problem arises from the recent lack of river water that the communities in the northern region have always relied on, as a coping mechanism, the population of the north has increased their water supplies from local groundwater wells. The need for water has overshadowed the fact that local wells were unfiltered, and the water extracted from such wells was of poor quality.

This has drastically increased hospital cases with symptoms like diarrhoea, vomiting and fever. The local logic of drinking such water is simple, unsanitary water is better than no water at all (Laffert & Sala, 2021). While local wells and ground pumping could not be described as a new phenomenon in Syria, still the water decreased from the Euphrates River has drastically increased the need for new water supplies. This correlates with the World Health Organisation report that shows a 133 per cent increase of hospitalised diarrhoea cases in May 2021 compared to May 2020 (ibid). Moreover, the spread of diesel-powered generators in the north, and specifically in the northeast, has exacerbated lung problems amongst children who breathe in unhealthy gases. This issue is a direct link between water shortages and electricity production, as diesel-powered generators are used to compensate for the lack of grid electricity (ibid).

Another aspect that links water's availability and human well-being is determined by the river flow. For instance, the current low flow of the Euphrates River has increased the spread of water-prone diseases due to the high concentration of wastewater. The reduction of the river flow made wastewater harder to dilute, and the very little available water in the northern region has also become a health hazard to use for human consumption (Souleiman & Hackman, 2021). Moreover, data gathered by the REACH humanitarian initiative in north Syria has shown that water-prone diseases are becoming more prominent in the area. Besides the already mentioned issue of unsanitary well water, there is also a storage issue. The REACH report demonstrates that 34 per cent of the communities assessed in their data used previously-stored water as a coping mechanism to the decline in the Euphrates water. This coping strategy leads to health risks as often water tanks can be contaminated, such is the case in IDP camps. This issue is heightened during the summer months due to the high temperatures that enhance the growth of microorganisms in water tanks (REACH, 2021). More issues arise in the form of increased turbidity. For instance, in Raqqa the water station reported in May 2021 that water there has reached four nephelometric turbidity units (NTU), keeping in mind that reaching five NTU and above would mean that the water

does not meet the minimum quality standard. This has a significant impact on health as high levels of turbidity can stimulate the growth of bacteria. The REACH report attributes the increased levels of turbidity directly to the decrease in the Euphrates water (ibid). Water's impact on health transcends beyond the direct impact of diseases on the human body. Lack of water also has an impact on the operation of health facilities. Decreased or interrupted supply of water through networks has a strong impact on the facilities. For instance, 75 per cent of the functioning public health facilities in the northern region have reported relying on network pipelines as the main source of water for the facility. Meaning that water cuts and reductions from the pipelines left the majority of the public health centres without water. Moreover, as of the end of 2020, 76 per cent of the operating public health centres reported not having a generator. This also meant that these facilities were ill-equipped to deal with the inevitable electricity shortages caused by water shortages (ibid).

While water scarcities in the north are affecting the health and well-being of a large proportion of the population, these scarcities are most felt amongst the vulnerable. The UNICEF report Running Dry (2021) shows the significant impacts of water scarcities on children. For instance, the mentioned rise in diarrhoea cases is particularly dangerous for children as it inhibits their absorption of key minerals and nutrients. The effects of this are irreversible on young children's mental and physical development. Moreover, unsafe water and sanitation conditions cause malnutrition in children and as a result, make them more vulnerable to diseases. Poor sanitation can lead to many diseases, for instance, polio-infected faeces can spread through unsanitary water and turn into an outbreak. Such an outbreak was reported in Syria back in 2013 and spread to Iraq. Further issues arise from the water coping strategies such as the over-extraction of deep groundwater. Such over-extraction by the adult population led to skeletal fluorosis, which can cause permanent disability in children. Indeed, children have less body mass compared to adults, meaning that water-borne chemicals and toxins that are relatively harmless to adults, could cause serious

health hazards for children (UNICEF, 2021). The UNICEF report highlights the permanent effects water scarcity could cause to children. Stunting for instance has been linked to children growing up in drought-like conditions. Studies by the World Bank show that girls born during severe drought grow up to be physically shorter because of malnutrition (ibid). Education is also affected by water shortages as children in water-poor areas are often forced to collect water from alternative sources that are far from their homes. Compared to the necessity of collecting water, school attendance becomes unimportant. Moreover, the lack of water in schools also reflects many hygiene issues that impact girls' attendance, particularly during menstruation (ibid).

Water availability and sanitation are also essential in the battle against Covid-19. In the northern region of Syria, severe waves of Covid-19 have been reported. Reported positive cases in the northwest rose from 39,000 in August to 73,000 in September. Only 3 per cent of the northwest population are fully vaccinated against the virus. In the northeast, and by the end of September 2021, an average of 342 people were reported to test positive daily (Mahase, 2021). While some data is available, it remains impossible to assess the real extent of the Covid-19 spread in the entirety of the northern part of Syria because of limited health care infrastructure and lack of tests (ibid). A joint statement on World Water Day by the Regional Humanitarian Coordinator for Syria (RHC) and UNICEF (2021) of the UN has emphasised that access to safe water is a key element of maintaining health during the pandemic. Moreover, access to safe water and sanitation is especially important during the current effort to curb the spread of the pandemic. Arguing furthermore, that lack of access to water during these times directly endangers the lives of children and families (RHC & UNICEF, 2021).

5.1.4 SDG 7: Affordable and Clean Energy

The focus of goal 7 is to increase energy sustainability and make energy, in general, more available. Access to electricity in poor countries is particularly

emphasised in this goal with clean and safe cooking fuel also included in the discussion of this goal. For the case of north Syria and the Euphrates River, the focus of this analysis section will be mainly on electricity in relation to the following three targets of goal 7:

- 7.1: by 2030, ensure access to affordable, reliable, and modern energy services.
- 7.2: by 2030, increase the share of renewable energy in the energy mix.
- 7. B: by 2030, expand infrastructure and upgrade to technology that can maintain and supply modern energy services.

(United Nations. 2022a)

These targets propose a real challenge for the northern region of Syria. For instance, target 7.2 on renewable energy is alone very difficult to achieve. The only renewable source of energy that the Syrian government has developed over the years was hydropower generation. The Euphrates River is the main source of hydropower and the only renewable energy source in the country. While the government has allowed private investors to fund the green electricity sector such as wind and solar energy, such energy is still highly underused in Syria and the investors' contribution remains negligible (Hatahet & Shaar, 2021). Syria's electricity remains largely dependent on fossil-fuel-run power plants; eleven plants are spread across Syria to generate electricity. However, during the conflict, three major plants were destroyed, the Thermal Station of Aleppo was destroyed in 2015, Zayzoon of Idlib in 2016 and, al Taim of Deir ez-Zor in 2017. What is important to highlight here is that these three plants had a combined electricity generation capacity equal to 18.25 per cent of the total nationwide capacity (ibid). Moreover, another essential aspect to highlight is that these three major electricity plants were located in the northern part of Syria. This meant that with the destruction of the fossil-fuel-run power plants, the population in the north became largely dependent on the renewable energy generated from the dams on the

Euphrates River. This consequently suggests that the recent water scarcities in the Euphrates River directly impact electricity accessibility in northern Syria.

The reduction of water flow from the Euphrates has resulted in an evident decrease in electricity generated from the hydropower plants on the river. The three stations of Tishreen, Mansoura, and Tabqa were all affected by the recent water reduction. Reports from The New Humanitarian (2021) suggest that the electricity generated by the three dams has decreased by two thirds from the beginning of 2021 until December of the same year (Laffert & Sala, 2021). The same data suggests three million people rely on the electricity generated from the Tabqa dam alone. Accordingly, most communities that rely on hydropower electricity were left with five hours of electricity a day (ibid). The Tabqa dam is Syria's largest dam on the Euphrates and is reported to have reached its lowest water levels since data was first recorded in 2002, Figure 5 shows the water levels in metres to be alarmingly close to the dead level of 298 metres. The water levels have drastically dropped and are now hovering dozens of centimetres above dead level (Souleiman & Hackman, 2021).

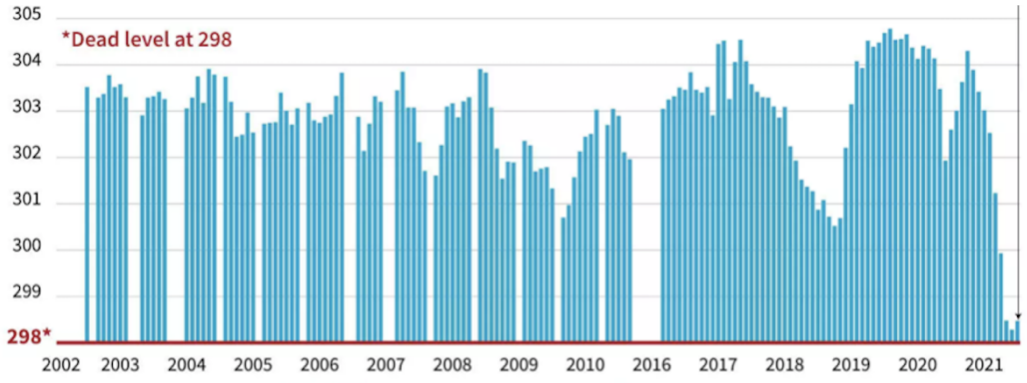

Figure 5. Water levels at Syria’s Tabqa dam. (Source: Souleiman & Hackman, 2021)

Syria’s second-largest dam, the Tishreen dam, faces even further water flow issues. Recent reports from the North Press Agency suggest that as of May 2022, the Tishreen dam, as a result of Turkey's decrease in water flow, could soon be non-operational. The report confirms a vertical drop of water in the Tishreen dam

lake to have reached five metres, this is significant as the report claims that five and a half metres are the entire strategic reserve of the lake (the amount of water that can operate the dam). The low flow of water results in the dam not working from ten p.m. until four p.m. (18 hours), confirming other reports that such operating hours can only generate about 6 hours of electricity (North Press Agency, 2022b). Indeed, the REACH report on northern Syria (Idlib not included), reflects a drastic decrease in electricity availability between January 2021 and May of the same year as illustrated in Figure 6 (REACH, 2021).

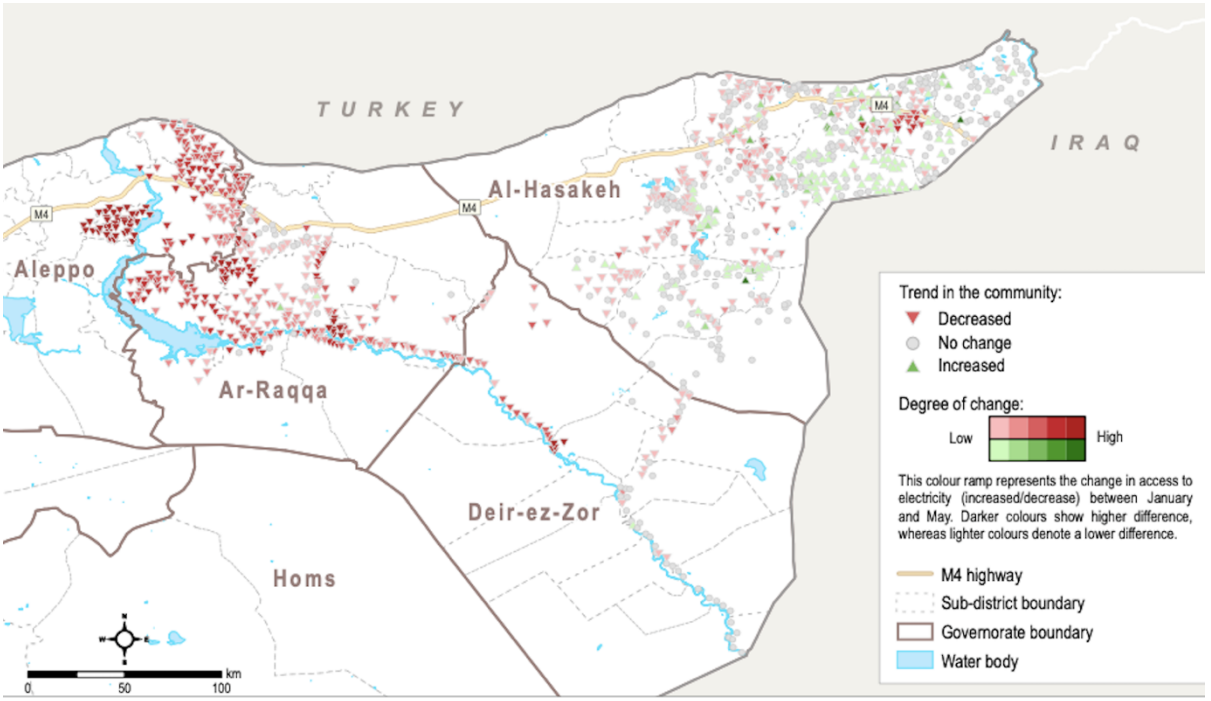

Figure 6. Change in access to electricity (hours/day) between January and May 2021. (Source: REACH, 2021)

5.1.5 SDG 15: Life on Land

The United Nations explain SDG 15 with phrases such as “nature is critical to our survival” (United Nations, 2022f). Indeed, the focus of this goal is built to protect nature that provides oxygen, regulates weather patterns, pollinates the crops, and helps produce the food. Nature is indeed critical to the survival of human beings

therefore, it is critical to protect that nature from the various human-related activities that are estimated to have altered 75 per cent of the earth's surface (United Nations, 2022f).

SDG 15 provides an enormous challenge for the country of Syria in general. For instance, we can already assess target 15.1 that was supposed to be achieved by 2020. The target advocates to ensure the conservation, restoration and sustainable use of inland freshwater ecosystems and their services (United Nations, 2022f). As explained in the literature review, the Syrian government has for decades encouraged unsustainable use of the land's freshwater to achieve a status of food efficiency, with no effort to restore or conserve freshwater ecosystems. Today in 2022, it is fair to draw a quick conclusion on target 15.1 and suggest that Syria has not met such a target, especially in the northern part, where freshwater ecosystems were historically overexploited and are currently almost non-existent.

As with all the SDGs, there is an interplay between SDG 15 and other SDGs such as 1: No Poverty, and 2: Zero Hunger. For instance, PAX (2021) has reported that due to economic hardships communities and authorities in northern Syria have increased their oil production capacities to boost the economic situation of the poverty-ridden area. However, this meant that oil facilities in the north were polluting the water with oil waste in rivers and creeks. As of 2021, over 227 kilometres of rivers and creeks in Syria are polluted, an area that is similar to the entire size of Lebanon. The oil waste has a direct impact on the ecosystems, causing permanent damage and impacting the livelihoods of farms (irrigation) and communities (drinking water) (PAX, 2021). The North Press Agency has also reported on oil spills and leaks due to smuggling operations from the north provenance of Deir ez-Zor to the Syrian government-controlled areas across the Euphrates. The water of the Euphrates faces further quality struggles as the smuggling of oil has polluted the river. The smuggling operations are conducted by local authorities in the north and Syrian government officials across the river, in exchange for financial profits (North Press Agency, 2022a). While increasing

oil production and smuggling such oil is not directly linked to water shortages, it often is the case that things are more complex than a single direct link. It could be argued in this analysis, that oil production and oil smuggling are coping mechanisms for the economic deterioration of the north region caused by the water scarcity. This argument would not be too presumptuous, especially as explained earlier with water from the Euphrates being a vital economic resource for most of the communities in the northern region.

More threats to life on land could be observed in northern Syria. Boloorani et al (2021) conducted a study on water bodies changes in the Euphrates basin. The study draws a general conclusion that the dried beds of water in the Euphrates are producing large dust emissions in the region surrounding it. Dust storms in the arid regions of Syria including the north, impact different components of the earth system, including atmospheric absorption, surface and groundwater quality and soil formation processes. Changes in water bodies in the Euphrates mean that the water bodies become highly susceptible to wind erosion and consequently lead to dust emissions. The various human-related activities including deforestation, dam construction, and the overall mismanagement of water resources have led to the reduction of quality and quantity of the Euphrates River and as a result the disruption of the ecosystem in the entire surrounding area (Boloorani et al, 2021). Indeed, the Euphrates drying up has a direct impact on the increase of dust storms that further disturb the ecosystem of the area.

5.2 Discussion

The data collected in northern Syria shows that water interacts in complex ways with all the pillars of development. Water as such is a commodity that has high value for drinking and sanitation, however, in agricultural societies such as that of north Syria, water transcends its value as a commodity and becomes something far greater, a key resource that is at the heart of development in the region. Relying back on the Water, Energy, and Food (WEF) Nexus and as the data have

shown in the analysis section, an understanding of water scarcity and development must be multidimensional and must take into consideration other aspects such as energy and food. With the data collected from the analysis section, this discussion section can examine the process of development utilising the WEF nexus approach with water resources at the core as illustrated in Figure 7.

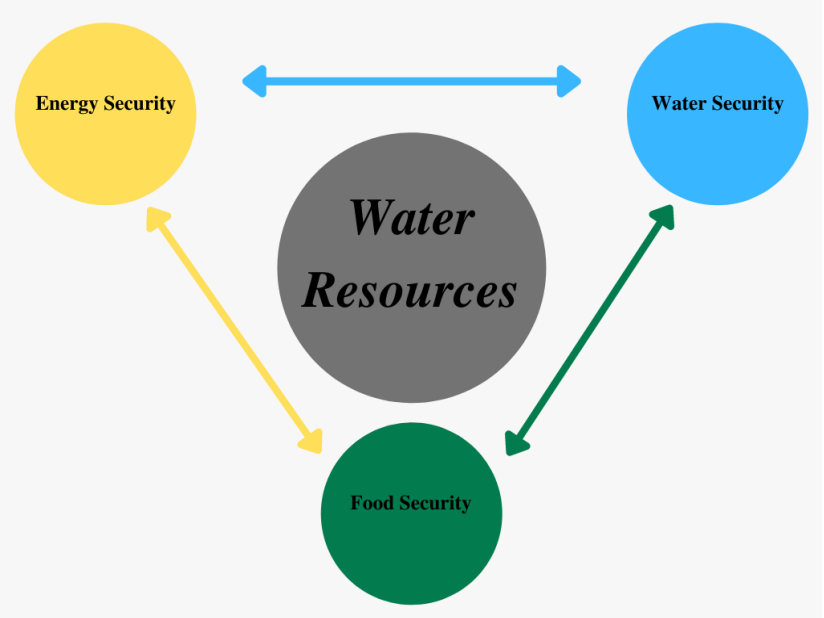

Figure 7. WEF nexus with water resources at the core. (Author illustration)

Water resources impact all components of the WEF nexus. Through the analysis of the SDGs and water scarcity, this study provides a discussion on food security, water security, and energy security. The security of these three concepts of the WEF nexus is vital for the process of development in any region. (Bazilian et al, 2011; Pittock et al, 2013; Bizikova et al; 2013; Weitz, 2014). This means that insecurity in any of the main components of the nexus consequently threatens the process of development. The data already gathered on the SDGs will be used to discuss the nexus main components and the aspects of security.

Starting with energy security, as Bizikova et al (2013) explained earlier in Table 1, to meet energy security there must be elements of (1) continuity of energy

supplies relative to demand, (2) physical availability of supplies, and (3) supply sufficient to satisfy demand at a given price (Bizikova et al, 2013). However, with the data collected and analysed from the SDGs and water scarcity in northern Syria, there are evident struggles in meeting energy security. Data collected on water scarcity and SDG 1 for instance, showed that due to the water shortages in the Euphrates, the population in the north have lost a significant amount of their economic income. The northern population that is known for their agriculture production that provides for the entirety of Syria were directly impacted by the water shortages in the main river and their economic situation has further deteriorated (PAX 2022; Pawson, 2021; Suleiman & Hackman, 2021). This has meant that the population of the north were incapable of meeting element number (3) of energy security. Moreover, by examining the data collected on SDG 6, there is an evident issue in water availability in the northern region of Syria, this corresponds to element (2) of energy security, as energy in the north comes mainly from water-powered generators. Finally, data from SDG 7 and water scarcity show that northern Syria is highly dependent on renewable energy from the dams on the Euphrates River. This is especially true after the destruction of three main fossil-fuel-run power plants in the north (Hatahet & Shaar, 2021). Meaning that with the recent water shortages in the Euphrates, energy was directly affected as most of the north was left with only 5 hours of electricity a day, affecting the continuity of energy supplies relative to demand (element 1). By utilising the data on SDGs (1,6,7) and water scarcity in northern Syria in relation to energy security elements, the data shows an evident struggle for northern Syria to meet the main elements of energy security. See Table 2 for a simplified illustration of the SDGs and the corresponding security elements.

Table 2. Shows Issues that correspond to the Sustainable Development Goals (SDGs) and the element of energy security that these issues affect.

Data from SDGs and Water Scarcity	***Elements of energy security***
Issues of SDG 1: Economic hardships and poverty	Element (3): Supply sufficient to satisfy demand at given price
Issues of SDG 6: Decrease in physical water in the river	Element (2): Physical availability of supplies
Issues of SDG 7: Decrease in renewable energy (lack of electricity)	Element (1): Continuity of energy supplies relative to demand

For the food component of the nexus, four elements must be applied to achieve food security. (1), food availability (production and distribution of food), (2), access to food (affordability, allocation), (3), utilisation (nutritional value, food safety), (4), food stability over time (Bizikova et al, 2013). Data collected on water scarcity and SDGs (1,2,3 and 7) in northern Syria, provides an analytical lens into the concept of food security. Starting with SDG 1, and as explained earlier, the decline in agriculture production has led the northern population into further economic poverty, making element (2) access to food particularly difficult as households struggle to afford food. Economic hardships caused by water scarcity also affect element (1) food availability and production. The collected data on SDG 2 and water scarcity reflect strong links with food insecurity. This could be seen for example, in the significant wheat and barley production decline that affects the element of food availability (1), keeping in mind that barley and wheat are essential products in the diet of the Syrian people (OCHA 2021; WFP, 2021b). Moreover, the farmer's inability to prepare for the next season of harvest also affects element (4) of food stability over time (ibid). Furthermore, analysed data on SDG 3 and water scarcity show that the adults and children face issues of malnutrition due to the severe water scarcity conditions, this corresponds to element (3) of food utilisation and nutritional value (UNICEF, 2021). Finally, data

collected on SDG 7 and water scarcity shows that the lack of water effectively meant a lack of energy to operate agricultural facilities and technologies, suggesting further the inability to produce food (element 1). The data collected from the SDGs 1,2,3 and 7 with regard to water scarcity shows a clear and a grim picture of a region that is unable to meet any elements of food security.

Table 3. Shows issues that correspond to the Sustainable Development Goals (SDGs) and the element of food security that these issues affect.

Data from SDGs and Water Scarcity	***Elements of food security***
Issues of SDG 1: Economic hardships and poverty	Element (1): Food availability (production) Element (2): Access to food (affordability)
Issues of SDG 2: Decrease in agricultural production SDG 2: Farmers' inability to prepare for the harvest of the next season (health and economic conditions)	Element (1): Food availability (production) Element (4): Food stability over time
Issues of SDG 3: Issues of malnutrition.	Element (3): Food utilisation (nutrition value)
Issues of SDG 7: Lack of energy	Element (1): Food availability (production)

Finally, the water component of the nexus. For this component, security means meeting the elements of (1) water access, (2) water safety and (3) water affordability. With an emphasis as well on the protection of the natural environment (Bizikova et al, 2013) The collected data from all the SDGs relates to water security, especially since the data was collected with a focus on water scarcity. Element (3) of water affordability corresponds with data collected on SDG 1 as it shows that the population of northern Syria struggle to afford water supplies (from water trucks, or wells digging) (WASH, 2021; Pawson, 2021).

Moreover, issues of water safety (element 2) are seen in the collected data on SDG 3. Indeed, a reduction in the flow of the Euphrates River, as well as unfiltered local wells, resulted in dire health conditions for the population in northern Syria (Laffert & Sala, 2021; Souleiman & Hackman, 2021; REACH, 2021). Moreover, data collected from SDG 15 shows multiple threats to the natural environment in the shape of oil leaks in the Euphrates and dust storms in the region surrounding the river (Boloorani et al, 2021; North Press Agency, 2022a).

Table 4. Shows issues that correspond to the Sustainable Development Goals (SDGs) and the element of water security that these issues affect.

Data from SDGs and Water Scarcity	***Elements of water security***
Issues of SDG 1: Economic hardships and poverty	Element (3): Water affordability
Issues of SDG 3: Water-related diseases (caused by the decrease in river flow as well as unfiltered local wells)	Element (2): Water Safety
Issues of SDGs 1,2,3,6,7 and 15 display data on water scarcity in northern Syria.	Element (1): Water access
Issues of SDG 15: Oil leaks in the Euphrates River and dust storms in the surrounding area.	Conserving the natural environment.

Indeed, the data collected on water scarcity and SDGs 1,2,3,6,7 and 15 has shown systematically how water, food, and energy security cannot be met in northern Syria. All components of the WEF nexus have shown to struggle with insecurity caused by water scarcities. This is especially alarming given the nature of the WEF nexus with the components being interlinked. This means that for instance, water insecurity in northern Syria can cause food insecurities, energy insecurities

or both. A nexus system with all its components suffering from insecurities is bound to have negative trade-offs between the components, leading to what can look like a cycle of negative events.

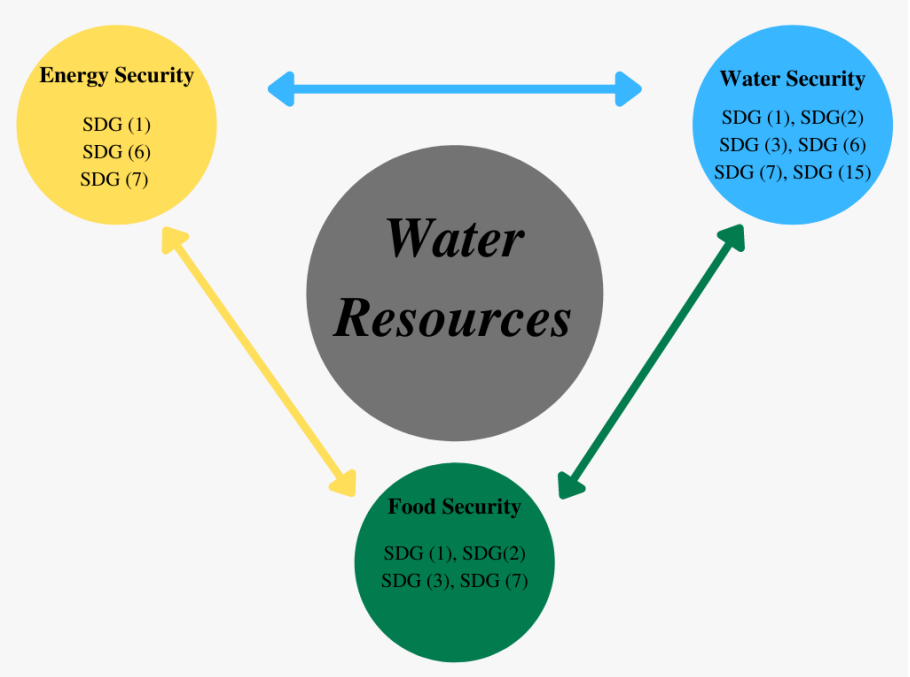

Figure 8. WEF nexus approach with water resources at its core and relevant SDGs allocated to each security discussion.

Another important aspect to discuss is the SDGs themselves. With less than a decade to 2030, it is important to assess the status of the SDGs and to examine realistically how achievable they are in northern Syria. The selected SDGs were examined from the perspective of water scarcity, meaning that concepts such as poverty, hunger, health, energy and natural ecosystems were all studied under the lenses of water scarcity. In other words, to see how the current severe water scarcity crisis in the northern part of Syria interacts with the main drivers for development. The findings from each selected SDG were alarming at best.

For SDG 1: No Poverty, World Bank data and Multidimensional Poverty Index (MPI) data show severe poverty in Syria and specifically in the northern region,

this meant that the process to achieve SDG 1 was already challenging in the northern region but adding the recent water scarcities to the equation has made the situation disastrous. This is especially true given the north's population dependency on agricultural production as their main source of income. Similarly, for SDG 2: Zero Hunger, multiple reports have shown the northern region to suffer from food insecurities, especially as the production of wheat and barley has been significantly affected by water scarcities. Soil erosion coupled with drought-like conditions has resulted in crop yield failures on a large scale in the north affecting food production for both consumers and producers.

As for SDG 3: Good Health and Well Being and 6: Clean Water and Sanitation, northern Syria has shown a deterioration in health conditions that correspond to the 2021 water scarcity in the Euphrates. Diarrhoea, lung problems, stomach diseases and Covid-19 were more prominent in the second part of 2021 in comparison to the same time of 2020, showing multiple direct links between negative health conditions and the water scarcities in the Euphrates. In regards to SDG 7: Affordable and Clean Energy, electricity from Syria’s three largest dams was reported to have witnessed a decrease of two-thirds of its generation potential. Data shows that electricity availability was drastically decreased in a similar time frame to that of water flow reduction in the Euphrates River, leaving the north region with only 5-6 hours of electricity a day.

Finally, SDG 15: Life on Land, shows that the natural environment around the Euphrates River was highly impacted by the 2021 water shortages. The deterioration of the economic conditions in the region has incentivised an increase in oil production to compensate for income lost as well as to compensate for renewable energy lost (from hydropower). This increase in production was accompanied by an increase in oil waste and leaks in the Euphrates River, contaminating large parts of the river. The oil production increase was also followed by oil smuggling operations to government-controlled areas across the river; such illegal operations have resulted in many oil leaks over the river.

Moreover, the newly dried areas in the Euphrates River have been argued to cause wind erosion and consequently dust storms in the entire surrounding area of the river.

Before concluding on water scarcity and development, and the SDGs and their possible achievability in 2030, an important emphasis must be placed on the origin of water scarcity in northern Syria. While all the data is collected on the physical water scarcity in the area (Supply problem), it is essential to highlight that the origins of such recent physical water scarcities are largely associated with human interventions and water mismanagement (Demand problem). This is indeed important as the data collected could be viewed through a singular lens of physical water scarcity, however through the lenses of political ecology and realism, and based on an extensive literature review on water resources in Syria, it is evident that the origins of the 2021 water scarcities in the Euphrates are on the demand aspects. Indeed, decades of water mismanagement by the national Ba'ath party has permanently and negatively affected the soil and the groundwater reserves in Syria. Moreover, Turkey, the upstream country, has continuously enforced its role as a hydro hegemon on the Euphrates River. Various reports accused Turkey of playing a vital role in the 2021 water scarcities in the Euphrates River. Nonetheless, this study does not aim to find the exact origin of the recent water struggles, however, it can instead pinpoint that these scarcities are largely due to human intervention and therefore any future solutions for water scarcities in northern Syria, should indeed treat the water scarcities as a demand problem.

6. Conclusion

This study has provided a comprehensive overview of the water scarcity implications in northern Syria. Triggered by the 2021 critical water shortages in the Euphrates River, this study sought to examine the process of development in the northern part of Syria with water shortages at the core of the analysis.

This study aimed to explore *what are the implications of water scarcity on development in northern Syria.* as well as to examine a selection *of Sustainable Development Goals (SDGs) and assess their achievability in the same geographical location*. The SDGs had multiple uses in this study, first: the SDGs provided descriptive codes to assist the processes of data reduction and data display and second: the SDGs provided a conceptual framework for the main concepts involved in the development process, concepts such as poverty, hunger, health, energy, and nature preservation. Data collected on each of the selected SDGs 1,2,3,6,7 and 15 were used to assess water scarcity and development in northern Syria.

The findings of this study demonstrate that water scarcity has decisive implications for the development of northern Syria. The Euphrates water crisis has affected all aspects of the population living in the northern part of Syria. The data shows that the largely agricultural provinces of the north will suffer further extreme economic hardships caused by the reduction in the Euphrates flow. The already poverty-ridden region has reported a large loss of income sources in 2021 due to water scarcity. Food production is also reported to have been largely disturbed by water scarcity, leaving the population suffering from food-related struggles. Moreover, data suggest that severe negative health conditions were associated with the Euphrates water shortages. Further issues were also concluded regarding energy and the natural ecosystems in the northern part of Syria. Energy production from the hydro-power dams on the Euphrates was severely affected

and the dams are alarmingly close to shutting down due to lack of water flow. Finally, the analysis also reveals that the natural ecosystem in northern Syria is under real threat of sandstorms and water contaminations, both of which are caused by the Euphrates water shortages.

While the above findings alone reflect the massive implications of water scarcity on development in northern Syria, further discussion of the data using the WEF nexus approach provides a different angle on what constitutes development, however, concluding the same results. Using the data inputs from the SDGs to assess WEF nexus concepts of water, energy and food security shows that due to water scarcities, northern Syria is unable to fully meet any component of security in the nexus approach. Meaning that northern Syria could be described as food, water, and energy insecure. The findings of this study draw a strong conclusion about the importance of water resources to the development of the northern part of Syria. While water could be argued to be part of any development process, this study suggests that in northern Syria water availability and successful management is simply essential to development. In simple words, no water, no development. The findings of this study are alarming, to say the least, the 2021 water shortages threaten the lives of millions and hinder any possible development in the region. Further studies should take into consideration these findings on water scarcity when discussing any development plans for the northern part of Syria. Moreover, a theoretical understanding of political ecology (PE) water scarcities in Syria has historically been attributed to human interventions in nature. As for the possibility of achieving the SDGs in northern Syria by 2030, the data suggest that water scarcity hinders any progress toward the selected SDGs 1,2,3,6,7, and 15. If the current trends of water availability continue, the region has no possible path toward achieving the SDGs, in fact, the current water crisis threatens the entire area to regress toward disastrous living conditions.

6.1 Suggestions for further research

For further studies, identity could be interesting to study in relation to water scarcity. identities such as political affiliation, ethnicity, or religious sect could all be examined in regard to the distribution of scarcity. For instance, current provinces with severe water scarcity are either administered by the ethnically Kurdish government, or by the Syrian opposition government. Identity has played an important role in the conflict since 2011 and therefore it would not be surprising if identity motivated different trends of water scarcity distributions. More studies could also be conducted with different geographical scopes, for instance, Iraq was not mentioned in this study, however, Iraq is also a beneficiary of the Euphrates River and arguably the country with the least water shares from the Euphrates River. Lastly, while this paper provides an overview of water scarcities in Syria, it does not conduct a systematic study on the origins of such scarcities, especially regarding the Euphrates Water flow reduction. Given the critical impacts of the 2021 water scarcities, a systematic analysis of the origin of this new water development could provide insightful data in the discussion on water scarcity.

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