The water crisis in Northeast Syria (NES) spans multiple dimensions – a meteorological drought, reduced flow in the Euphrates River, and a long-term reduction in groundwater levels. Together, these have led to a severe deterioration in the humanitarian situation.

The drought began in late 2020 with a delayed onset of winter rains and low rainfall, later made worse by heatwaves and an early cessation of rains in the spring of 2021. This is particularly problematic as Syria has seen decades of overexploited groundwater, leading to severe reductions in groundwater levels. This is exacerbated by the single largest source of freshwater in Syria, the Euphrates, which is underutilized and downstream usage are causing further declines in water flow.

The changes in surface water and groundwater level are particularly evident in the lower Euphrates River and the Damascus Dam. Levels in lake Assad being around a meter higher than in 2021, though still two meters below the long-term average levels in the current agricultural season.

Observatory warned in March 2022 of a medium to high risk of drought impact on agriculture – for comparison, no areas had a high risk in March 2021. Thus, the European Drought Observatory ID: DSW-0468510-01 warns of a 2% risk of severe drought conditions in Syria through 4,828 KIs. While most communities in NES are assessed, the data is indicative of the single largest source of freshwater in Syria as well as being an important source of water, electricity, and the impact on agriculture.

In March 2022, REACH conducted a Rapid Needs Assessment (RNA) reviewing the agricultural livelihoods, food security and health in NES. Furthermore, the REACH sources, secondary sources, and information from REACH’s field team are used in this briefing note. This includes the monthly Humanitarian Situation Overview in Syria (HSOS) up to March 2022. In March, HSOS collected data on 1,267 communities assessing the situation across 60 subdistricts in Al-Hasakeh governorate, Syria. In particular, RNA conducted by REACH in March of 2022 to assess the impact of the water crisis on agriculture in Al-Hasakeh governorate, Syria.

The water crisis in NES is particularly relevant given the recent developments in Syria, as well as reporting delayed winter rains and low rainfall. These developments are highly relevant to the well-being of people in NES.

REACH SOURCES USED

- **HSOS HH**: - 5 KIs conducted monthly by REACH in NES
- **HSOS KI**: - 14 subdistricts (see figure 1) conducted quarterly by REACH in NES
- **RNA**: - 60 subdistricts (53 KIs) conducted by REACH in March of 2022
- **JMMI**: - 4,828 KIs conducted by REACH in March of 2022 to assess the impacts of the water crisis on agriculture in Al-Hasakeh governorate, Syria.
2. Average Loss of Surface Water from 2020 to 2021

Methodology Note

The monthly surface water data was generated through supervised image classification (Random Forest) based on Sentinel-2 and Sentinel-1 satellite imagery, using training data from Global Land Analysis and Discovery (GLAD).

Surface water occurrence (SWO) is the frequency with which water was present on the surface through a year (as % of months). Water occurrence detections (WD) take the value of 1 if water was detected on the monthly surface water datasets, and the value of 0 otherwise. To compute the SWO, WDs from each month of the year are added and then divided by 12 (SWOyear = ∑WD / 12).

The change in surface water occurrence between 2021 and 2020 is calculated as the difference in percentage points between the SWO of 2021 and the SWO of 2020 (SWO2021 - SWO2020).
**Key highlights**

April 2022

**Water and Electricity Access**

- Reduced water levels in the Euphrates paired with low levels of rainfall led to strong declines in access to water across 2021. This was due to water levels sinking too low for water stations to operate and low levels of hydroelectric power meaning that not enough electricity was available to power the stations. Accordingly, KIs on average reported that 21% of households in their community had insufficient access to water in August 2021.

- The high cost of water trucking was the most cited barrier to water access, reported by KIs in up to 46% of communities.

- Water access improved after August 2021 due to the onset of the rainy season and increased flow in the Euphrates. Thus in March 2022, KIs reported on average that 14% of households in their community had insufficient water access.

- Most of the network electricity in NES comes from dams on the Euphrates – with decreased water flow in 2021, these dams produced much less electricity.

- In January 2021, KIs in 50% of assessed communities reported having 9 or more hours of electricity per day in their community – by December, this had reduced to 19%. Levels have remained low into March 2022 despite rising water levels in the Euphrates because rationing has continued.

- Households are unable to cope with network shortages as the alternatives, solar and fuel-powered generators, are beyond the purchasing power of most. At the same time, water stations and other essential services are heavily impacted by the lack of electricity.

**Health Impact**

- Reduced water access has led households to restrict their hygiene practices (particularly bathing and doing laundry), which may make them more vulnerable to infectious diseases and skin diseases.

- Furthermore, the use of untreated water from boreholes, wells and water trucks increases the risk of waterborne diseases. In August, KIs in 19% of all assessed communities reported that drinking water was perceived to be making people sick – at 32%, this was even higher in communities that primarily relied on private water trucking for drinking water.

- Unsafe water is thus likely the cause of a strong increase in diarrhoea cases observed in 2021. Diarrhoea can further increase the risk of malnutrition, which is particularly problematic as the high cost of food has already led to unprecedented high rates of malnutrition across Syria.

**Livelihoods Impact**

- NES is seeing high rates of livestock death and sell-offs due to the inaccessibility and high cost of fodder.

- This is a result of the failure of fodder crops, including barley, and the drying up of pastures in 2021 due to the shortage of rainfall. As current rainfall levels have remained low, there are concerns that agriculture – and hence livestock – will see further negative impacts of drought in 2022.

- Due to difficulties in importing food and rising global food prices, this shortfall in regional production cannot be adequately compensated, leading to strong increases in food and fodder prices.

**Food Security Impact**

- Food insecurity in Syria now is higher than at any other time since the onset of the crisis. In NES, households particularly struggle with the high cost of foods paired with low purchasing power; in March 2022, KIs in 82% of communities reported that households were unable to afford essential food items.

- Low wheat harvests in 2021 due to the drought have strongly contributed to this. Thus, with low rainfall continuing into the current agricultural season and considering the global surge in food prices, it is likely that this situation will worsen over the course of 2022.

- In response, KIs have reported a large number of coping strategies centred around borrowing money and reducing expenditure. More extreme coping strategies are also employed, such as skipping meals (KIs in 20% of assessed communities in March) and reducing meal sizes (19%).
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The water crisis has particularly affected households in their source of water, with the use of networked water decreasing and reliance on unregulated sources such as boreholes, wells, and private water trucking increasing. Particularly the dependence on water trucking is difficult for households, with the high price of water from trucks being the primary barrier to water access reported. While water levels in the Euphrates are set to alleviate some of the problems, persistently low rainfall levels will continue to impact household water access in the coming year, especially for households relying on surface and groundwater.

**Low Water Levels in the Euphrates**

Whereas water levels in the Euphrates were notably affected, which decreased continuously from January 2021 up to the end of July 2021. Since the 1st of March 2022, Alouk was functioning between mid-June and the end of July 2021. Since the 1st of March 2022, Alouk was not pumping at all for at least a third of the time (see figure 3). It is situated in Al-Hasakeh governorate, KIs in more communities in Ar-Raqqa and Deir-ez-Zor governorates were notably affected, which decreased from 12 to 20% in the same month. The water crisis has particularly being the primary barrier to water access, with the high price of water from trucks being the primary barrier to water access reported.
1. Situation Overview: Water Shortages

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4. Access to Sufficient Water in March 2022

Access to sufficient water

Data source: REACH HSOS March 2022

% of households with access to sufficient water as reported by KIs:

- 1% to 20% of households
- 21% to 40% of households
- 41% to 60% of households
- 61% to 80% of households
- 81% to 99% of households
- 100% of households

Map showing access to sufficient water in different regions of Turkey and Iraq, with indications of varying percentages of households with access to sufficient water.
1. Situation Overview: Water Shortages

April 2022

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5. Monthly Rainfall Levels Compared to Long-term Average

Rainfall for NES\(^3\), this impacts all households, but most directly those relying on rainwater collection (for instance in wells), surface water, and boreholes.

\(\text{HNAP data}\) indicated that 46% of households had to use a secondary water source in summer – primarily water trucking – up from 26% in at the beginning of the year, suggesting that various sources of water had become unreliable or insufficient.

However, access recovered after October 2021, with values dropping to around 16% from November, similar to the year before.

With the rainy season beginning around October, water demand tends to decrease and reservoirs refill, thus naturally decreasing barriers to water access. See figure 4 for levels of access in all assessed communities in March.

Sources of All Purpose Water

The Standard Precipitation Index (SPI), which quantifies differences between current rainfall and the long-term average, shows that rainfall since late 2020 was extremely low for NES, on average (see figure 5). A rainfall shortage over 6 months already leads to reduced streamflow and reservoir storage. Above 12 months, recharge of groundwater and reservoirs is affected.

This impacts all households, but most directly those relying on rainwater collection (for instance in wells), surface water, and boreholes.

In March 2022, KIs in 46% of assessed communities reported (private or community) boreholes or wells as being the primary source of water, making the persistent shortage in rainwater a serious risk to water access. This particularly affects Aleppo governorate, where KIs in 74% of assessed communities reported this source, and Al-Hasakeh governorate with 55%. In 2021, reliance on boreholes further increased while reported use of the water network declined. This was such that when use of the network as a primary source was at its lowest in September 2021, reported by KIs in 29% of communities (down from 39% in December 2020), use of boreholes and wells had increased to 46% of assessed communities, (up from 42%). However, besides the depletion of groundwater, this comes at the associated cost of drilling deeper boreholes and increased expenditure on fuel, the latter of which is particularly prohibitive due to high fuel prices.

For a map of water sources for all assessed communities in March 2022, please see figure 8.

Sources of Drinking Water

Note the distinction KIs in NES made between water for all purposes and drinking water, the latter being predominantly sourced from the network (KIs in 39% of assessed communities in March 2022) and from private trucking (32%). The use of private trucking specifically for drinking water became somewhat more common during the previous summer, reported by KIs in 39% of communities in August of 2021 (highest point).

According to HNAP data\(^*, 25%\) of households who relied on closed individual wells as their primary water source last summer used a different source for drinking water, compared to 10% of those whose primary source was the network.

This is necessary as groundwater in Syria tends to have high salt and mineral concentrations which make it unsuitable or harmful for human consumption.

Situation for Out-of-Camp IDPs

The situation for out-of-camp IDPs was notably worse than that of the host community, as indicated by REACH’s profiling of informal sites and settlements last October. Particularly in Aleppo and Deir-ez-Zor, KIs in almost half of all assessed sites reported that at least 50% of IDPs had insufficient access to water. The situation was reportedly relatively better in Al-Hasakeh.

(Continues on page 10)

\(^*\) Statistics were obtained by aggregating household data from sub-districts in which HSOS assessed at least one community in March 2022. Statistics are therefore not representative for NES.
1. Situation Overview: Water Shortages

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6. Average Groundwater Levels in NES between 2010-2021 (mm per month)

7. Average Groundwater Storage in NES (mm)

Note on Ground Water Analysis

REACH is developing an analysis of groundwater levels in Syria using remote sensing data. As noted above, groundwater levels in NES have been falling over the past decades, and reoccurring droughts prevent water levels from recharging. This is evident from the graphs shown here, with water levels across NES having substantially declined in 2021 compared to 2020. As groundwater levels decline, deeper boreholes are required and more energy is needed to pump the water to the surface – either from electricity or from fuel – which increases costs. These rising costs have already priced out many farmers who would ordinarily have relied on irrigation from boreholes (see section on livelihoods). This is particularly true in Al-Hasakeh, Ar-Raqqa and Aleppo, where water extraction for irrigation is the highest.

Al-Hasakeh
Quamishli
Ar-Raqqa
Deir-ez-Zor

Groundwater Storage average (2021)

Data source: NASA’s Gravity Recovery and Climate Experiment (GRACE)

<table>
<thead>
<tr>
<th>Region</th>
<th>Groundwater Storage Range (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al-Hasakeh</td>
<td>1,601 - 1,965</td>
</tr>
<tr>
<td>Quamishli</td>
<td>1,401 - 1,600</td>
</tr>
<tr>
<td>Ar-Raqqa</td>
<td>1,201 - 1,400</td>
</tr>
<tr>
<td>Deir-ez-Zor</td>
<td>1,001 - 1,200</td>
</tr>
</tbody>
</table>

Groundwater change in percentage

Change in Groundwater Storage
2021 average - 10 years average (2011-2020)

Data source: NASA’s Gravity Recovery and Climate Experiment (GRACE)

<table>
<thead>
<tr>
<th>Range</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6.0% to -7.5%</td>
<td></td>
</tr>
<tr>
<td>-5.0% to -5.9%</td>
<td></td>
</tr>
<tr>
<td>-4.0% to -4.9%</td>
<td></td>
</tr>
<tr>
<td>-3.0% to -3.9%</td>
<td></td>
</tr>
<tr>
<td>0.0% to -2.9%</td>
<td></td>
</tr>
<tr>
<td>0.1% to 1.1%</td>
<td></td>
</tr>
</tbody>
</table>

See methodology in the HGQRWHV
1. Situation Overview: Water Shortages

8. Main Sources of Drinking Water and Water for All Purposes in March 2022

Main source of drinking water
Main source of water for all purposes

Most reported by Sub-district:
- Piped water network
- Combination of water network and private water trucking
- Private borehole or well
- Private water trucking conducted by private citizens
- Private borehole or well and piped water network

Community:
- Piped water network
- Combination of water network and private water trucking
- Water trucking conducted by authorities or an NGO
- Private water trucking conducted by private citizens
- Community borehole or well for free
- Community borehole or private well
- Private borehole or well
- Surface water lake pond dam river
- Springs

Data source: HSOS March 2022
In line with the summer of 2021, according to HNAP data*, 69% of water sourced from water trucks. The other factor is the increased amount of community water expenditure from January 2021 to August, and August to March 2022 (see figure 10 for changes in price of water trucking in NES increased by 32% in 2020), which can be explained by substantial more than in the previous year (41% on average in 2021 compared to 38% in March 2022 (see figure 9). This was of communities in the past year, and in January.

In August of 2021, KIs in 73% of assessed communities reported coping strategies, at 73% in August up from 58% in January 2021. Correspondingly, Aleppo had the lowest reported rates of relying on private water trucking. This meant that KIs in 21% of communities reported this barrier compared to 0.8% and 1.3% in Al-Hasakeh, compared to 5% of monthly expenditure relative to income was highest in Deir-ez-Zor and Al-Hasakeh. This appears to be due to the lower levels of income in these governorates and a greater reliance on private trucking.

High Cost of Water

The most commonly cited barrier to water access was the high cost of water trucking, KIs in 28% of communities in Aleppo reported this barrier during the past year, which also include the lack of containers for water storage.

Barriers to Accessing Water

In 2022 that community members bought water with money that would usually be spent elsewhere, down from 26% in 2021 to 10% in 2022. This coping strategy may be detrimental to the nutritional status. To have negative effects on the household's welfare. Particularly in light of high and rising food prices (see section on food security).

High price of water trucking

Not enough containers to store water

Not enough pressure to pump

Alternative sources too expensive

Water pumps only function a few hours per day

Main network partially/completely not functioning

Boreholes not providing any or not providing adequate quantities of water

Main network does not reach all households

Infrequent Water Access

The other factor is the increased amount of water access in assessed communities.

FRPSDUHG WR WKH SUHYL RXV HDU, V PRUW WR RWHQ HUSSRUVHFWLRQDV

High Cost of Water

The most commonly cited barrier to water access was the high cost of water trucking. In Deir-ez-Zor, around 5% of monthly funds towards drinking water are expected to have negative effects on the household's welfare. Particularly in light of high and rising food prices (see section on food security).
10. Change in Monthly Water Expense between January 2021 and March 2022

Change in monthly water expense (January 2021 - August 2021)

Data source: REACH HSOS

Change in monthly water expense (August 2021 - March 2022)

Data source: REACH HSOS

## Change in the community:

**Increased:**
- 1% to 50%
- 51% to 100%
- 101% to 500%
- 501% to 1000%
- 1001% to 2900%

**Decreased:**
- 1% to 33%
- 34% to 66%
- 67% to 100%

**No change**

- Community where water expense was 0 before and greater than 0 after
- Community where water expense was greater than 0 before and 0 after
**2. Situation Overview: Impact on Electricity**

**Electricity Production – The Dams**

The most important source of electricity in NES is the Tabqa and Tishreen dams. Both are crucial for the production of electricity, and any decline in their water levels can severely impact electricity generation. For example, in January to March 2022, the water levels in the Euphrates river were observed to be lower than in previous years. The level in Tishreen dam was around 302 meters, which is slightly lower than the level in 2020. However, it shows a substantial recovery up to 310 meters by the end of March.

**Decline in Electricity Access**

Increased water levels are typically associated with reduced electricity access. In January 2021, only 15% of communities had less than 2 hours of access to electricity. This number increased to 4% in March 2022. The reasons for this decline are primarily related to the reduced water levels in the dams. Without sufficient water, the turbines cannot generate electricity.

**Alternative Sources of Electricity**

In cases where electricity access is limited, communities often resort to alternative sources. Solar panels are increasingly used as a backup source, especially in rural areas. However, these sources are expensive and not a reliable substitute for the grid.

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**Notes:**

- The data presented is based on information from various sources, including REACH's HSOS and WASH assessments.
- The electricity situation is dynamic and can change rapidly due to variations in water levels and maintenance of infrastructure.

---

**Figure 11:** Daily Access to Electricity

| January 2021 | March 2022
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 hours</td>
<td>14%</td>
</tr>
<tr>
<td>From 2 to 4 hours</td>
<td>14%</td>
</tr>
<tr>
<td>From 5 to 6 hours</td>
<td>14%</td>
</tr>
<tr>
<td>From 7 to 8 hours</td>
<td>14%</td>
</tr>
<tr>
<td>From 9 to 10 hours</td>
<td>14%</td>
</tr>
<tr>
<td>From 11 to 12 hours</td>
<td>14%</td>
</tr>
<tr>
<td>More than 12 hours</td>
<td>14%</td>
</tr>
</tbody>
</table>
12. Access to Electricity and Main Source of Electricity in March 2022

**Average hours of electricity per day**
Data source: HSOS March 2022

**Main source of electricity**
Data source: HSOS March 2022

**Most reported average hours of electricity per day:**
- Less than 2 hours
- From 2 to 4 hours
- From 5 to 6 hours
- From 7 to 8 hours
- From 9 to 10 hours
- From 11 to 12 hours
- More than 12 hours

**Most reported main source of electricity**
- Main network
- Community generators
- Private generator
- Solar panels
- Car batteries
- Other batteries

---

**Legend:**
- Community
- Sub-district
- Main network
- Community generators
- Private generator
- Solar panels
- Car batteries
- Other batteries

---

**Map:**
- IRAQ
- TURKEY
- Aleppo
- Rural
- Damascus
- Homs
- Hama
- Al-Hasakeh
- Deir-ez-Zor
- Ar-Raqqa
2. Situation Overview: Impact on Electricity

April 2022

Solar has become particularly relevant as households struggle to access (subsidised) fuel and cover high costs of electricity from generators. Even though solar power remains accessible even during periods of fuel unavailability and high costs, the cost of solar panels is such that only relatively better-off households can afford it.

Thus, while alternatives to the network exist, the costs exceed the limited purchasing power of households. This is particularly important in a context where the cost of essential items has risen substantially; the cost of the Standard Minimum Expenditure Bundle (SMEB) increased by 53% year-on-year to March 2022, and by almost 100% since January 2021. Meanwhile, household income has not increased to match the higher costs of living, and this is because the weak economic situation means that wages cannot be increased.

Impacts of Electricity Shortages

Besides private consumption, the lack of electricity is a serious barrier to the functioning of necessary infrastructure. This includes around 200 water pumping stations along the Euphrates which use electricity from the dams. It has also been stated for the whole of Syria that “the shortage of electricity remains the root cause of water supply systems’ underperformance or cessation altogether”.

There have been reports of water treatment systems being bypassed and rationing which aim to save enough energy to supply water pumping stations (and irrigation systems). Especially bypassing water treatment systems poses a large risk to consumers as the water may be contaminated. As few households take measures to make drinking water safer, this may severely affect their health (see health section). Furthermore, hospitals have had to rely on generators and solar power to ensure continued functioning, which increases their costs and decreases their functionality.

The food system as well has suffered as for instance mills report shortages of fuel and electricity. Energy shortages, especially in the context of high costs of other power sources, affect all areas of civilian life and the economy. However, it is difficult to estimate the extent of the humanitarian impact caused by the water shortages because the lack of electricity has been an ongoing problem. For instance, there was a clear downwards trend in electricity access and an increased frequency in reports of rationing in 2021.

Yet, access was already low (9.8h on average) while rationing was frequent (58%) in January 2021, before water levels dropped. REACH’s field team for instance noted the need to rehabilitate the turbines in the dams to improve electricity generation, citing this as a cause for the shortages. Added to that, publicly available information on the energy situation remains scarce and further investigation may be useful.
Agricultural livelihoods have been severely impacted by the water crisis. Rainfed crops largely failed in the previous season while irrigated crops saw large reductions in harvests, leading to a loss of income while food prices have risen. Meanwhile, pastoralists are facing serious issues with sourcing fodder for livestock, leading to large-scale destocking and livestock death. Rainfall levels have remained at a low level this season, causing concern that the livelihoods situation will continue to worsen this year.

Agriculture

The agricultural sector in Syria has come under pressure during the last decades due to droughts paired with falling groundwater levels. The impacts of meteorological droughts have been particularly severe in recent years.

Crop Cultivation

Drought Situation

The meteorological drought (i.e. caused by a lack of rainfall) experienced since late 2020 is illustrated in figure 14. It uses the Standard Precipitation Index, which compares the long-term average rainfall with current rainfall. Thus, we see that almost the entire area of NES experienced an extreme shortfall in precipitation in 2021. This sums to about a 51-68% reduction in rainfall in each governorate in the 2020-2021 agricultural season against the long-term average. Together with the delayed onset of rainfall, the early cessation, and heatwaves starting in April of 2021, this led to extremely low harvests, notably of wheat and barley. For the current season, we again see below-average rainfall in NES, as shown by the SPI; therefore, the Global Drought Observatory reported in March a medium risk of drought impacts on agriculture in NES with parts of Al-Hasakeh governorate at high risk.

Barriers to Irrigation

Irrigation is a highly effective tool for mitigating the impacts of meteorological droughts. However, in NES, many areas lack access to irrigation water due to a combination of political restrictions, infrastructure damage, and competing needs.

Administrational boundaries

- NES
- Sub-districts

SPI

-2 Drier than normal
-1 Drier than normal
0 Near to normal conditions
1 Wetter than normal
2 Wetter than normal

14. Comparison of the 6 Month Aggregated Rainfall Levels with Long-term Averages

March 2020 - August 2020

September 2020 - February 2021

March 2021 - August 2021

September 2021 - February 2022

15

Informing more effective humanitarian action

North East Syria Sector (NES) Food Security & Livelihoods

Agroecology Working Group

NEXUS Forum

REACH

April 2022
3. Situation Overview: Impact on Livelihoods

April 2022

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This becomes particularly obvious when considering harvests in the previous season. Figure 15 shows different land use areas using historical data, with yellow indicating rainfed agriculture and blue irrigation farming. For instance, the Euphrates (West) and Khabur (East) have experienced significant irrigation due to the rivers. Al-Hasakeh governorate uses groundwater for irrigation, allowing for irrigation in areas without surface water.

Figure 16 shows the areas of cropland lost between 2020 and 2021, with irrigated areas on the Euphrates as well as areas using water from canals having experienced fewer losses. Areas around the Khabur river saw losses, likely due to the long-term drying of the Khabur that has been observed.

Figure 17 shows cropland losses by land use type. Observations of harvests confirm that while irrigated crops saw strong declines compared to the 2019-2020 season, rainfed crops in large areas of NES failed entirely. Access to irrigation water was problematic, partially due to reductions in water flow in the Euphrates and the Khabur. REACH conducted a rapid needs assessment (RNA) in Al-Hasakeh governorate in March. Here, 9 out of a total of 13 KIs in Areesheh, Markada, and Shadadah indicated problems with irrigation water being a barrier to agriculture in their subdistrict due to low availability and high cost of water. This appears to be a more important problem than elsewhere in Al-Hasakeh. The subdistricts are situated downstream of the biggest dam on the Khabur river, thus receiving less water than areas upstream. REACH staff in Areesheh subdistrict have previously reported problems with irrigation water in the area, noting that during years of low rainfall, the dam cannot be opened to provide water to farmers in Areesheh – and by extension to Markada and Shadadah – posing a large barrier to agriculture.

Besides the lack of surface water, HSOS data for March shows a strong correlation between reported deficiency of rainfall and lack of water for agriculture – where rainfall is lacking, farmers require irrigation water; if this water is abundantly available, the low rainfall poses little barrier to crop cultivation and vice versa.

(Continues on page 18)
16. Cropland Loss from 2020 to 2021

Methodology Note
The data on cropland changes were derived from annual cropland maps (2021-2020) produced by UNOSAT. These maps were generated based on optical satellite imagery (Sentinel-2, Landsat 8, MODIS), radar imagery (Sentinel-1), optical indices including the Normalized Difference Vegetation index (NDVI) and the Normalized Difference Water Index (NDWI), seasonality metrics, Sentinel-1-derived texture and ancillary data such as elevation and slope. Processing was performed in Google Earth Engine (GEE).
3. Situation Overview: Impact on Livelihoods April 2022

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The highest rate of rainfall deficiency in March was recorded in Aleppo governorate, with 86% of communities reporting this barrier; correspondingly, 69% reported a lack of water for agriculture. Aleppo further lacks resilience against low rainfall levels as it experienced the greatest damage to irrigation infrastructure due to the conflict, together with Al-Hasakeh governorate, with irrigation canals that previously provided water from the Euphrates having been destroyed.

Falling Groundwater Tables

Additionally, groundwater levels have been declining since the 1970s due to a push to increase irrigation. Thus, less water is available, and the cost of accessing it has increased as boreholes need to be deepened and more fuel is required to pump water to the surface. This is exacerbated by rising fuel prices and fuel shortages, as reported by REACH's market monitoring. Note that manually refined fuel is widely available, though at increasing costs, while high-quality fuels were frequently reported to be unavailable. This persistent fuel shortage comes from a lack in capacity. Because of this lack in capacity, the oil reserves present in the area cannot be effectively utilised.

In REACH's RNA in Al-Hasakeh governorate, 92% of KIs (49 of 53) reported the high cost of fuel for pumps as a barrier, with further 58% reporting the high cost of electricity for pumps and 74% reporting the high cost of solar power. Together with the unaffordability of agricultural inputs such as fertilisers, this explains why operational costs were the most frequently cited barrier to accessing livelihoods from agriculture in HSOS, reported by KIs in over 65% of communities in March.

Crop Failures in 2021

In terms of harvest, wheat is Syria's most important winter crop with cotton being the most important summer crop. The FAO reported for the whole of Syria that irrigated wheat productivity halved from 3.2 tonnes per hectare (t/ha) in 2020 to 1.7 t/ha in 2021. Meanwhile, rainfed wheat yields reduced by 2/3 (1.4 t/ha to 0.4 t/ha), going down to zero in Al-Hasakeh and Ar-Raqqa governorates. Thus, after accounting for the increase in area planted, total yields were estimated at 1 million tonnes, just over 1/3 of what was produced the year before. Barley production saw an even stronger decline, with harvests just under 1/9 of the previous year's. This is due to the vast majority of areas not being irrigated (Continues on page 19)
3. Situation Overview: Impact on Livelihoods

April 2022

In cooperation with

Impact on Livelihoods

For cotton harvests, no definitive values for changes in production could be found. However, it is clear that large losses were incurred due in part to decreased cultivation areas in response to high prices of cultivation since the onset of the conflict as well as crop failures due to the lack of water compounded by heatwaves in spring.

This is particularly relevant as Syria was formerly a major cotton exporter with an export value around 420 m USD in 2010 at 4.4% of total export value.

Impact on Farmers' Livelihoods

The RNA in Al-Hasakeh governorate further shows the severe impact of the drought on farmers' livelihoods. 83% of KIs (45 of 54) reported a decrease in the number of people cultivating crops for income.

Tal Hmis had the largest reported decrease, with all three KIs reporting a decrease of 51-75% in their subdistrict. If there was a decrease, KIs most frequently reported people compensating for the loss in income by providing (non-military) security services (37 of 45) or moving into construction (36 of 45). For agricultural wage labourers, somewhat fewer KIs reported a decrease (41 out of 54), however the decreases were reported to be stronger and the increases less intense. Furthermore, while 69% of KIs reported that when people stopped growing crops for income, they stayed within the agricultural sector in a different capacity, only 10% reported this for wage labourers. Instead, 98% (40 of 41) reported that daily wage labourers moved into security services and 85% reported movement into the construction sector.

Darbasiyah, a subdistrict on the border to Turkey, stands out with all five KIs reporting a 26-50% increase in the proportion of people cultivating crops. Darbasiyah was hard-hit by the drought with agricultural cropland decreasing by 65%, but it performed better than Al-Hasakeh governorate on average, which experienced an 82% loss in cropland between 2020 to 2021 (see figure 16). Al-Malikeyyeh subdistrict, in the far north-east of Al-Hasakeh, tends to experience the highest levels of rainfall and correspondingly lost the least cropland at 46% (see endnotes). The RNA thus suggests it saw an increase in the number of agricultural wage labourers and little decrease in crop farmers.

For a breakdown of changes by sub-district, please see figure 18.

(Continues on page 20)
Another solution was to allow households to sell productive assets as a common coping strategy for repaying debts. In addition, 30% of KIs (13 of 53) reported selling of productive assets as a common coping strategy for repaying outstanding debt services, further leading to a vicious cycle of households taking more loans or borrowing more money to cover outstanding debt services, further increasing debt. In March 2022, while borrowing may be effective in bridging short-term gaps in household's disposable income, the ongoing economic difficulties in Syria over the past have eroded households savings and led to high debt interest rates for irrigated crops specifically. By selling productive assets, households reduce the ability to generate income, leaving them even less well-placed to repay debts due to increased demand and the high cost of imports. Due to increased demand and the high cost of imports, which experienced strong price increases the past year (see Crop Cultivation), animals to feed on unharvestable crops. This includes smaller ruminants such as sheep and goats with fewer cows and poultry. Next to crop agriculture, livestock farming is also the most commonly reported strategy for both rainfed crop cultivation, and 25% (13 of 53) did for irrigated crops.

Livestock Farming

Situation Overview

19. Percentage of Assessed Communities Dependent on Livestock in which KIs Reported High Rates of Livestock Death as a Barrier to Livelihoods

20. Change in Herd Size between March 2021 and March 2022

Most reported change in size of herds in the past year by KIs in the Sub-district: Data source: REACH RNA March 2022

- Decreased: 51% to 75%
- 26% to 50%
- 1% to 25%
- No change
- Not applicable

Most reported in which KIs Reported High Rates of Livestock Death as a Barrier to Livelihoods

**Type of herd:**
- Chicken
- Cow
- Goat
- Sheep
- Not applicable

Sub-district where all KIs reported underfeeding animals and giving up livestock farming.
High Rates of Livestock Death and Destocking

%HV LGH VUD WHY R IOLY H WVFN GDWH V D 80, JX DWHKHGU WR LV DP YRU D WH GHV DHU HD, %LVHGVUV WHHYRPH GD WHK, %LQSQJX EADS FSHU HGHGFXLQJOVJKLQWWHGDH V D 80, which many farmers sold parts of their herds to be able to afford fodder for the other animals. The main source of income was agriculture and to a better performance in the eastern sector.

Destocking led to a decline in the meat prices being almost doubling for cow's and goat's milk. Meanwhile, dairy prices increased strongly, about halve despite high inflation rates. Sheep also had the largest median of KIs reporting reductions of over a quarter. However, sheep also had the largest median of KIs reporting reductions of over a quarter. Sheep were most strongly affected, with 67% (34 of 51) of KIs reporting herd sizes at 30 animals, compared to June 2020, most notably for goats and sheep for milk which each saw prices to June 2020, most notably for goats and sheep for milk which each saw prices.

Spill-over Effects from the Agricultural Sector 2017-2019

21. Normalized Difference Vegetation Index (NDVI) for Aleppo Governorate

40,48

The high cost of food for many agricultural households in Aleppo was reported as bad off or worse off than the previous year (see figure 20). Sheep were the most strongly affected, with 67% (34 of 51) of KIs reporting herd sizes at 30 animals, compared to June 2020, most notably for goats and sheep for milk which each saw prices to June 2020, most notably for goats and sheep for milk which each saw prices.

Spill-over Effects from the Agricultural Sector 2017-2019

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Food security is particularly impacted by record low harvests in 2021, as well as ongoing issues with high food prices and barriers to importing food. With current rainfalls remaining low and global food prices rising due to the crisis in the Ukraine, food security is set to worsen further.

High Levels of Food Insecurity

Syria is currently experiencing unprecedented levels of food insecurity. While the drought substantially contributed to this, the situation should be seen in the context of long-term trends in food security. Notably, in 2010, it was tentatively estimated that over 3.5 million people were food insecure. The conflict exacerbated this in multiple ways—by creating strong barriers to agriculture which increased dependence on imports while creating barriers to cross-border supplies, and by eroding purchasing power, thus decreasing households' abilities to cope with high food prices.

COVID-19 has further worsened the situation by causing disruptions to supply chains and decreasing incomes, leading to a 60% increase in food insecurity in one year, up to 12 million people in the whole of Syria in 2021.

This situation is likely to continue deteriorating given extremely low harvests in 2021, paired with new barriers to imports due to the Ukraine crisis.

Impacts of Drought-Related Crop Failure

NES is the main food-producing area in Syria, and thus relies heavily on local production. This is particularly true for bread, with the region previously having been self-sufficient in wheat. However, 2021 saw the failure of rainfed crops and strong reductions in irrigated wheat. Bread has now been rationed, with reports of bakeries substituting up to 20% of wheat with corn. Figure 22 shows the price of bread and flour over the past year. Noticeable here is that flour prices more than doubled year-on-year with a relatively continuous increase. Meanwhile, bread saw a 78% increase with strong fluctuations across the year. These fluctuations predominantly correspond with changes in subsidy regimes, with September 2021 and December 2021 seeing increases in prices of subsidised bread and decreases in support to bakeries. This particularly affected Al-Hasakeh in September and Deir-ez-Zor in December, though the situation in Deir-ez-Zor was later resolved through reinstated support. Note that bread is heavily subsidised in NES, with one report suggesting that consumer prices of subsidised bread only represents around 25% of total production cost. This then also explains the low cost of bread relative to flour, with flour seeing lower subsidies. Decreases in quality and, more recently, partial replacement of wheat with corn flour have mitigated price rises.

Furthermore, regional differences in bread prices are large. Deir-ez-Zor governorate had the highest prices in February of 2022 at 900 SYP (~0.25 USD for an 8-piece bundle) according to REACH's Market Monitoring, around three times as high as in other governorates. This is a strong departure from the situation in November 2021, during which bread prices in Deir-ez-Zor were substantially lower than prices in Al-Hasakeh governorate. iMMAP reported for November that while Deir-ez-Zor had the lowest functionality of bread processing facilities, costs of bread production were lowest in Aleppo and Deir-ez-Zor. However, provisions of subsidised wheat reportedly differed by governorate, with bakeries in Deir-ez-Zor resorting to buying unsubsidised wheat from local markets in the hopes that they might later be reimbursed. However, the administration announced that it would postpone flour payments until further notice and additionally announced late in November 2021 that it would reduce support to bakeries by 20%. This led to bakeries closing in strike and widespread protests as the population lost access to bread. The situation only improved after authorities announced they would support bakeries such that they could work for two to three days a week.

(Continues on page 23)
4. Situation Overview: Impact on Food Security

April 2022

IN COOPERATION WITH

Beyond the cost of bread, food prices increased across the board in the past year. The Survival Minimum Expenditure Bundle (SMEB) for food increased by 56% year-on-year to March 2022 (see Figure 23). September 2021 saw a relatively strong increase after a few months of smaller changes, brought on by a slightly stronger currency deflation paired with increases in prices of some foods, notably bread.

Cost of Food Exceeds Household Purchasing Power

Data suggests that households have been struggling to cover rising food costs. In REACH's HSOS, KIs in 82% of assessed communities reported in March that households cannot afford food. Deir-ez-Zor stands out with KIs in every community reporting this barrier, while the lowest rate was observed in Ar-Raqqa at 73%. In fact, HNAP data for summer 2021 suggests that mean expenditure on food was 61 USD (median 47 USD) while mean income was 89 USD (median 91 USD), suggesting that the majority of household income is spent on food. The highest relative expenditures were recorded in Menbij subdistrict, Aleppo governorate, where the ratio was 95%. This is highly problematic as KIs in 92% of communities reported in March that incomes did not cover the cost of living, according to REACH's HSOS.

Coping strategies reflect the problems with affordability, as purchasing food on credit and borrowing money (reported in 79% of communities), buying less preferred and lower quality foods (76%), and buying food with money usually spent on other things (67%) are most frequently reported in the March 2022 round of HSOS.

REACH further conducted an RNA in March 2022 in which KIs reported decreases in farming for income and agricultural wage labour in most subdistricts in Al-Hasakeh. However, there were notable increases in the number of households growing crops for own consumption in many subdistricts. Own food production may be beneficial to food security as it makes households less dependent on the functioning of food markets, thus increasing resilience against price spikes, barriers to access, and such.

Conclusions for Food Security

Both high levels of relative food expenditure and the (common) use of multiple coping strategies are indicators of high food insecurity, showing that households have difficulties in acquiring enough quality food and that they are vulnerable to fluctuations in the cost of food. The World Food Programme reported for February 2022 that NES had some of the highest levels of insufficient food consumption, affecting 70% of households in the whole of Ar-Raqqa and 60% in Al-Hasakeh.

The severity of this food insecurity is reflected not only in the number of coping strategies used, but also in the use of more extreme coping strategies. KIs in 20% of assessed communities reported households skipping meals, and 19% reducing meal sizes, to cope with the lack of food in March 2022. Adults are also particularly strongly affected as they often go without food to ensure that vulnerable household members can eat.

The current situation is set to worsen further in 2022 due to the previous year's low food production leading to diminished food reserves and eroded purchasing power, while the difficult geopolitical situation of Syria and rising global food prices make food imports expensive.

23. SMEB Price of Food

24. Change in Proportion of Households Growing Crops between June 2021 and March 2022
5. Situation Overview: Impact on Health

The crisis has mainly impacted health through reduced access to safe drinking water and water for hygiene, as well as through reduced food security. Of particular concern are waterborne diseases as well as high rates of malnutrition. However, malnutrition monitoring in NES is incomplete and requires further attention.

Reductions in Hygiene

The changes to water consumption resulting in reduced food availability reportedly led households to reduce their use of water for hygiene. Specifically, KIs in 32% of communities reported in July and August of 2021 that households bathed less frequently; 32% reported in June that laundry was done less often; and 12% reported reduced handwashing in August. This comes with a range of issues, including the spread of infectious diseases such as COVID-19 and the risk of skin disease.

Low Water Quality

In addition, in 2021 there was an increase in communities for which KIs reported the use of private boreholes and wells as the primary water source while use of the piped network decreased. For drinking water specifically, KIs reported a greater reliance on water trucking last summer (see section Water Availability).

Boreholes allow access to groundwater, which is of mixed quality in Syria. Around 40% has high levels of sulphate or salt, making it unsuitable for consumption. Furthermore, PAX reported on high levels of surface and groundwater pollution through leakages of oil and oil waste, unsafe waste disposal, and discharge of untreated sewage. For NES, KIs in 80% of assessed communities reported that their community was not connected to the sewage network, which likely impacts the quality of local water resources and increases the risk of waterborne diseases. In Ar-Raqqa and Deir-ez-Zor governorates in particular, sewage is directly evacuated into the Euphrates. Not only does this impact communities on the Euphrates, but also communities sourcing water from trucks that rely on the river.

Given the issues with water quality, groundwater and water from trucks often require treatment to be safe for consumption. Chlorine for instance can be used to inactivate bacteria and viruses. Free residual chlorine then indicates that enough chlorine was used to initially sanitise the water, and that the water is...
protected from contamination during storage. The safety of stored water is particularly important as many households use stored water for drinking, cooking, and personal hygiene. Water stored in closed wells may be protected from contamination during storage, but the method of storage may protect the water from contamination, but does not make it safer. Meanwhile, 63% of water from closed wells had no residual chlorine. The WHO reports increased levels of acute diarrhoea in NES in 2021 compared to 2020, particularly from late March through June. The highest caseload was reported in Deir-ez-Zor, which had severe acute malnutrition.

Malnutrition

Malnutrition has severe health impacts, particularly for children, leading to increased mortality, higher rates of morbidity, second only to influenza-like illness (ILI), twice as high as the year before (around 300 cases per week). The WHO reports increased levels of acute diarrhoea in NES in 2021 compared to 2020, particularly from late March through June. The highest caseload was reported in Deir-ez-Zor, which had severe acute malnutrition.

Malnutrition

Global acute malnutrition, of which 3% of children between 6-59 months were moderate acute malnutrition, and 13% of under-5-year-olds suffered from severe acute malnutrition, and 13% of under-5-year-olds suffered from severe acute malnutrition. In five communities in NES, which found that 7% of children between 6-59 months were moderate acute malnutrition, and 13% of under-5-year-olds suffered from severe acute malnutrition, and 13% of under-5-year-olds suffered from severe acute malnutrition. Children reported on cases of mothers wasting (suggesting acute malnutrition) going without food in favour of buying clean water, and subsequently struggling to produce enough and high-quality breastmilk. They further conducted a study of breastmilk and soon after, the onset of the water crisis.

Medical findings are therefore omitted from the graph. Malnutrition is currently the second leading cause of child death, second only to influenza-like illness (ILI), twice as high as the year before (around 300 cases per week). The WHO reports increased levels of acute diarrhoea in NES in 2021 compared to 2020, particularly from late March through June. The highest caseload was reported in Deir-ez-Zor, which had severe acute malnutrition.

5. Situation Overview: Impact on Health

April 2022

In cooperation with

Regional findings are therefore omitted from the graph.

26. Water Perceived to Be Making People Sick

Data from HNAP in the whole of Syria last summer reports that 19% of water from trucks and, which was associated with water from HSOS trucks.

Global acute malnutrition, of which 3% of children between 6-59 months were moderate acute malnutrition, and 13% of under-5-year-olds suffered from severe acute malnutrition. In five communities in NES, which found that 7% of children between 6-59 months were moderate acute malnutrition, and 13% of under-5-year-olds suffered from severe acute malnutrition. Children reported on cases of mothers wasting (suggesting acute malnutrition) going without food in favour of buying clean water, and subsequently struggling to produce enough and high-quality breastmilk. They further conducted a study of breastmilk and soon after, the onset of the water crisis.
Footnotes

a. REACH HSOS data asks KIs what proportion of households in their community had access to sufficient water. Responses are classed in intervals of 20% (0%, 1-20%, 21-40% etc.). The average here is calculated by taking the midpoint of the interval (0%, 10%, 30% etc.). The 20% insufficiency reported here is the average for assessed communities, rather than of the assessed households.

b. The reduced use of the private network appears to have been compensated through the increased use of private boreholes and wells.

c. In August, a KI in one community reported the piped network as the primary water source.

d. For the Standard Precipitation Index (SPI), historical rainfall data is fitted to a probability distribution. This means that the differences between current rainfall and the long-term average can be related to how much annual difference would be expected (in terms of standard deviations). An SPI of less than -2 suggests extreme dryness (2 standard deviations lower than the long-term mean), and is extremely unlikely. Note that this only refers to meteorological drought and does not capture streamflow in rivers, groundwater levels, or such.

e. Note that this reliance on agriculture is based on KI reports of agriculture or livestock being a common source for meeting basic needs in their community, and thus does not necessarily reflect the number of people that rely on agriculture. For a subdistrict level breakdown of the percent of working aged population engaged in agriculture, please see Figure 2 in source 34, which shows particularly high rates of agriculture in parts of Aleppo and Deir-ez-Zor.

f. Reported at the same frequency as lack of access to fodder for livestock.

g. Note that a distinction is made between people who cultivated crops for income, which are people who own, rent, or otherwise have access to land on which they grow crops, and agricultural wage labourers, who are hired by farmers to work on land that is not their own.

h. Vegetation here is quantified using the NDVI, which uses satellites to measure vegetation greenness. It is useful in understanding both the density and the health of vegetation, with higher values indicating a higher density and greenness.

i. Including areas of the governorates outside of NES.

j. Fertiliser can lead to eutrophication of water, which occurs when nutrient levels in water increase. This leads to strong aquatic plant growth, depleting oxygen in the water and potentially causing harmful algae bloom which may be toxic to humans.

k. KIs in 69% of communities (24 of 35) who reported a combination of the network and trucking as their primary source and 54% (19 of 35) who reported private water trucking reported that they perceived the water to be making people sick. For those who predominantly used the private network, only 13% reported this (2 of 15).

Changes in Cropland Areas

The data on cropland area referenced on p.18 (figure 18) and the changes to cropland map on p.17 (figure 17) was derived from annual cropland maps (2017-2021) produced by UNOSAT. These maps were generated based on optical satellite imagery (Sentinel-2, Landsat 8, MODIS), radar imagery (Sentinel-1), optical indices including the Normalized Difference Vegetation index (NDVI) and the Normalized Difference Water Index (NDWI), seasonality metrics, Sentinel-1-derived texture and ancillary data such as elevation and slope. To differentiate cropland from other land cover classes (e.g. water or urban areas), supervised image classification (Random Forest) was applied using training samples that were collected through visual interpretation of satellite imagery.

NDVI Graph

The data for the NDVI graph shown on p.21 (figure 21) is generated based on optical satellite imagery (Sentinel-2). Non-cropland was masked out using 10m annual cropland maps produced by UNOSAT; as the cropland map of the season 2021/2022 is not available yet, NDVI images of this season were masked with the cropland map of 2020/2021. This could lead to less accurate NDVI trends for the current season 2021/22, as active crop fields might be excluded and inactive crop fields included.

Groundwater Analysis

The GRACE satellite measures anomalous changes in gravity compared to long-term averages. At monthly scales, changes in gravity are primarily due to terrestrial water movement. Gravitational changes can therefore be converted to Terrestrial Water Storage (TWS) changes, i.e., changes in water thickness (mm). TWS is a sum of snow water, soil moisture, surface water, and groundwater storage. The groundwater storage (GWS) is defined as the water stored below the root zone soil layer and above the bedrock and derives by modeling and subtracting soil, surface, and surface water from TWS.

GWS = TWS - RootZoneSoilMoisture - SnowWaterEquivalent – CanopyInterception

Sources

\[ V(D\backslash S) + 626 GDWD DVNV_... YKWKLH FRDQLQDLQWDK FDWLQLQDK DVQRWDEORFXUUHLQKWKH \]
The Standard Precipitation Index (SPI) describes the probability of variation from the normal precipitation over multiple years of data, on a monthly (or multiple months) time step (McKee et al., 1993). SPI is defined by the z-score deviation of the mean rainfall for a given reference period (e.g., given month of the year) in units of the standard deviation. Positive SPI values indicate greater than long-term mean rainfall (wet conditions) while negative values indicate lower than long-term mean rainfall (dry conditions).

To compute SPI, Climate Hazards Group InfraRed Precipitation With Station (CHIRPS) data were used. CHIRPS have a spatial resolution of 0.05 degrees (≈5.5km) and a temporal resolution of one day starting in 1981.

SPI was computed in Google Earth Engine (GEE) following recommended practices by UNOSAT. Due to limitations in GEE, a gamma probability function, which is commonly used to calculate SPI, could not be applied. Therefore, results should be interpreted as estimations of SPI.

4. iMMAP. (2021c). Water Dynamics, Crises, and Challenges in Northeastern Syria.


34. North East Syria Agriculture Working Group (AWG), iMMAP , Food Security and sites/reliefweb.int/files/resources/NES-WtB-Summary-Report-November_V2_020222.pdf


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