SITUATION OVERVIEW

Current Situation of the Water Crisis in Northeast Syria and its Humanitarian Impacts

July 2023 | Northeast Syria

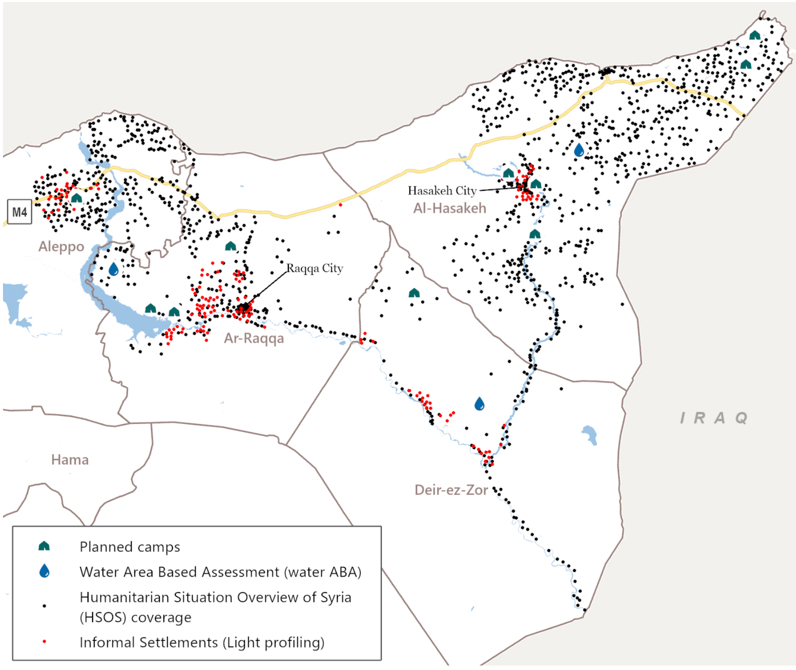
CONTEXT & RATIONALE

Water has always been scarce in Syria, but it has always been available. In Northeast Syria (NES) in particular, people have long benefited from the Euphrates River, from groundwater, and higher rainfall levels at the northern border. However, in recent years, all of these resources are in decline: Euphrates dams have faced unprecedented lows in water levels,[1] groundwater reserves have fallen below anything seen in 20 years of data,[2] and over the past three years, rainfall in the whole region has been lacking.[3] This would be concerning under any circumstances. However, given more than a decade of conflict in Syria, the country is in a challenging position to respond to the ongoing water crisis and protect itself against future dry periods.

This situation overview is split into five separate sections. After the introduction, the second provides insights into the drivers of the water crisis. The third looks at the regional humanitarian situation, and is complemented by a zoom-in on local assessments shown in section four. The final section gives insights into ways forward.

ASSESSMENT COVERAGE

Locations assessed in the four key data collections included in this report



KEY MESSAGES

Primary water sources have remained largely the same over the course of the water crisis despite unprecedented lows in Euphrates and groundwater levels. This is most **likely due to the success of humanitarian interventions**, though severe gaps in WASH systems persist.

The **risk of waterborne diseases spreading is high** due to the lack of appropriate sewage management and households' reliance on untreated water sources. This puts Northeast Syria at a **risk of a second wave of cholera** during the summer.

Agriculture across much of NES appears to be recovering after 2 years of failed harvests. However, large parts of Al-Hasakeh governorate are still showing signs of poor crop health.

Food has become unaffordable, due in part to local production shortfalls. Households are skipping meals and reducing meal sizes to cope.

Looking ahead, **water scarcity is likely to become more severe**. While humanitarian actors are already implementing programs to mitigate the impacts, **sustainable action at all levels will be necessary to adapt to the changing climate**.

North East Syria Sector (NES) FOOD SECURITY & LIVELIHOODS Agriculture Working Group
WASH Working Group North East Syria
REACH Informing more effective humanitarian action

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METHODOLOGY OVERVIEW

This report uses a wide range of data sources.

In terms of primary data, this includes publicly available **remote sensing data** which provides information on rainfall, groundwater levels, and vegetation health.

Additionally, many of REACH's regular humanitarian assessments are incorporated. This includes the **Humanitarian Situation Overview in Syria** (HSOS), which interviews key informant (KI) each month about the humanitarian situation in their communities using a structured questionnaire. Multiple KIs are interviewed in each community, with each KI answering questions on a different sector according to their expertise. In April 2023, this included 1,323 communities with 4,775 KIs. A similar assessment is run three times per year in informal settlements and collective centres (**Light Profiling**). In March 2023, 183 sites were assessed.

Please note that due to the KI methodology, both of these assessments are indicative of the humanitarian situation in assessed locations, but do not represent the situation of all people.

Data on prices comes from REACH's monthly **Joint Market Monitoring Initiative** (JMMI). In this assessment, vendors are interviewed about the availability and prices of the basic goods they sell. In May 2023, 1,865 vendors were surveyed.

REACH's local assessments are also included here. This includes the **HSOS Urban Household Assessment**, which represents the situation of the average resident in Al-Hasakeh and Ar-Raqqa cities respectively. The **Full Profiling** is an assessment of internally displaced people's camps conducted quarterly in eleven larger camps in NES. The Full Profiling includes KI interviews, a representative households-level data collection, and a mapping exercise. Finally, the **water Area Based Assessments** (water ABAs) were run in three locations in NES and included extensive focus-group discussion with various groups of people involved in the local water management systems.

In addition to existing REACH assessments, 24 NES response actors joined **three workshops** (Focus Group Discussions) in June 2023 to speak about the water crisis, how humanitarian actors have responded so far, and which opportunities and barriers exist for the future. These sessions were conducted in English, excluding Arabic or Kurdish speaking response actors. This forms a key gap in this assessment.

The aforementioned data sources were complemented by a **secondary data review**. This includes a review of news articles, reports by humanitarian actors, and academic papers. For the full list of references, please see the endnotes.

For more information on REACH's assessments, and to review the Terms of Reference for this analysis, please consult the Resource Centre.

Data Reference Guide

HSOS	Humanitarian Situation Overview in Syria
LP	Light Profiling (informal settlements and collective centres)
JMMI	Joint Market Monitoring Initiative
FGD	Focus Group Discussions

SECTION 2 - Crisis Drivers

In 2021, the water crisis in NES shifted in multiple ways. Technical actors began to report precipitation shortfalls in Syria and Iraq.[1,2,3] At the same time, water levels in the Euphrates, Syria's largest river and a key source of water and electricity in NES, dropped off.[4,5] To add to this, the Alouk water station stopped functioning multiple times, impacting the water supply of around one million people in NES.[6,7] NGOs then began to report on the humanitarian impacts of this water crisis, publishing analytical reports[8,9,10] and advocacy pieces[11,12,13,14] as traditional media began to pick up on the crisis.[15,16,17] Two years have gone by since then, with both years having shown extremely low wheat harvests,[18,19,20] and historically low levels of rainfall, groundwater, and Euphrates River flows (see below).

Rainfall levels have been below average during the past three years.

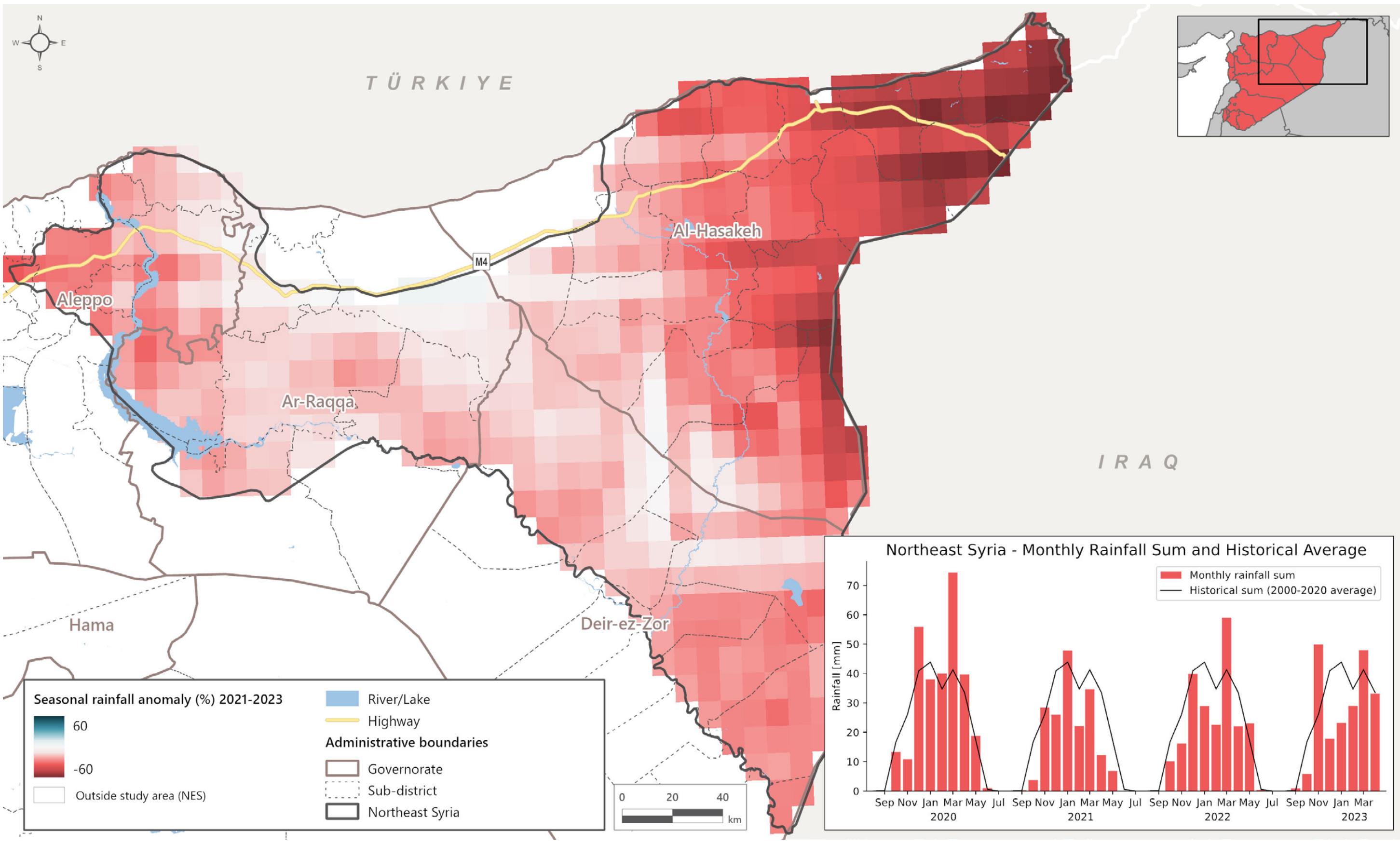
Map 1 shows the average seasonal rainfall anomaly from January 2021 to May 2023. It shows clearly how dry these seasons were. Within NES, this particularly concerns Al-Hasakeh governorate. The governorate generally has higher precipitation levels than the south and west of NES, but has seen up to 60% less rain over the past 3 years. The graph additionally shows monthly rainfall. The 2019/20 winter season was close to average, whereas the winter seasons since then showed unusually dry conditions. The most recent winter rainfalls, with the exception of November 2022, were shifted towards the end of the agricultural season (March-April).

Looking at regional rainfall patterns is important when considering river flows and groundwater. The Euphrates River, for instance, derives the vast majority of its water from precipitation in the Armenian highlands in Türkiye.[21] As such, it has been severely impacted both by the current shortfalls in precipitation, but also by the long-term trend of decreasing rainfall. It is estimated that water in the Euphrates had already reduced by around a sixth by the 2010s due to a combination of climate variability, increased droughts, and increased water usage.[21] In the current dry period, the Euphrates dams in Syria have reached previously unseen lows,[22] and operations at Tishreen hydropower dam were suspended for a week in March as water levels reached their lowest point since construction.[23] Studies have further estimated that due to climate change, water levels will continue to decrease strongly.[a,24] As such, sustainable solutions will be needed to cope with reduced water flow, but also with the associated deterioration in water quality.[25]

Groundwater levels have been significantly decreasing across the past 20 years, reaching a 20-year low in 2021/22.

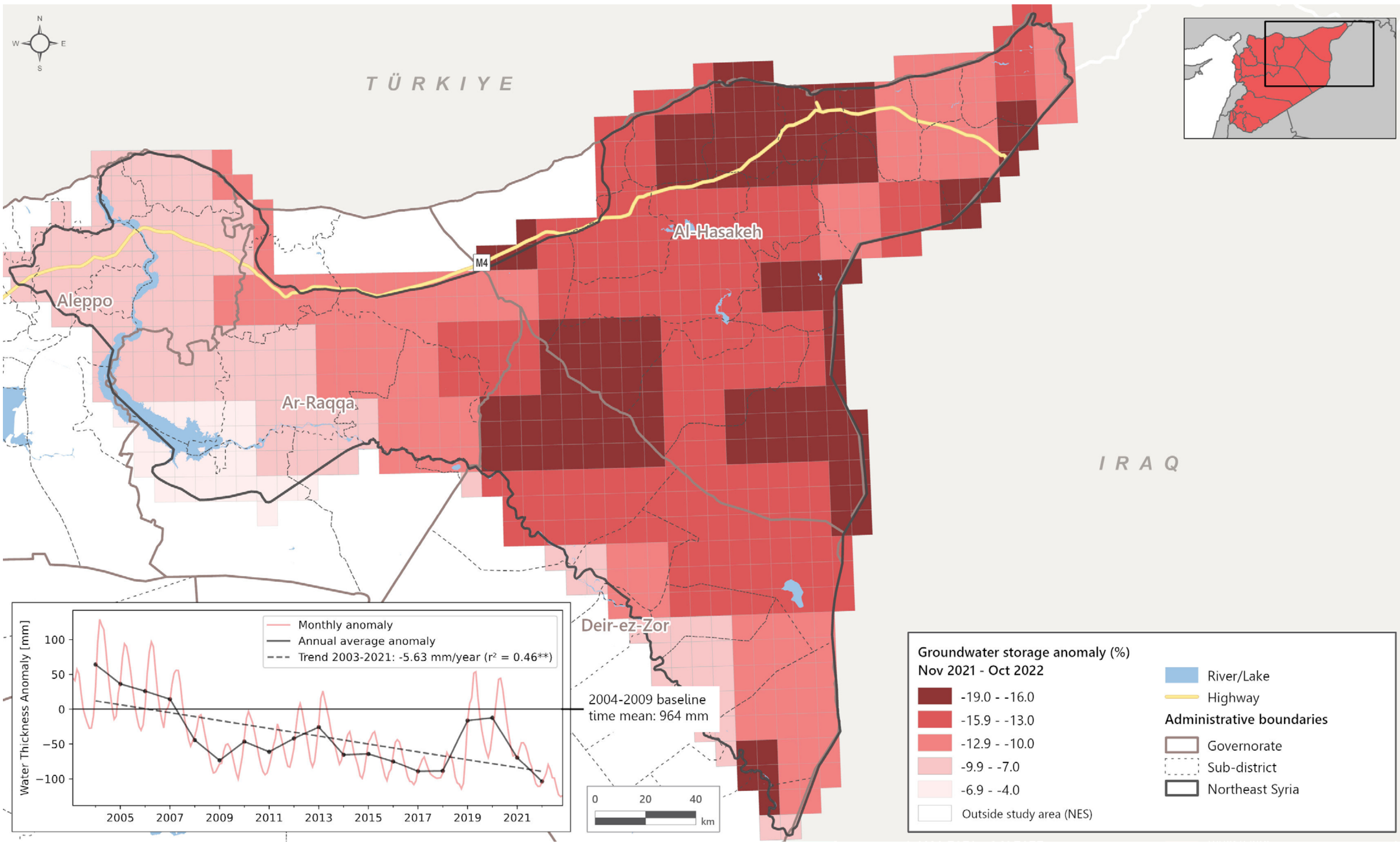
Similarly, much of the groundwater in NES comes from rainfall in Türkiye.[26] It, too, is severely impacted by rainfall shortages. Looking at how monthly rainfall and groundwater levels in the area compare, data suggests a significant relationship between rainfall over the past 2-5 months and current groundwater levels across much of NES. As such, the dry conditions in the region over the past three years led to drastically reduced

Map 1: Seasonal Rainfall Anomalies, Averaged Over January 2021 to May 2023[i]



[a] The amount of water is expected to reduce by 30-70% by the end of the century compared to the 1970-2000 period.

Map 2: Groundwater Volume From November 2021 to October 2022 Compared to the Long-Term Average[ii]



groundwater levels. Map 2 shows the latest available data, from November 2021 to October 2022, for the amount of groundwater compared to the long-term average. Groundwater across the whole of NES was low, with some areas seeing almost a fifth less groundwater than usual.

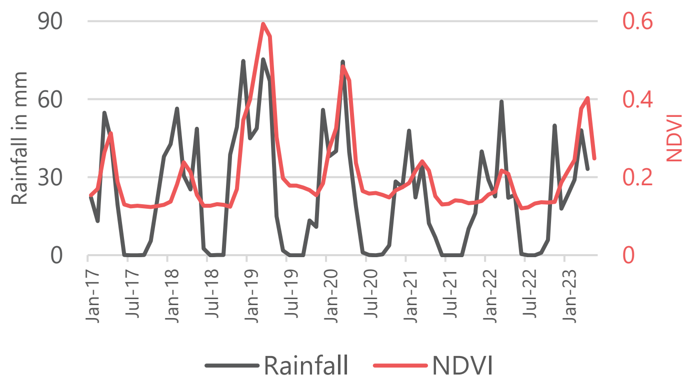
The graph highlights two things. Firstly, that groundwater is seasonal, with substantially lower water levels in the summer months than in the winter. Secondly, the past 20 years for which this data is available indicate that the amount of groundwater has been decreasing. Many factors contribute to this, notably intensive usage of groundwater for agriculture as well as natural factors such as changes in precipitation. These same factors have also contributed to a deteriorating quality of groundwater, including increased salinity,[26] making groundwater less suitable for drinking and agricultural purposes.

Given the importance of groundwater in NES, both for domestic and agricultural purposes, it is essential to better understand the dynamics of groundwater use and recharge. However, this would require a large amount of field-level data over a long time frame, which are currently unavailable. In the absence of this, sustainably managing groundwater sources becomes exceedingly difficult. The WASH Working Group, for instance, raised concerns about the lack of alternatives to Alouk water station, which has been largely out of operation since August 2022. Many of the private tanker trucks supplying households in Al-Hasakeh in the meantime are currently relying on unregulated boreholes in the Shamouka area, which are at risk of depletion.[a] Feasibility studies are needed to identify suitable alternatives.[27]

Crop health has suffered from the rainfall deficits, but appears to be recovering this season.

NES is referred to as Syria's "bread basket" due to its high levels of wheat production, but water deficits have dimished agricultural production. Most directly, this affects rainfed crops. However, irrigated crops may also be impacted due to reduced access of farmers to surface and groundwater, and the increased cost of extracting these. Figure 1 shows the relationship between rainfall and the Normalised Difference Vegetation Index (NDVI) on cropland. NDVI is a measure of how green vegetation is and, as such, gives an early indication of how agriculture is performing. Cropland turns green with a slight delay after the onset of rainfall, and higher rainfall levels are associated with much higher levels of NDVI.

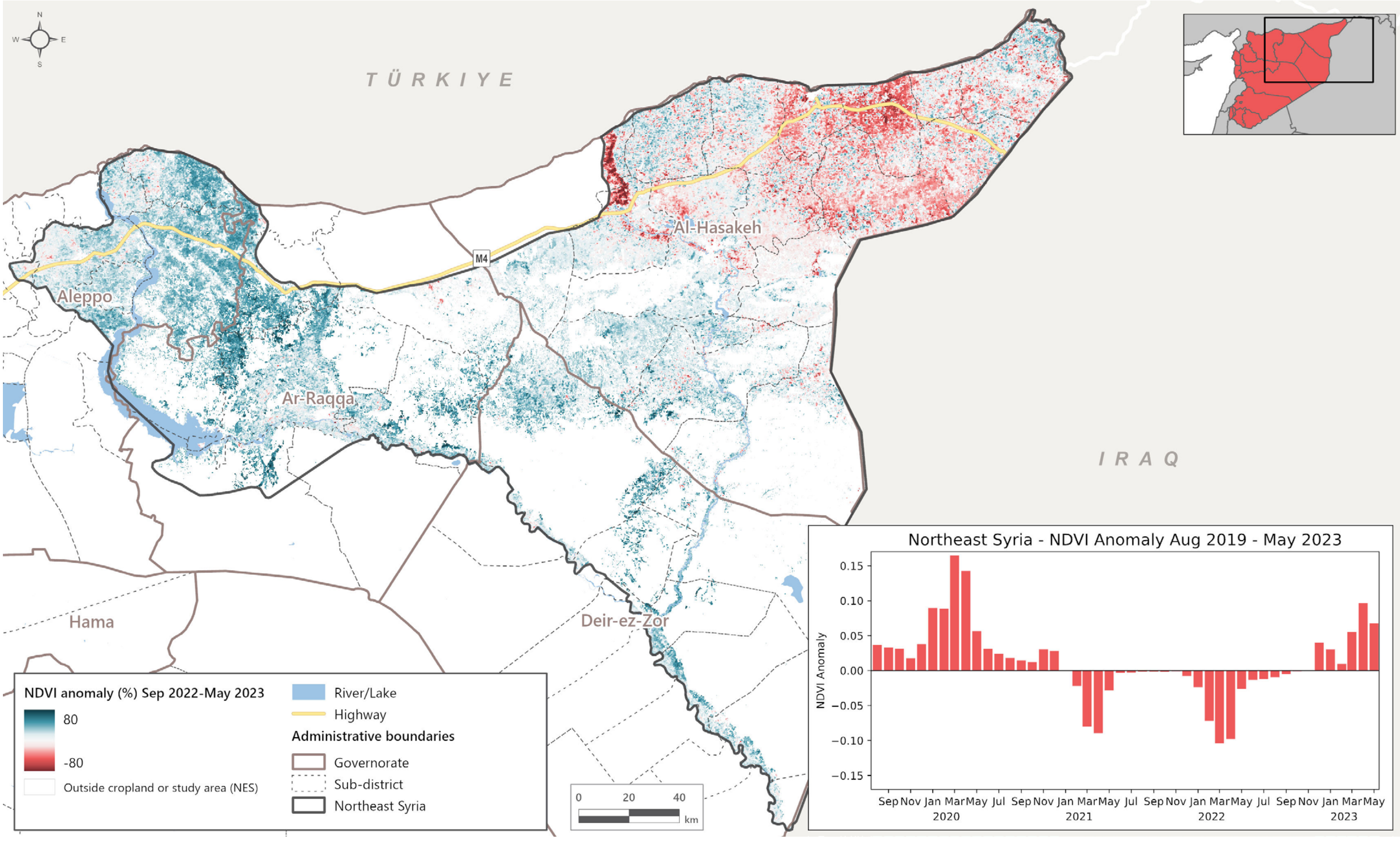
Figure 1: Monthly Rainfall and NDVI between January 2017 and May 2023



[a] Private vendors also use Tel Azan water station, which relies on a deeper aquifer at a lower risk of depletion. However, this station is 40km away from the city.

Looking at the current agricultural season (2022/23), cropland was much less green than usual in the eastern part of Al-Hasakeh governorate, while the situation looked normal or better in the rest of NES (map 3). While the post-harvest survey will be needed to make any definitive statements about this year's harvests, both this data as well as news reports[28] and information from REACH's FGDs provide a hopeful indication that this year's harvests may be better than in the previous two years.

Map 3: Vegeatation Health (NDVI) on Cropland in September 2022 to May 2023 Compared to the Long-Term Average[iii]



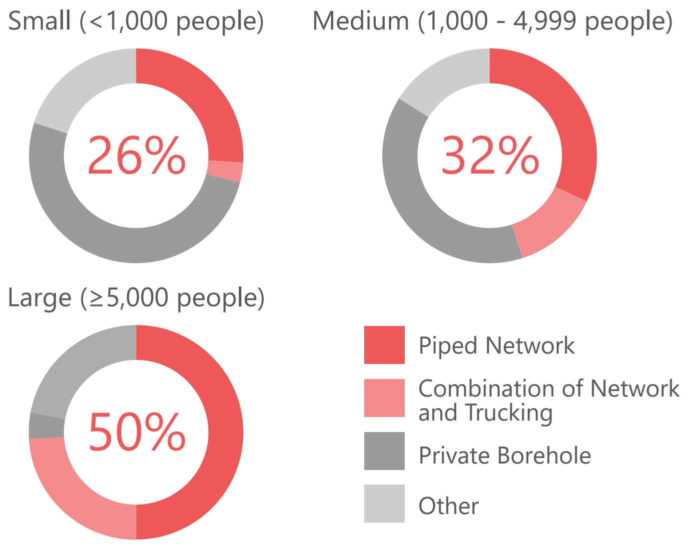
SECTION 3 - Regional Impacts

3.1 Domestic and Drinking Water

Large communities depend strongly on the piped water network, and households in these communities tend to have access to more and safer water.

In NES, communities with at least 5,000 inhabitants are often reported to rely on piped water networks.[a] These communities appear to have had fewer problems with water insufficiency – in over half of them, key informants (KIs) reported that all households had enough water. In comparison, in communities relying on other sources of water, only around a quarter of KIs reported that households had sufficient water (see figure X). Additionally, where the piped water network was reportedly the main source of drinking water, KIs were less likely to mention any problems with water quality.[b,HSOS]

Figure 2: Primary source of water for all purposes by community size (as reported by KIs in assessed communities)[HSOS]



[a] In April 2023, 50% of assessed communities with 5,000 people or more saw KIs reporting the piped network as the main source of water for all domestic purposes. For communities with less than 5,000 people, 28% were connected. Community size estimates were taken from the Humanitarian Needs Assessment Programme (HNAP); neighbourhoods in Quamishli city were estimated to have 13,000 people, the average for HNAP's Quamishli neighbourhoods. 11 communities without HNAP estimates were excluded.

[b] In 80% of communities where KIs reported the main network as the primary drinking water source, they reported no problems with drinking water. The only other common source where this was similarly high was free community boreholes (71%).

However, the functionality of the network is limited. Besides conflict-related damage to the infrastructure, the ongoing energy crisis and low water levels have had severe impacts.[1] The reduced water flow in the Euphrates decreased the amount of available water, but also reduced electricity generation at the dams.[2] This doubly impacts water services, particularly for those stations not connected to service electricity lines.[a] The WASH Working Group has done extensive work to ensure the continued functionality of these stations, with FGD participants indicating that this was a key factor in keeping the water supply stable.[FGD,3] Meanwhile, Alouk water station, which would under normal circumstances service around one million people in NES, has remained largely offline since August 2022.[4] Households in Al-Hasakeh city, which would usually rely on the network supply from Alouk, have since been serviced by private, public, or NGO water trucking (see section 4).

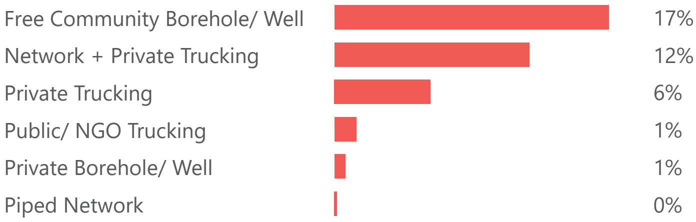
The reliance on water trucking in areas that previously relied on Alouk is evident when looking at map 4 and map 5, which show the primary source of water for all purposes and for drinking respectively. Visible in the centre of the map in light blue are the communities around Al-Hasakeh city which reportedly relied on private or NGO water trucking. The maps also show two areas with higher reliance on the water network, indicated in green, those being in Ar-Raqqa and the north of Al-Hasakeh.

In terms of network quality, water monitoring conducted by the WASH Working Group following the cholera outbreak in September 2022[5] shows that water in the piped network did not always contain Free Residual Chlorine.[6] This suggests that the amount of chlorine used to make the water safe for drinking was insufficient, making it vulnerable to contamination with pathogens.[7]

Private water trucking is an alternative or supplement to networks, providing often unregulated water at a higher cost.

Private water trucking is often reported as a source of water for domestic purposes.[HSOS] However, response partners express concerns about the safety of trucked water. Private vendors are often unregulated, and thus there is no guarantee that the water is safe for consumption.[8] In communities and informal sites, KIs were somewhat more likely to report that water was perceived to be making people sick if they reported private water trucking as the main source of drinking water, which is weakly indicative of this issue (figure 3).[b,HSOS,LP] However, a clear understanding of water trucking systems, as well as water quality testing for private vendors, is missing in order to understand if, and if so how, water trucking relates to waterborne diseases.

Figure 3: Communities Where Drinking Water Was Perceived to be Making People Sick, by Primary Source of Drinking Water (as reported by KIs in assessed communities)[HSOS]



N.B. factors such as transport and storage may affect water quality

In communities where KIs reported water trucking as the primary source of water for all purposes, they tended to report higher monthly water expenditures for households. By contrast, private boreholes were associated with lower costs while the piped network was associated either with low, or with no costs to households.

Private boreholes were commonly used in small communities for domestic purposes, but usually were not used for drinking water, possibly due to the low quality of groundwater in these areas.

While the piped network and private trucking were the most commonly reported sources of drinking water, private boreholes were the most widespread source of water for all domestic purposes. However, though these were reportedly the main source in almost half of all assessed communities, this only corresponds to around 16% of the population living in assessed communities[c] as private boreholes were mostly used in smaller communities. Larger communities mostly relied on the network.[HSOS]

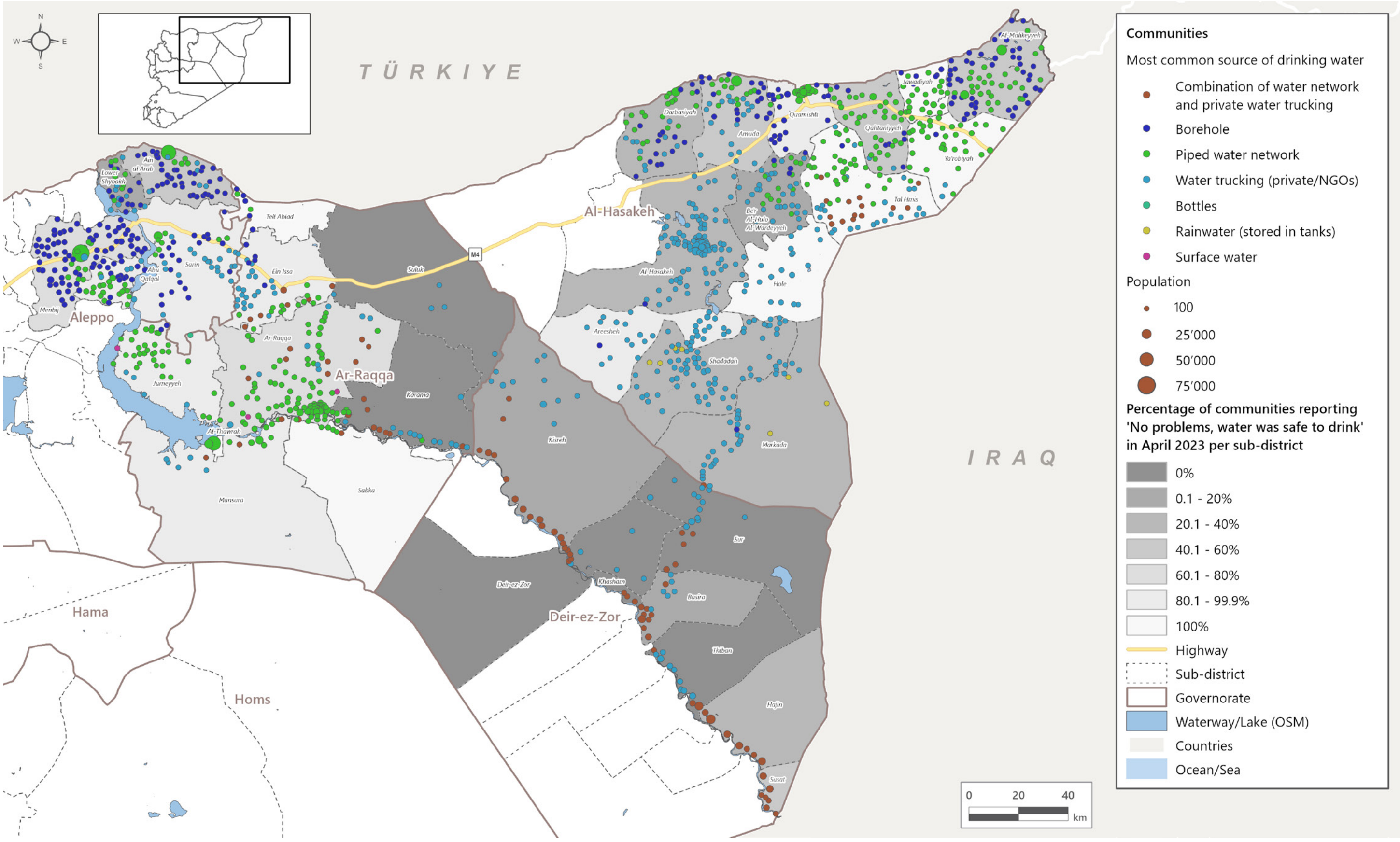
Remarkably, KIs in communities which relied on private boreholes usually reported a different source of drinking water. For instance, in Al-Hasakeh district, almost all KIs reported a different main drinking water source (most commonly private water trucking, followed by water trucking through authorities or NGOs). This stands in contrast to Al-Malikeyyeh and Menbij districts, where this distinction was not usually made.[HSOS] This may be due to the varying quality of groundwater in Syria, with some aquifers being less suitable for drinking. A large portion of groundwater in Al-Hasakeh governorate contains high quantities of salts and minerals, and the vast majority of groundwater in Ar-Raqqa and Deir-ez-Zor governorates suffer from this problem.[9] Given climate change, overextraction of groundwater, and increasing rates of minerals in the groundwater due to irrigation with untreated sewage, groundwater quality is expected to continue to deteriorate.[9,10]

[a] Service lines are designed to provide electricity to essential infrastructure for the entire day, even when the usual network sees reduced functionality. FGD participants indicated that these are working well for most of the day, though not all water stations are connected.

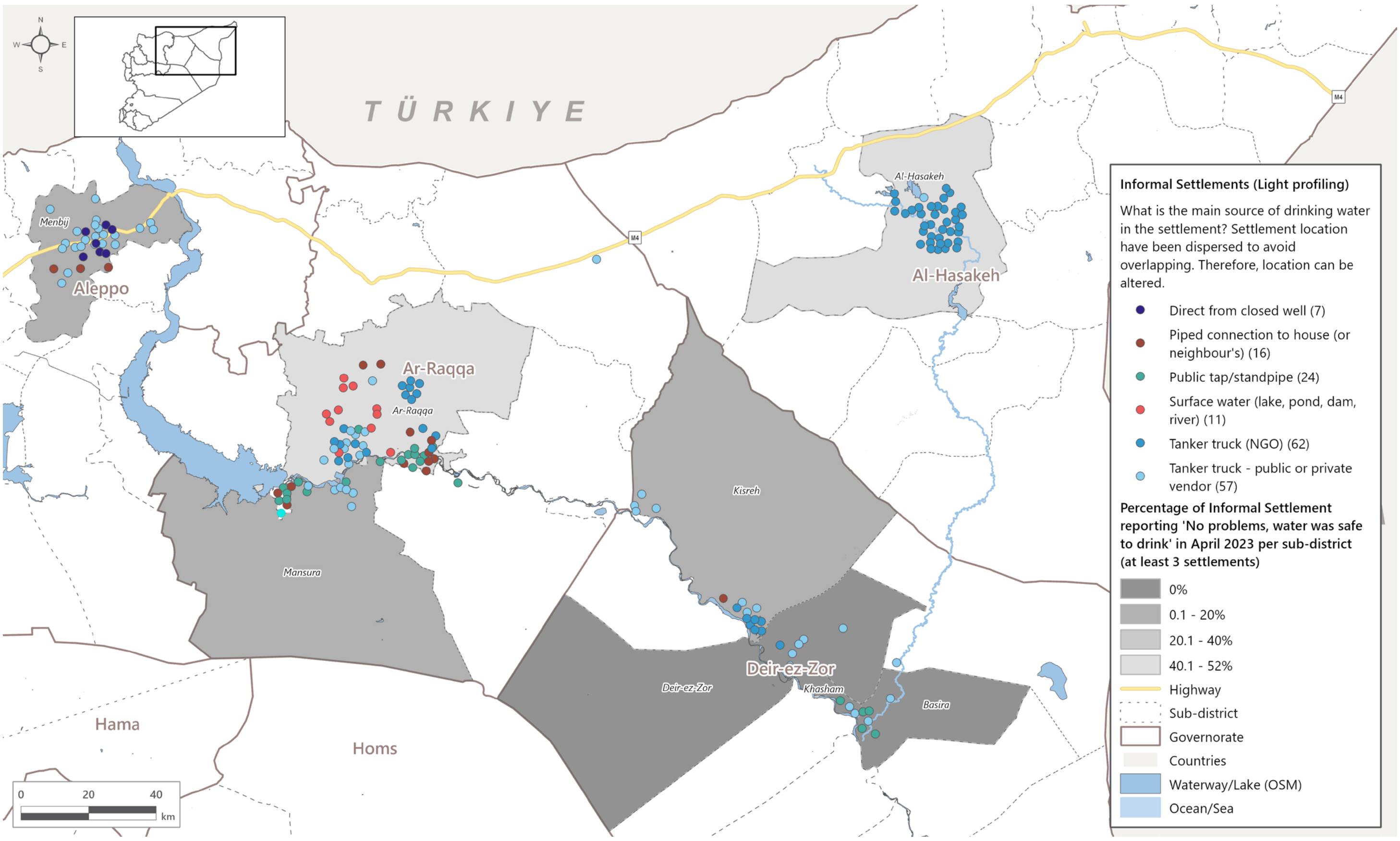
[b] In April 2023, KIs in 7% of communities in which they reported private water trucking or a combination of private trucking and the water network as the main source of drinking water also reported that water was perceived to be making people sick. For all other sources, it was 1% though free community boreholes stand out at 17%. For informal sites, in March 2023, in 23% of cases where KIs reported private trucking as the main source of drinking water, they reported that people got sick after drinking water. Note that KI information is indicative, and the reported problems with drinking water are not specific to the main source of drinking water.

[c] Community size estimates were taken from the Humanitarian Needs Assessment Programme (HNAP); neighbourhoods in Quamishli city were estimated to have 13,000 people, the average for HNAP's Quamishli neighbourhoods, since REACH uses different neighbourhood boundaries.

Map 4: Primary Source of Drinking Water in Communities, and Percentage of Communities in the Sub-district Without Reported Drinking Water Problems (as reported by KIs in assessed communities)[HSOS]



Map 5: Primary Source of Drinking Water in Informal Settlements and Collective Centres, and Percentage of Informal Sites in the Sub-district Without Reported Drinking Water Problems (as reported by KIs in assessed informal sites)[LP]



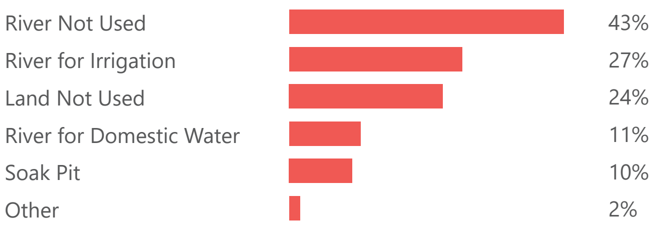
IDPs in informal sites more often relied on water trucking through NGOs or private vendors; and often relied on unsafe water sources.

Compared to communities' reliance on the piped network, private water trucking, and private boreholes, IDPs in informal sites reportedly relied most on trucking through NGOs and private vendors for drinking water.[LP] However, there are large differences in the types of informal sites in the various governorates, and accordingly there are strong differences in water sources. Most notably, in Ar-Raqqa governorate, KIs in 15% of sites (12 out of 80 sites) reported surface water as the main source of drinking water in March 2023, and another 18% as the secondary source. In most of these locations, KIs did not report any method for making drinking water safer.[LP] This means that households are highly vulnerable to any waterborne diseases or other contaminants that may be in the water.

Given the large gaps in sewage management and treatment, reliance on untreated sources of water is particularly dangerous.

The risk of contamination of surface water is particularly high due to the large gaps in sewage management. In an assessment in late 2022, KIs in around a fifth of the 1,600 assessed communities reported that a sewage network was present, with almost all larger communities reportedly having been connected. However, none of the KIs in these locations reported any form of treatment to the sewage. The WASH Working Group has also indicated that only one wastewater treatment plant in NES is currently operational, despite some response actors being in the process of developing further pilot facilities. The assessment also indicated that most networks in assessed communities discharged into rivers and streams (see figure 4). Although these were generally water resources the communities did not use themselves, this may create problems for downstream water users and the environment.[11]

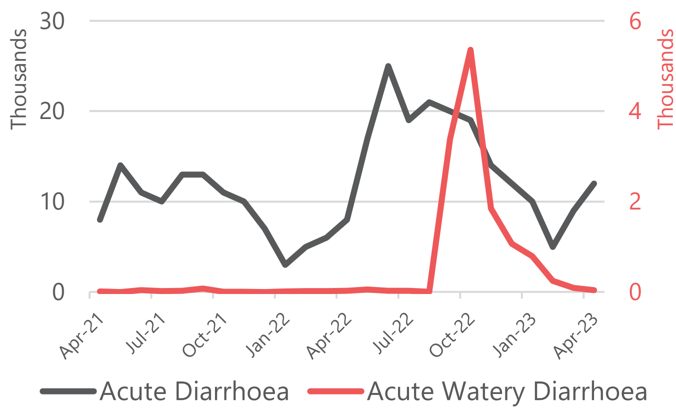
Figure 4: Locations to Which Sewage Networks Discharged (according to KIs in assessed communities)[11]



Water problems have remained relatively consistent over the past two years, though the situation tends to worsen in the hot and dry summer months.

Despite the ongoing water crisis, since early 2021, there were no substantial changes in key WASH indicators in HSOS. However, some seasonal changes can be observed. This mainly included that the proportion of communities or sites in which KIs reported that everybody had enough water decreased during the summer months,[HSOS,LP] indicating somewhat higher levels of water stress during the dry season.

Figure 5: Monthly Cases of Acute Diarrhoea and Acute Watery Diarrhoea (According to Health WG 4Ws)[12]



Furthermore, water being perceived to be making people sick was notably more common in the summer months than in the winter months.[HSOS,LP] This is supported by data from the Health Working Group, which indicates increased levels of acute diarrhoea during the summer months (see figure 5), as well as other waterborne diseases. Possible reasons for this are that higher temperatures and lower rainfall can negatively affect the quality of surface water – such as leading to higher levels of bacteria – if there are sources of pollution.[13,14] This is likely the case in NES as large amounts of untreated sewage are discharged into rivers.[11] With decreased river flows, the sewage is not diluted as much, and higher rates of water evaporation contribute to pollutants becoming more concentrated.[13] Any waterborne diseases present in the sewage would be at a higher risk of spreading. This is an issue during Syria's dry and hot summer months, but also during drought more generally.

The persistent gaps in households' access to WASH services has facilitated the spread of cholera.

Despite there being no obviously recognisable trend in waterborne diseases over the past two years, the outbreak of cholera in September 2022 indicates the severity of the WASH situation and the high risk of waterborne disease spread. Cholera causes severe acute watery diarrhoea, with high fatality rates when left untreated. Treatments for cholera are low-cost and effective, usually only requiring timely administration of oral rehydration salts.[15] Humanitarian actors also intervened to provide chlorine to water stations, truck safe drinking water to affected communities, and raise awareness for cholera prevention practices, amongst other things. With these interventions, the whole of Syria has seen over 100,000 suspected cases[a] and 100 suspected cholera deaths as of April 2023.[16] In NES specifically, almost 22,000 suspected cases have been reported, including 23 fatalities.[17] For a more sustainable mitigation of cholera, however, structural investments would be needed to ensure safe water supplies, basic sanitation, and good hygiene.[18,8] Though few new cases have been recorded since early March, humanitarian actors in NES are concerned about and preparing for a second cholera outbreak in summer 2023,[17] further highlighting the need for sustainable solutions to accessing WASH services.

[a] In terms of laboratory testing, 5,000 stool samples were tested for cholera. Of these, 20% tested positive, indicating that these were cholera cases.

3.2 Food and Agriculture

Agriculture is an essential source of food and livelihoods in NES, but farmers do not have sufficient resources to mitigate the impacts of the drought.

The population across NES heavily relies on agriculture as a source of livelihoods and food,[HSOS] with an estimated 18% of the working-age population working in agriculture.[19] However, agriculture in NES is highly sensitive to variations in rainfall (see section 2). Yet, the relationship between precipitation and vegetation health differs by area. Only the far northeast and north receive enough rainfall each year to be suitable for some rainfed agriculture. By contrast, most of Deir-ez-Zor and Ar-Raqqa governorates are unsuitable for rainfed agriculture and depend fully on artificial irrigation.[20] These areas are more likely to be affected by changes in surface and groundwater availability, as well as on costs of fuel or electricity for pumps. Map 6 shows the communities in which KIs reported a lack of water or rainfall for agriculture, and rainfall levels over the previous years. This highlights the difficult situation in parts of north-eastern Al-Hasakeh, as well as along the Khabour river.

The lack of productivity in crop production has severe consequences for the livestock sector. In March 2022, a flash report was put out to highlight the severe lack of fodder and livestock feed available to farmers, strongly linked to the reduced production of fodder and feed materials due to the water crisis.[21] Meanwhile, KIs were increasingly reporting high rates of livestock deaths – up to a peak of 41% of communities in April 2022.[HSOS] While rates have since declined, FGD participants highlighted that livestock herders have already reached the lower limit for their herd sizes.[FGD] This is particularly concerning as reduced livestock numbers, due to livestock death or destocking, reduce farmers' abilities to generate incomes, and therefore have long-term implications for their livelihoods.

While food continues to be available in NES, it is widely unaffordable.

Agricultural production costs and agricultural productivity are particularly important when considering food security. This has several related reasons. The first is that in NES, the level of reliance on locally produced food is relatively high, particularly for wheat products (including bread).[22] As such, when drought leads to an increase in production costs – due to higher irrigation needs and reduced yields – this forces farmers to pass these costs on to consumers. Additionally, any reduction in local food production decreases the food supply, driving up prices.[23,24] Shortfalls in local production can generally be compensated through imports. However, in the context of the strong depreciation of the Syrian Pound,[JMMI,25] imports are costly. Figure 6 shows the strong increases in food prices compared to the USD to Syrian pound exchange rate.

These factors together – high production costs, low yields, and high import costs – mean that despite food being generally available in NES, it is widely unaffordable.[HSOS] By

Map 6: Lack of Rainfall or Water Reported as a Barrier to Agriculture in April 2023, and Precipitation from January 2021 to May 2023 (as reported by KIs in assessed communities)[HSOS]

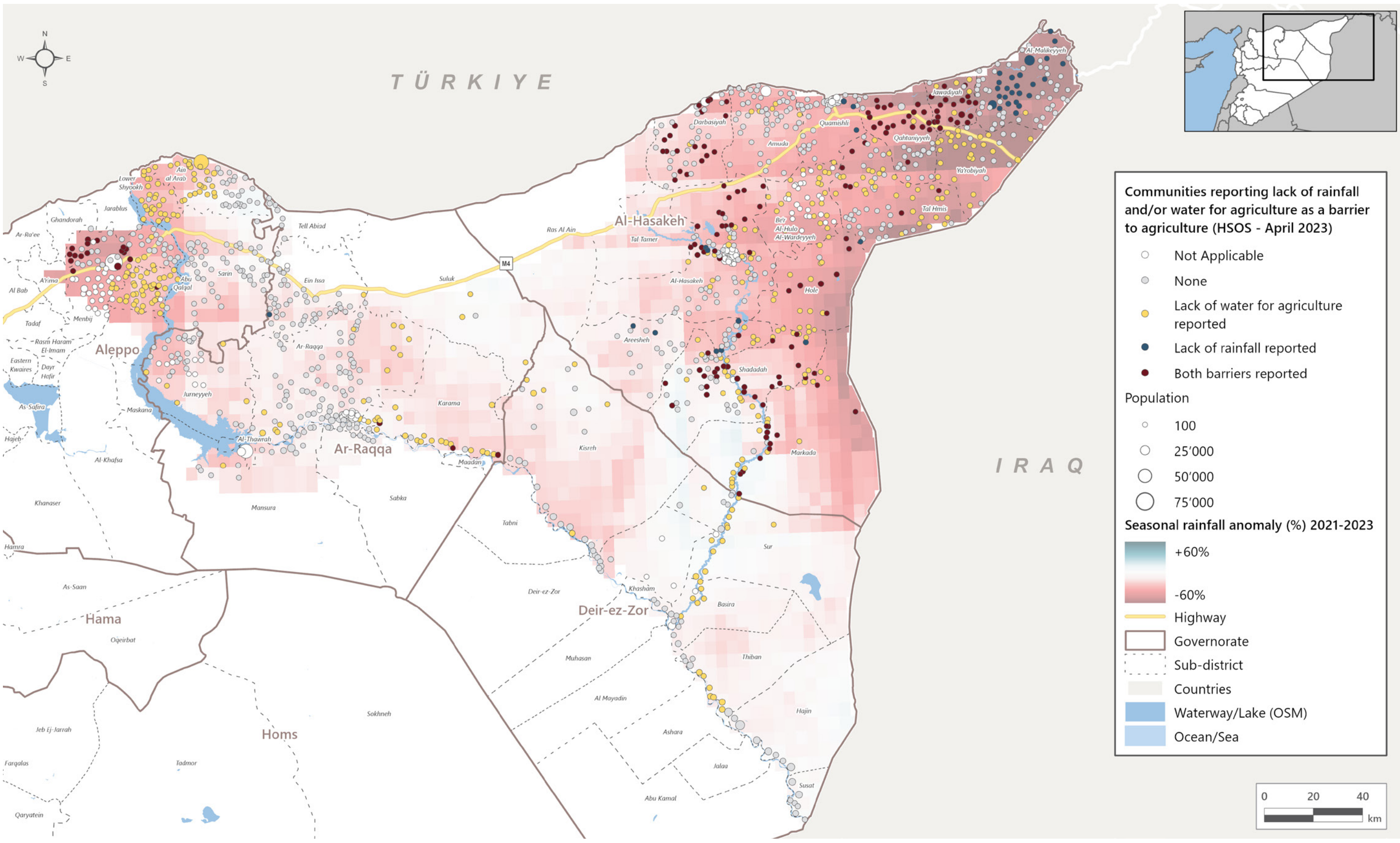
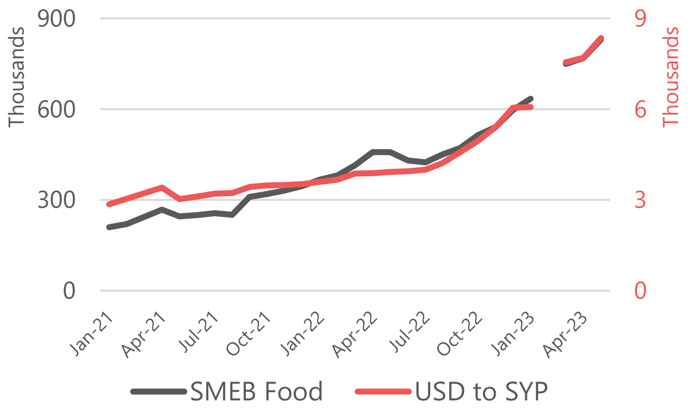


Figure 6: Cost of Food in the Survival Minimum Expenditure Basket (SMEB) and USD to SYP Exchange Rates[JMMI]



May 2022, the median household was consuming around 75 USD worth of food each month while the median monthly household income was 153 USD, meaning that around half of households' money was going towards paying for food.[19] While this is within the range of what is acceptable internationally,[26] it should be seen in the context of a quarter of households skipping meals, and a quarter prioritising the feeding of vulnerable household members.[19] Additionally, reliance on less preferred or lower quality foods became more widespread across NES,[a] affecting almost all communities.[HSOS] All of these coping strategies indicate that households are already compromising on their nutrition to cope with the lack of access to affordable foods.

3.3 Livelihoods

Lack of income is an important cause of humanitarian problems, and it is strongly linked to the performance of the agricultural sector.

Lack of income is a crucial issue across NES. It was the single most commonly reported barrier to accessing livelihoods in February 2023.[HSOS] This is underlined by the fact that in May 2022, household expenditures were more than twice as high as incomes.[19]

Generally speaking, the economy of NES is built up around the primary sector, specifically around fuels and agriculture.[27] The fuel sector is not affected by water crises, though it has been heavily impacted by conflict.[28] However, the production losses in the agricultural sector severely affect the estimated 18% of the employed population working in the agricultural sector. This is particuarly the case as the majority are self-employed.[19]

High operational costs are the key barrier to agricultural livelihoods, limiting farmers' abilities to generate incomes.

KIs reported high operational costs as the most widespread barrier to agricultural livelihoods.[HSOS] However, drought mitigation requires substantial investments into the land. This could include investments into drought-tolerant seed varieties, and fuel or electricity to operate irrigation pumps and efficient irrigation systems more generally, but potentially also to adopt sustainable agricultural practices that are resilient to drought. As such, the high operational costs may limit farmers' abilities to cope with water shortages and thus endanger their livelihoods. In light of consumers' low purchasing power, it limits the extent to which farmers can transfer increased costs onto consumers through higher prices.

Dependence on agriculture is likely to persist, and efforts should therefore be made to reduce the vulnerability of the sector to droughts and other disasters.

KIs in REACH's agricultural assessment in Al-Hasakeh governorate in March 2022 indicated that people were moving out of the agricultural sector and into other employment.[29] This suggests a possible loss of incomes at the same time as food prices are increasing, diminishing the purchasing power particularly of rural agro-pastoralist communities. Considering the widespread return to agriculture after the severe 2007-2009 drought[30] and the previously mentioned reliance on agricultural as a source of employment, it seems unlikely that any movement away from agriculture will be permanent. However, farmers' decisions to leave agriculture highlight the extent to which droughts impact livelihoods – namely that people can no longer hope to meet their basic needs through agriculture and must find alternative sources of income. Therefore, it becomes even more important from a socio-economic perspective to move towards agricultural systems that are more resilient to drought and weather extremes.

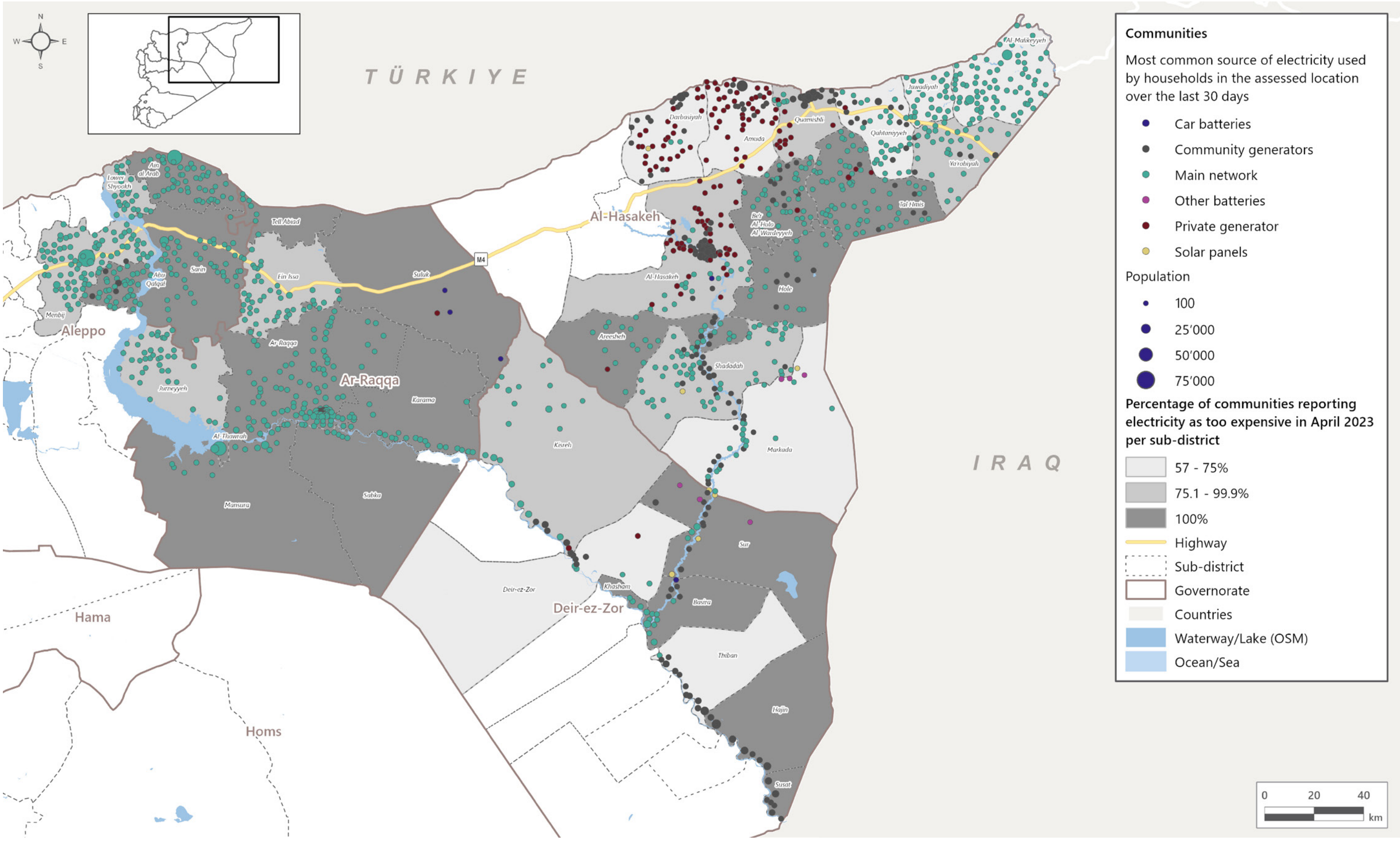
Beyond agriculture, all sectors are affected by the reduction in electricity generated through the hydroelectric dams on the Euphrates.

While agriculture is most directly impacted by changes in water availability, all sectors are affected through the changes in availability of hydroelectric power. NES has two key sources of electricity: the hydroelectric dams on the Euphrates river and fossil fuels, especially through Sweidiyeh gas power plant.[1,31] Hydropower production depends strongly on water flow through the Euphrates, with reduced flow rates and depletion of the dams having led to a temporary shutdown of the Tishreen dam in early 2023.[32] The failure of electricity networks requires households and businesses to rely on alternative energy sources.

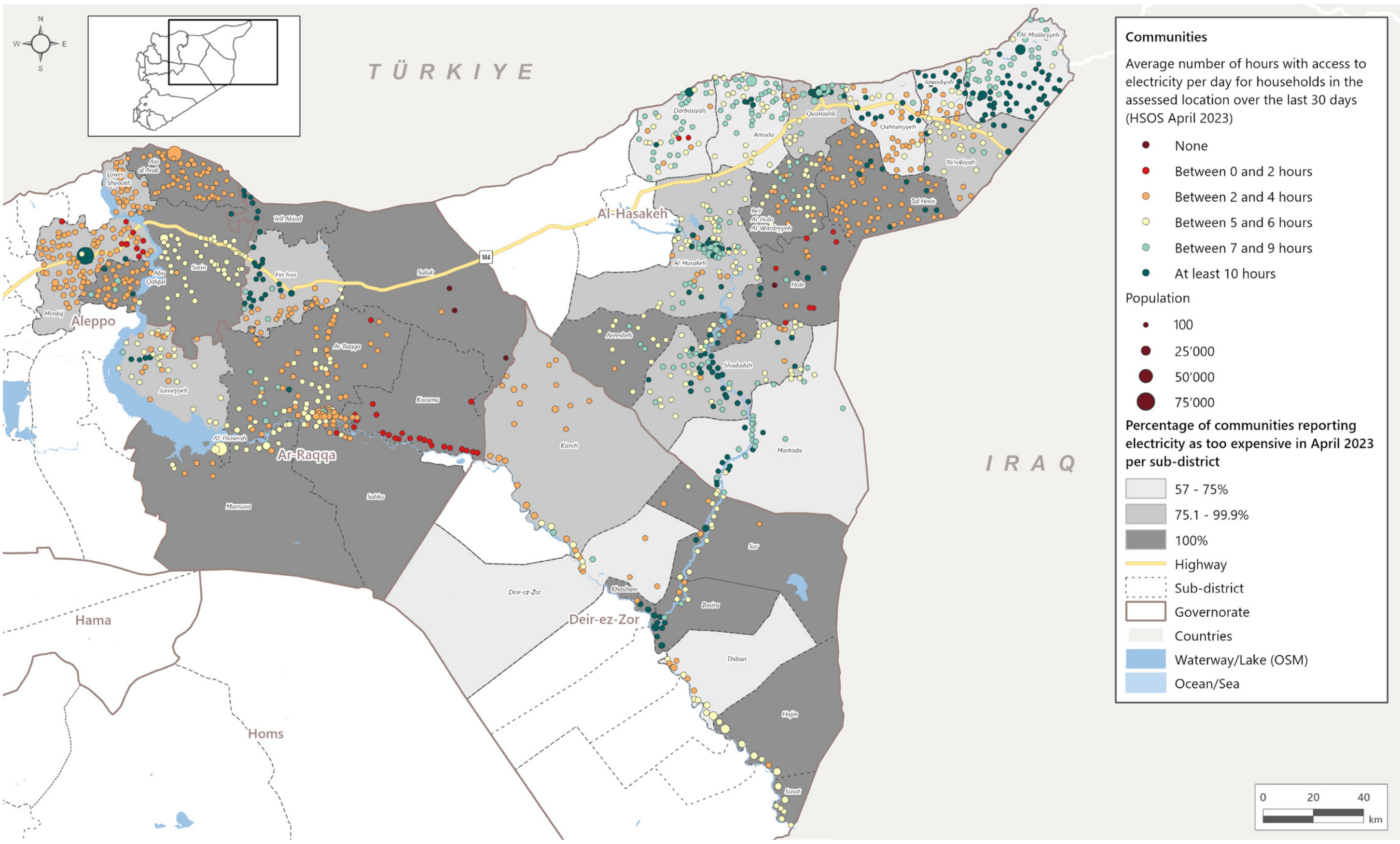
Electricity availability is currently low. KIs in two thirds of assessed communities reported that, on average, households had six or less hours of electricity per day in April 2023 (see map 8). For communities reportedly relying on the electricity network, this was even higher – almost 80%. The communities that reportedly had better electricity access were those relying on community generators. However, KIs in these communities and in communities reportedly relying on private generators were by far the most likely to report the high cost of electricity as a barrier (see map 7).[HSOS]

[a] From February and April 2021, KIs in 63-69% of assessed communities reported this strategy, compared to 86-89% in the same period in 2023.

Map 7: Primary Source of Electricity for Households in Communities, and Percentage of Communities Reporting the High Cost of Electricity as a Barrier to Electricity Access (as reported by KIs in assessed communities)[HSOS]



Map 8: Average Hours of Electricity Access for Households in Communities, and Percentage of Communities Reporting the High Cost of Electricity as a Barrier to Electricity Access (as reported by KIs in assessed communities)[HSOS]



A similar picture arises when looking at businesses in Ar-Raqqa and Al-Hasakeh cities. These often relied on more than one source of electricity, further indicating that electricity provided by networks and community generators is insufficient to cover the needs even of micro and small enterprises. Reported expenditures on private generators were also higher compared to either for community generators or public electricity sources, highlighting the economic disadvantage of private generators. Nonetheless, electricity expenditures (including fuel) made up a very small proportion of businesses' running costs. Private generators accounted for around 4% of business expenditures in Al-Hasakeh (49 USD per month) and 2% in Ar-Raqqa (51 USD) in fall of 2022.[33,34] One FGD participant noted that this is likely because businesses cannot afford to spend more on electricity. They also noted this as a barrier to new job opportunities in energy-intensive sectors, such as manufacturing.

SECTION 4 - Local Impacts

While regional data emphasises that water shortages have adversely impacted communities across NES for the past years, these regional trends hide the large range of experiences of communities. The following section looks at localised assessments which REACH has conducted in order to better understand these local experiences. They show that depending on factors such as the geographic location, water source, and distribution systems, the impacts of the current water crisis have differed strongly.

Zooming into Water Management in Three Locations.

In 2022, REACH conducted water Area Based Assessments (water ABAs) in three locations in NES to better understand how water was managed, focusing particularly on the actions that humanitarian partners can take to support local water systems. As such, they included various focus group discussions and panel discussions with water station managers, sector experts, farmers and livestock owners, water truckers, and operators of the piped network. The water ABAs provide detailed, technical, and locally-owned information, and the full reports can be accessed upon request.

1 The areas assessed in the water ABAs are situated in Al-Hasakeh, Ar-Raqqa, and Deir-ez-Zor governorates, at varying distances from the Euphrates. The Jurneyyeh area in Ar-Raqqa is in close proximity to the river. Correspondingly, the local water station sources water from the Euphrates. This location was thus doubly impacted by the reduced river flow – both in terms of water availability, and by the reduction in hydroelectric power that the water station relies on. Electricity had become so unreliable in the Jurneyyeh area that KIs reported electricity outages could last between one and two weeks, greatly reducing the pumping capacity of the water station and the water pressure in the network. At the same time, although water for irrigation was available, farmers were struggling with the inaccessibility of fuel for pumping water up from the Euphrates and the increased energy needed for pumping resulting from the low water levels. Between the difficulties in sourcing water from the Euphrates, the delayed and reduced rainfalls, and the high input costs, farmers reported both reduced yields and a loss of employment opportunities in the agricultural sector.

2 The Rweished area, located in Deir-ez-Zor governorate, received a mix of water from groundwater and the Euphrates. As the local water station was not functional due to a lack of funding and capacity, it depended on water trucked from a nearby groundwater station and a somewhat more distant Euphrates pumping station. This was associated with extremely high water expenditures, with household water expenditures amounting to around 18% of total income in 2021. This was despite the low quality of the water, with over two thirds of households having reported that they were dissatisfied with the water quality due to bad taste, colour, or the presence of sediments. Water treatment capacity at the groundwater station was low due to the limited access to electricity, which led to a de-prioritisation of treatment, but also due to a lack of inputs. Water from the Euphrates was not being treated. Correspondingly, in 2021, households reported problems with diarrhoea and skin disease due to the low water quality.

3 The Tal Brak area in Al-Hasakeh governorate relies on groundwater from a nearby water station. While all households were serviced by the network, insufficient availability of electricity meant that there was not enough pressure to pump water to households at the end of the pipelines. These households relied on regular water trucking instead. In addition to the lack of electricity, fluctuations in electricity availability also led to frequent equipment failures at the water station.

Looking at agriculture, respondents noted that wells were providing less water and that the remaining water contained higher levels of minerals and sediments. Between this, the dry weather conditions, and the high cost of inputs, farmers reported a reduction in yields. KIs noted that support to farmers to implement sustainable water practices, such as the use of efficient water delivery systems, drip irrigation, and reclaiming water for livestock use, could improve the availability of water and improve agricultural activities. As with Rweished, however, despite awareness for and interest in adopting sustainable water management practices, both areas lacked support and funding to do so.

Ar-Raqqa and Al-Hasakeh Cities – Situation in Urban Areas

Al-Hasakeh and Ar-Raqqa cities are the two largest urban areas in NES. However, the two cities differ markedly in their water supply systems, and thus also in households' access to sufficient amounts of safe water. The HSOS urban household assessments interviews households in the whole of Ar-Raqqa and parts of Al-Hasakeh[a] cities four times a year, and thus provides representative information on the humanitarian situation of households in these areas.

[a] Due to security restrictions, the south of Al-Hasakeh city could not be assessed.

Al-Hasakeh City

Al-Hasakeh has been severely affected by the situation at Alouk water station. Alouk water station provides water for around one million people in Al-Hasakeh governorate, including the city of Al-Hasakeh.[1] However, it stopped functioning on 9 August 2022 and was virtually non-operational until April 2023.[2] Due to recent agreements and maintenance work, the station went back online on 19 April 2023, but has since been operating less than a quarter of the time (as of June 2023).[3,4] The extended interruption to the water stations' functionality significantly impacted residents. Where previously over 70% reported relying on the piped network for drinking water, and over half for water for all purposes, both dropped to just over 10% in October 2022. Instead, reliance on private water trucking increased, which had previously been a secondary water source. The alternative sources of water that water truckers are widely relying on are also largely unsustainable, with no obvious alternative being currently available.[5]

Water was generally considered by households to be too expensive, with the average household having spent over 7% of their monthly income on water in October 2022. While there is no agreed-upon standard for what level of water expenditure is acceptable, international organisations tend to set 3-5% for the median household as an upper limit, suggesting that water in Al-Hasakeh is concerningly expensive.[6] While it is clear that purchasing water from private vendors is generally more expensive than the network, water expenditures did not increase in USD terms between early August 2022, when the network was still functioning, and October 2022, when it was not. This could have a range of different explanations, including that households were already purchasing trucked water as a secondary source. However, almost all households were reducing water consumption. In fact, significantly more households reported reducing water usage for cleaning inside the house (80%) and for doing the laundry (66%), but even for handwashing (13%). As such, it seems likely that the constant water expenditure reflects the limits of households' economic abilities to spend on water, leading them to reduce water consumption rather than pay more for the same amount of water.

Al-Hasakeh also faced widespread issues with water quality. Most commonly, KIs reported that water tasted bad. However, there was also a surge in households who thought water was making people sick in October 2022, with 40% of households having reported this problem (down to 19% in May 2023). However, given that the Health Working Group did not capture a particular increase in waterborne diseases at that time,[7] this increase may be due to households' heightened awareness of waterborne disease risk following the outbreak of cholera.

Ar-Raqqa City

The situation in Ar-Raqqa is very different. Where residents of Al-Hasakeh relied on a mix of the water network and water trucking and even so do not have sufficient water, all households in Ar-Raqqa relied on the piped network, and most said that they could meet all of their water needs. This is directly reflected in household water expenditures – where households in Al-Hasakeh spent over 8,000 SYP per person, households in Ar-Raqqa spent around 360 SYP per person (USD 0.04). Water quality was an issue here too, with residents reporting that the water had a bad colour, but also that it tasted or smelled bad. Water being perceived to be making people sick also peaked in the August and October 2022 assessment rounds. While multiple years of data would be necessary to better understand this, this may be linked to seasonal variations in waterborne diseases.

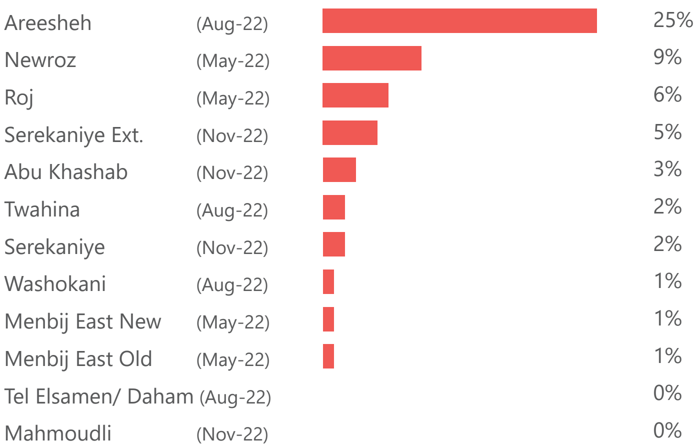
Water Access in Larger IDP Camps

NES has 12 larger camps, hosting around 20% of the IDPs in the area.[8] As the majority of these camps are managed by various NGOs which provide basic services, their situation differs substantially from that in communities or informal sites. However, NGOs too have faced difficulties in accessing suitable water sources.

REACH assesses all larger camps in NES except Al-Hol camp where household-level assessments and interviews with camp managers are conducted. Access to water differed greatly from camp to camp. In most, households had access to a public tap or standpipe for their water needs. As such, it was rare for households to report a lack of access to water for two consecutive days – for the majority of camps, less than 5% of households reported this (see figure 7). Exceptions exist, with an estimated 25% of households in Areesha having gone two consecutive days without water in August 2022, up from 11% in February of that year. Coping strategies to prevent running out of water were more common, particularly modifying hygiene practices and storing water. This suggests that while water may have been available most days, households could not necessarily access sufficient quantities of water and therefore had to compromise on their hygiene.

Recent data suggests that water was only inconsistently treated at the source, which is reflected in the frequent reports of water quality issues. Households commonly reported water tasting, smelling, or looking bad. In some cases, households also reported that people got sick after drinking the water. While this was generally rare, it did affect over 40% of households in Serekaniye camp in May 2022, before reducing to 14% in November of that year. Diarrhoea, which is also often linked to low water quality, was also elevated to around 30% or above in some camps.

Figure 7: Proportion of Households That Went Two Consecutive Days Without Access to Water



SECTION 5 - Looking Ahead

Understanding the causes of the water crisis is essential if we want to mitigate its impacts. However, three years into the current water crisis, and 12 years into the Syria response, humanitarian actors are largely familiar with the details of this crisis. What is missing in many cases are validated strategies to sustainably cope with water shortages.

Why sustainability matters – climate change in Syria

The current water crisis in Syria is not new. In fact, about two out of five years in the last half century were drought years, with the 2007-2010 drought having been the most severe since measurements began.[1] However, research indicates that this drought would likely not have been as extreme had it not been for a century-long drying trend.[2] In fact, various research has shown that droughts in Syria,[2,3,4] and in the Middle East more generally,[5,6] are becoming more frequent and more severe. This is strongly linked to a rise in temperatures, although it is not yet clear how rainfall will develop in the future. Euphrates water levels are also expected to continue to drop.[7] Away from the Euphrates, households, farmers, and water stations have widely been relying on groundwater. However, remote sensing data from the last 20 years shows a significant trend of reducing groundwater supplies (see section 2), which is similarly indicated by field-level reports of boreholes running dry or having to be extended.

40%
of years in the past half century were drought years

16%
less groundwater in NES between Nov-21 to Oct-22 compared Nov-03 to Oct-04

The lack of water is not the only problem. Drought will add to a range of factors which have been contributing to declining water quality in the Euphrates, such as wastewater discharge, return flows from irrigation, damming, and others.[8,9] The low quality of Euphrates water is already associated with waterborne disease outbreaks, including the September 2022 cholera outbreak.[10] Another example is that the drying conditions are increasing the risk of dust storms.[6] Dust and sand storms in 2022 caused widespread health problems, especially for those who already suffer from respiratory conditions.[11,12]

What these trends indicate is that the issues which the humanitarian response is facing today are likely to continue past the current water crisis. However, looking around the world, there are proven ways to deal with dry and drying conditions. Niger has seen huge success with allowing trees on farmland to regenerate, significantly improving agricultural outputs.[13] Farmers across Africa have seen up to 30% higher yields through the use of new drought-tolerant maize varieties.[14] Rainwater harvesting in Yemen, one of the driest countries in the world, has improved domestic water supply for thousands.[15]

In other words, we know that drought and climate change adaptation is possible. The key information gap now is which interventions would be most effective in Syria, within the scope of humanitarian action.

What (some of) the response says

To understand better what the humanitarian response in Syria has been doing so far, and which opportunities they see for the future, REACH spoke to 24 response members, spread across three workshops (focus group discussions, FGDs). While more research is needed to develop recommendations and action plans for climate action in Syria, these sessions provide a first idea of what opportunities there are, and what the response would need in order to implement them.

What is clear is that much has already been done. At a larger scale, this particularly goes for support to water stations. For instance, based on KI reports of the main source of water in their communities, there do not seem to have been widespread changes in these sources since early 2021.[HSOS] This is despite the clear and severe toll that the past years have taken on water resources. The most likely reason for this is that humanitarian interventions maintained access to water.[FGD] In particular, the WASH Working Group did extensive work on retrofitting water stations on the Euphrates to ensure that their pipes would reach the lower water tables.[16,FGD] Additionally, FGD participants indicated that NGOs have been working to support those water stations which are not connected to the service line with generators, ensuring their electricity supply despite reduced electricity production at the hydropower dams.[FGD] In Al-Hasakeh city, NGOs are doing essential work to provide water to an estimated 14% of residents while the water network is offline.[17]

Efforts to maintain access to water resources in NES are happening at a smaller scale as well. Looking at agriculture, NGOs are working to reduce water consumption and improve access to water. This includes establishing greenhouses,[FGD] which can reduce water use if appropriately managed by reducing evaporation, allowing for crops to be spaced more closely together, and by shortening crop cycles.[18,19] It also includes irrigation systems such as drip and sprinkler irrigation,[FGD] which are more water-efficient at a farm-level.[20] Some NGOs are also providing solar panels to power irrigation pumps. This alleviates barriers to irrigation, though at a risk of encouraging increased water use.[FGD]

Despite all this, NGOs highlighted the need to do more to reduce water use as water resources continue to decline.[FGD] Workshop participants were clear that there is no single strategy to achieve this, and that work needs to be done at multiple levels of coordination. This starts with communicating to residents the necessity of water conservation, how to respond to water crises, how to mitigate the risk of waterborne diseases, and others.[FGD] It also includes support to farmers to reduce their water consumption, considering that agriculture is the single largest consumer of fresh water.[21] For instance, the development of new rainwater harvesting systems could provide a renewable source of water[FGD] and have shown promise in other semi-arid or arid contexts.[22]

Looking at electricity, a diversification of electricity sources may help to make NES less dependent on hydropower. Solar, for instance, would be an option given the high levels of solar radiation that Syria receives. It is also generally cost-effective, assuming a 20-year run-time.[23] In fact, in all three water Area Based Assessments, respondents indicated that the operation of the water stations in their area could be improved with solar power. However, workshop participants pointed out that the high initial costs and limited local capacity to maintain solar systems, as well as the large areas of land needed, are barriers to implementing solar projects. As such, participants suggested that they are more suited to small-scale projects, such as microgrids for businesses or solar panels for greenhouses.[FGD]

Even with these smaller-scale water and electricity projects, participants clearly stated the need for infrastructure and governance improvements. As noted above, these have already occurred to some extent with retrofitting of water stations. However, participants mentioned for instance that damage to water networks risked water being contaminated before it reaches households.[FGD] In addition to the risk of contamination, it seems likely that water losses in the network are high – looking at the regional comparison, Jordan for instance loses around half and Gaza over 40% of water in their networks due leakages and other factors.[24] Additionally, participants indicated that in many areas, network water is free.[FGD] While this may be beneficial to the population given the high levels of poverty in NES,[25] participants noted that this may encourage overuse of network water, for instance for agricultural purposes, which ultimately means that there is not enough water for households at the end of the pipeline. Besides introducing tariffs, household meters were suggested as a possible solution. Similarly for electricity, one participant noted that costs for network power are very low. They suggested that because of this, revenues are insufficient to maintain or even extend the network. However, activities at this level of service provision cannot be conducted by NGOs alone, but rather require cooperation with local management actors.[FGD]

Finally, many of Syria's water systems are shared amongst neighbouring countries and areas. As such, equitable management of shared water resources is necessary to ensure that everyone can benefit from these resources. The most obvious example of this is the Euphrates. The river is shared amongst three countries, with Iraq, the country furthest downstream, having been most severely impacted by the reduced flow and declining water quality of the river.[26,27] As such, cooperation between all riparian countries is needed to ensure that all countries maintain sufficient access to water.

ABOUT REACH

REACH Initiative facilitates the development of information tools and products that enhance the capacity of aid actors to make evidence-based decisions in emergency, recovery and development contexts. The methodologies used by REACH include primary data collection and in-depth analysis, and all activities are conducted through inter-agency aid coordination mechanisms. REACH is a joint initiative of IMPACT Initiatives, ACTED and the United Nations Institute for Training and Research - Operational Satellite Applications Programme (UNITAR-UNOSAT).

SECTION 6 - Summary & Conclusions

Rainfall across NES has been below average for 3 years. Particularly the east of Al-Hasakeh governorate has seen up to 60% less rainfall on average per month. **The lack of rainfall both in NES and regionally has severely impacted water resources.** Groundwater in 2022 reached its lowest level within the 20-year period for which data was available, and water levels in the Euphrates dams dropped to an all-time low.

Meanwhile, the primary sources of water for communities in NES remained relatively stable. In larger communities – those with 5,000 or more inhabitants – KIs tended to report the piped water network as the primary source of water. Despite serious issues with water networks, reported access to water was better and fewer water quality issues were noted. On the other hand, small communities with less than 1,000 people usually relied on private wells and boreholes for most of their water needs, but tended to rely on water trucking for drinking water. This comes with risks, as water trucking is unregulated and much more costly than network water.

Reliance on unregulated water sources is concerning given the widespread water quality issues. The most notable is the ongoing cholera outbreak. While few cases have been recorded in NES between March and June 2023, the WASH Working Group is preparing for a second wave during the summer months. **This highlights the need to improve WASH infrastructure**, such as repairing sewage networks and establishing treatment facilities, ensuring that drinking water is treated and piped networks are protected from recontamination, and others.

In addition to impacting domestic water supplies, **the water crisis has reduced access to water for irrigation.** The lack of water led to severe shortfalls in agricultural production in the 2020/21 and 2021/22 seasons. **Though food remained available in markets, food prices increased.** Households struggled with the high food prices, opting to buy less preferred and lower quality foods, and in more severe cases reducing meal sizes and skipping meals.

High food prices should be seen in the context of the weak livelihoods situation. Particularly the almost one fifth of the working-age population employed in agriculture have been impacted by reduced agricultural yields. This also has spillover effects on other livelihoods sectors. If incomes for a large portion of the population drop, they will buy fewer goods and services in the markets, reducing earnings in all sectors. At the same time, **most sectors are impacted by the water crisis through its impacts on electricity** – hydropower, when functional, is the main source of network electricity. However, electricity production at the hydropower dams has reduced due to lower Euphrates River flows, leaving most communities with six or less hours of electricity access per day.

These regional issues are visible at a local scale. In three area based assessments, all areas were impacted by either lack of rainfall, lower Euphrates water levels, lower groundwater levels, or a combination of these. Thus, although the locations were far from each other (in separate governorates), they were all impacted by reduced production at the water stations and reduced agricultural yields.

Looking at Al-Hasakeh city, households relied on water trucking after Alouk water station went offline in August 2022. Underlining the high cost of water trucking, household spent 7% of their monthly incomes on water in October 2022, more than what is considered to be internationally acceptable.

The current water crisis is part of a long-term drying trend in Syria. This trend includes an increasing frequency and severity of droughts, and falling water levels in the Euphrates and the groundwater. **Sustainable action is needed to reduce the humanitarian impacts of the current and future water crises.** Humanitarian response actors have already begun to act, for instance by retrofitting water stations to adapt them to lower water levels in the Euphrates, by implementing water-saving projects in the agricultural sector and improving access to irrigation water through alternative energy sources. However, response actors have expressed the need for more sustainable action at all levels of coordination. This reaches from encouraging households to use water resources more efficiently, to implementing climate-smart agricultural practices, to upgrading the WASH infrastructure, to working to improve trans-boundary water management, and more.

Given the global successes already achieved with climate adaptation projects, it stands to reason that Syria, too, can adapt to climate change.

Endnotes

[i] To calculate rainfall sums in mm per month per pixel, the Climate Hazards Group InfraRed Precipitation With Station Data, Version 2.0 Final[a] (CHIRPS), with a spatial resolution of 0.05 degrees (≈ 5.5km), was used. For the charts, the spatial mean of the monthly sum was calculated using all pixels that fall within the area of the community. The historical mean for each month of the year was calculated based on the time period 2000-2020 (20 years). For the 2022/2023 and the 3-years anomaly map the seasonal months October to May were included. The rainfall anomaly is presented in percentage from the 20 years median.

[ii] To calculate groundwater storage (GWS) anomalies, NASA GLDAS CLSM[b] data, produced with Gravity Recovery and Climate Experiment (GRACE) data assimilation, were used. The product has a spatial resolution of 0.25 degrees (approx. 27-28 km). Monthly GWS anomalies in the trend chart represent the deviation from the baseline 2004-2009 mean (e.g., Van Loon et al. 2017, see also NASA JPL[c]). The annual GWS values represent the mean anomaly for each annual cycle (November-October). The trend graph describes the change in the annual mean anomaly from 2004-2022 over time where the slope indicates the change in mm per year and the r-squared value the significance of the trend. The annual anomaly map 2021/2022 was created based on the November to October and shows the percentage deviation from the baseline mean.

[iii] The NDVI is used to quantify vegetation greenness and is useful to understand vegetation health and vegetation density. High NDVI values correspond to healthy vegetation while low NDVI corresponds to unhealthy or little vegetation. As for annual crops, high NDVI values correspond to crops at their peak growth stage. Lower NDVI values reflect crops in their growing period before they have reached their peak growth stage. Low values can also represent bare soil just after harvest or during land preparation process before plant growth starts. Even though there is usually a relationship between NDVI values and crop yield, NDVI should not be interpreted directly as such, as there is not necessarily a linear relationship between NDVI and crop yield.

MODIS Aqua and Terra 8-day products[d] with a spatial resolution of 250m were used to create monthly median NDVI composites using all pixels within cropland area. A 10 meter resolution cropland mask combining years 2020 to 2022 (UNOSAT) was used to delineate the cropland area and mask out other land cover such as built-up areas. The annual anomaly map 2022/2023 was created based on the seasonal months November to May using the years 2000-2019 as a baseline to calculate the historical median. The NDVI anomaly are presented in percentage from the median, e.g., for annal anomalies, the annual median was subtracted from the November 2022-May 2023 median. Monthly anomalies were calculated by subtracting the monthly median from the monthly historical median, e.g., Jan. 2023 anomaly = Jan. 2023 – Jan. historical median.

[a] https://www.chc.ucsb.edu/data/chirps
[b] https://hydro1.gesdisc.eosdis.nasa.gov/
[c] https://grace.jpl.nasa.gov/
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