

THE DROUGHT-MIGRATION- CONFLICT NEXUS

Was the Syrian Civil War Really Caused by
Climate Change?



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THE DROUGHT-MIGRATION-CONFLICT NEXUS: Was the Syrian Civil War Really Caused by Climate Change?

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Front cover image: Formerly one of the
most active places in Daraa City, today it is
mostly rubble. Photo by Mahmoud Sulaiman,
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About UNU-INWEH

The United Nations University Institute for Water, Environment and Health (UNU-INWEH) is one of 13 institutions comprising the United Nations University (UNU), the academic arm of the United Nations. Established in 1996 through an agreement with the Government of Canada, UNU-INWEH is headquartered in the City of Richmond Hill, Ontario.

UNU-INWEH specializes in addressing critical global security and development challenges at the intersection of water, environment, and health. Through research, capacity development, policy engagement, and knowledge dissemination, the institute bridges the gap between scientific evidence and the practical needs of policymakers and UN member states, with particular attention to low- and middle-income countries. By collaborating with a diverse array of partners—including UN agencies, governments, academia, the private sector, and civil society—UNU-INWEH develops solutions that advance human security, resilience, and sustainability worldwide.

Foreword

Climate change is reshaping global security dynamics, with water stress, agricultural disruption, loss of livelihoods, population movements, and armed conflicts emerging as urgent and interconnected challenges. Yet, as this report demonstrates, the links between climate change, migration, and conflicts are complex. Oversimplified and reductionist narratives risk obscuring the deeper structural drivers of vulnerability—particularly those related to governance, resource management, socio-economic inequality, and human security.

The United Nations University Institute for Water, Environment and Health (UNU-INWEH) is pleased to present this timely analysis of the climate–migration–conflict nexus in the Syrian Arab Republic. The report offers a nuanced, evidence-based assessment of how climate stress interacts with long-standing agricultural and governance dynamics. It challenges the widely held view that the 2007–2009 drought singularly triggered the 2011 uprising, instead situating this period within a broader historical, institutional, and socio-economic context.

The Syrian experience offers the world a powerful lesson: agricultural vulnerability to drought is shaped far more by governance, policy choices, and long-term development pathways than by climate alone. Rapid expansion of water-intensive agriculture, dependence on subsidies, and weak water governance created deep structural fragilities which were often worsened by short-term fixes, such as large-scale irrigation. True resilience requires avoiding maladaptation, integrating traditional water-harvesting and land-management practices with modern technologies, diversifying crops and farming systems, and ensuring that adaptation strategies consider long-term impacts on people and ecosystems.

In conflict-affected contexts, stability, local-scale cooperation, and inclusive water governance become essential foundations for rebuilding. Ultimately, the world can learn that sustainable drought resilience depends not only on managing water, but on strengthening institutions, empowering farmers, including stakeholders in decision-making, and designing policies that reduce vulnerability and manage associated risks over time.

UNU-INWEH remains committed to advancing research that supports evidence-informed decision-making and helps governments, practitioners, and international partners address the interconnected challenges of environment, development, and security. This report offers meaningful insights to guide integrated policy and programming at national, regional, and international levels.

We look forward to working with partners to translate these findings into concrete action—supporting resilience, fostering sustainable development, and helping to build a more peaceful, stable, and climate-resilient future for the region.



*Prof. Kaveh Madani
Director, UNU-INWEH*

Executive Summary



A farmer tending to her crops in Idlib, Syria. Photo by Almed Akacha, Pexels.

Climate change is increasingly recognized as a major security concern, with drought-migration-conflict linkages attracting significant attention in both policy and research. While some narratives portray drought as a direct driver of migration and conflict, evidence shows a far more complex relationship: climate stress can lead to more migration in some contexts and less in others, with internal movements generally more common than international ones. For conflict, research generally finds socio-economic and political factors to be more important than climate stress. This report by the United Nations University Institute for Water, Environment and Health (UNU-INWEH) analyzes the linkages between climate change impacts, agricultural dynamics, migration, and armed conflict in the Syrian Arab Republic (Syria). Its findings challenge oversimplified accounts of the 2007–2009 drought as a singular trigger for the 2011 uprising, instead situating drought impacts within a longer history of unsustainable agricultural development, resource overexploitation, and governance shortcomings.

The Syrian climate-conflict nexus narrative focuses on how a meteorological drought between 2007 and 2009 led to widespread crop failures and rural to urban migration, the years before the Syrian uprising in 2011, which rapidly turned into a civil war. This narrative has been put forward both in media publications and in academic literature but has also been widely criticized for being overly simplistic and disregarding the history of the region, the socio-political context in the Middle East and North Africa (MENA) as a whole, and for the over-reliance on meteorological measures of drought, rather than agricultural and socio-economic perspectives.

This report draws mainly on meteorological data, satellite-based land use monitoring, and field research with Syrian farmers in the Republic of Türkiye to capture the complex interactions between climate stress and societal responses. It underscores that migration and agricultural challenges were already present before the drought and were later intensified by the civil war, rather than being its direct consequence.

The report identifies little drought related land abandonment, and high levels of cropland activity in 2010, just before the Syrian uprising started. The war, on the other hand, likely drove land abandonment due to shifting migration dynamics from an adaptive measure towards forced displacement with little chance of return to the land.

As Syria enters a post-Assad phase, addressing the compounded effects of conflict and climate stress will require integrated, conflict-sensitive policies. These should combine modern technologies—such as efficient irrigation systems and drought-resistant crops—with traditional approaches like rainwater harvesting and floodwater spreading, alongside governance reforms that strengthen adaptive capacity and reduce vulnerability.



A view of Daraa city from the Karak neighborhood in Syria. Photo by Mahmoud Sulaiman, Unsplash.

Key Findings

- **The ‘Drought-Migration-War’ narrative oversimplifies the complexity of agricultural vulnerability** – Syria’s civil war and ongoing crisis cannot be traced to a single cause but lies deeply rooted in the political system and maladaptive socioeconomic development, and their effects on the agricultural sector.
- **Shift in drought patterns** — Droughts in Syria have become more frequent and intense, with findings suggesting rising temperatures, rather than reduced precipitation, are increasingly driving these events.
- **The 2007-2009 drought caused short-term disruption, not collapse** — While cropland fallowness spiked during the drought, agriculture rebounded quickly; yet vulnerability to future droughts increased.
- **High land abandonment rates predated the 2008 drought** — 19% of cropland was abandoned between 2001–2016, driven by intertwined political, socioeconomic, and environmental changes, not solely by drought.
- **Migration before 2011 was mostly short-term and adaptive** — Prewar movements were largely internal and temporary, often linked to economic pressures and perceived drought impacts.
- **War shifted migration to forced displacement** — From 2011 onward, insecurity, loss of services, and conflict became dominant migration drivers, with external migration surging and adaptive labor migration declining.
- **Policy and governance failures amplified drought vulnerability** — Rapid expansion of water-intensive, subsidy-dependent agriculture, weak water governance, and later abrupt subsidy removals eroded farmers’ adaptive capacity and increased both short- and long-term risks.
- **Traditional practices and new crop varieties offer resilience potential** — Reviving rainwater harvesting, floodwater spreading, and drought-resistant crops could reduce vulnerability if integrated into long-term, conflict-sensitive strategies.



Sunflower in bloom, Idlib Governorate, Syria. Photo by Ahmed Akacha, Pexels.

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Acronyms and Abbreviations

CHIRPS	Climate Hazards Group InfraRed Precipitation with Station data
CRU	Climatic Research Unit (University of East Anglia)
FAO	Food and Agriculture Organization of the United Nations
GAP	Southeastern Anatolia Project (Türkiye)
ICARDA	International Centre for Agricultural Research in the Dry Areas
IPCC	Intergovernmental Panel on Climate Change
MODIS	Moderate Resolution Imaging Spectroradiometer
NDVI	Normalized Difference Vegetation Index
PET	Potential Evapotranspiration
PRIO	Peace Research Institute Oslo
SPEI	Standardized Precipitation Evapotranspiration Index
SPI	Standardized Precipitation Index
UNCCD	United Nations Convention to Combat Desertification
UNU-INWEH	United Nations University Institute for Water, Environment and Health

1. Introduction



A boy washing his face with water, Idlib governorate, Syria. Photo by Ahmed Akacha, Pexels.

The Syrian civil war - a climate war? The Syrian civil war, which began in 2011 was preceded by a severe drought between 2007 and 2009, with the most intense period occurring in 2008. The Syrian Arab Republic (Syria) regularly experiences drought conditions, with approximately every third year being a dry year¹. Nonetheless, it has been argued that the severity and length of the Syrian 2007-2009 drought was the direct result of climate change^{2,3}. In line of this argumentation, the drought has been claimed to have caused an agricultural collapse and to have been a significant trigger for the Syrian civil war, labelling it even as a “climate war”⁴. This label has fuelled an ongoing scientific debate, raising questions about the extent to which climate change can be directly attributed as a primary and sole driver of the conflict⁵. This report critically engages with this debate by examining the links between drought, agricultural land abandonment, and migration patterns in Syria over the past 20 years.

The drought-migration-civil war narrative has gained much attention, but critical uncertainties remain. A prominent claim is that drought-induced land abandonment and subsequent migration directly contributed to the Syrian civil war^{3,6}. However, this report argues that this narrative oversimplifies the dynamics of migration and conflict. The results indicate that migration before the conflict was largely internal, adaptive, and aligned with existing livelihood strategies, whereas the displacement during the war was primarily external, with limited prospects for return. This distinction is critical to understanding the drivers of migration in Syria, as well as the limitations of attributing such dynamics solely to singular factors.



Man walking down a road in Idlib Governorate, Syria. Photo by Ahmed Akacha, Pexels.



Aerial view of farm in Syria. Photo by Salah Darwish, Unsplash.

It is essential to clarify the direction of the relationship between drought, migration, and conflict. The idea that drought caused mass migration, which then led to conflict, overlooks other contributing factors to both migration dynamics and the civil war in Syria. While the scale and permanence of drought-induced migration as well as their influence on the emergence of the civil war are contested, this study finds that the conflict itself played a significant role in driving migration. Given that the 2008 drought affected the entire eastern Mediterranean region, not just Syria⁷, yet only Syria experienced the outbreak of a civil war, this report argues that simplistic cause-effect models fail to capture the non-linear relationships between drought, migration, and conflict. This investigation hence employs a comprehensive approach that integrates remote sensing analysis of land use patterns, meteorological drought indicators, and qualitative field surveys to provide a nuanced understanding of agricultural dynamics and their relationship to migration. Through this combined analysis, the report aims to clarify the causal links between drought impacts, agricultural vulnerability, and human displacement, offering new insights into the complex interplay between climate and conflict in Syria.

2. STUDY AREA AND CONTEXT



A Iraqi Kurdistan girl by the dried up river in 2012. Photo by Lina Eklund.

Syria has a complex history as a cultural and commercial hub in the Middle East. Today's nation-state was established as the 'Syrian Arab Republic' in 1961, but its predecessors and the region it encompasses look back on several millennia as a cultural and commercial center of the region¹. Situated on the geographical threshold between Eastern Europe, Northern Africa and Western Asia, the country has a diverse ethnic, political, religious and cultural history, with shifting territorial powers and influences. Emerging from centuries of imperial rule by the Ottoman Empire from 1516 to 1918 and a subsequent, short-lived mandate under France until 1946, modern day Syria, despite its manifold internal and external conflicts and problems, "has a manifest role in the region"⁸. It borders the Republic of Türkiye (Turkey) to the north, the Republic of Iraq (Iraq) to the east, Jordan to the south, Israel to the southwest, and Lebanon to the west, while its western coastline meets the Mediterranean Sea on a length of about 180 kilometers.

Syria's diverse topography features several distinct landscape regions. In the west, a coastal plain stretches along the Mediterranean, bordered to the east by the narrow mountain range 'Jabal al-Sahiliyah' that runs parallel to the coast and merges into the Anti-Lebanon mountains that form the country's south-western border to Lebanon. The interior is characterized by vast steppe plains and rugged desert mountains. The desert is intersected by the green ribbon of the Euphrates River and its fertile riverbanks.

As the arid climate exacerbates water scarcity through elevated evaporation rates, only few larger open bodies of water exist – mainly dammed sections of the Euphrates and its tributaries which are used for irrigation and hydroelectric purposes.

The Syrian climate is characterized by arid and semi-arid conditions. The country experiences a typical Mediterranean climate in the small western coastal plains, with mild, wet winters and hot, dry summers. Inland, the conditions become increasingly arid, from a semi-arid cold steppe climate in the west to a warm desert climate in the south-east of the country¹. Average annual rainfall is unevenly distributed, ranging from up to 1,400 mm in coastal areas to less than 200 mm in the Syrian Desert⁹. Seasonal rainfall variability and recurring periods of dryness are common¹; however, recent years have seen an increase in the frequency and duration of droughts, which have been attributed to the growing impacts of climate change on local meteorological patterns³.

Agriculture is a main pillar of the Syrian economy. The country's agricultural sector is split between irrigated and rainfed systems, with irrigated agriculture largely concentrated around the Euphrates River and its tributaries. Syria has rapidly expanded its irrigation infrastructure since the 1970s, as the agricultural sector became one of the main development priorities under the rule of Hafez al-Assad. As a result, Syria transitioned from a grain importer to an exporting

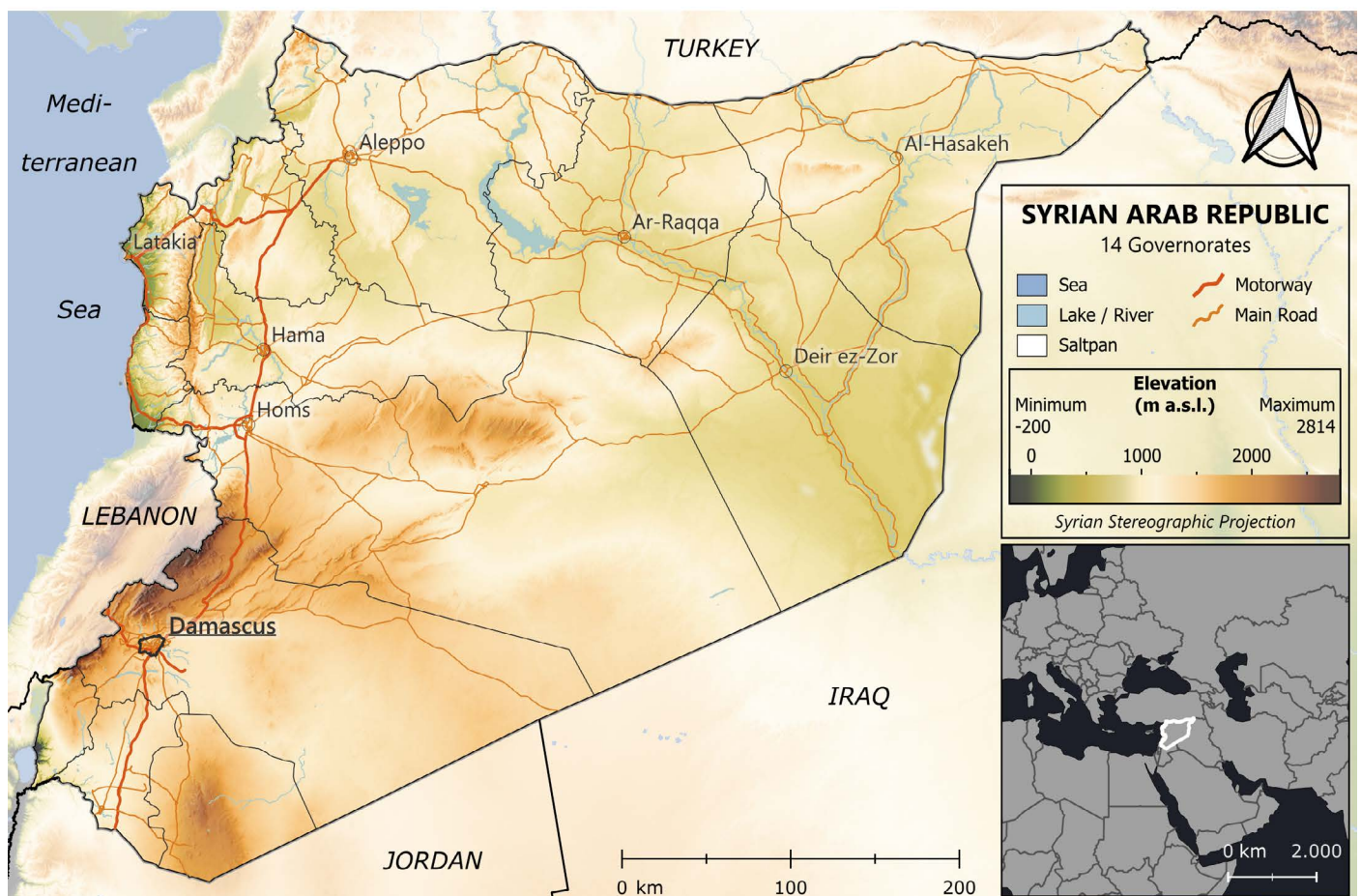


Figure 1: Topographical Map of Syria. Shown are the neighboring states and seas, the internal boundaries of Syria's 14 governorate states, the biggest cities and roads.

country in the 1990s¹. Today, however, the irrigation-dependent agriculture faces severe challenges due to over-exploitation of water resources, inefficient irrigation practices⁶, and transboundary water-politics between Türkiye, Syria and Iraq^{1,10}. By contrast, rainfed farming

is predominantly practiced in Syria’s northwest and northeast. Despite having been the dominant cropping system for millennia⁶⁰, its reliance on seasonal rainfall makes it highly susceptible to climatic variability and drought¹¹.

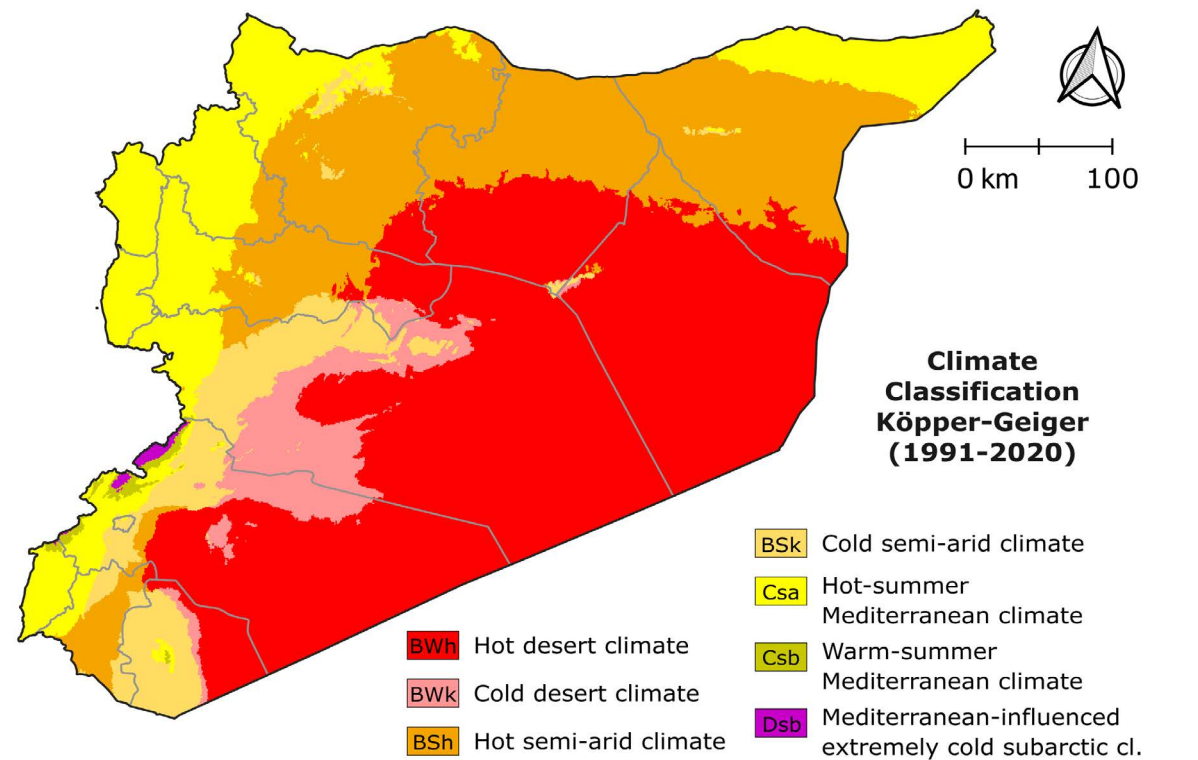


Figure 2: Map of climate classification zones in Syria. Zones according to Köppen-Geiger and based on climate data of the period 1991-202012.

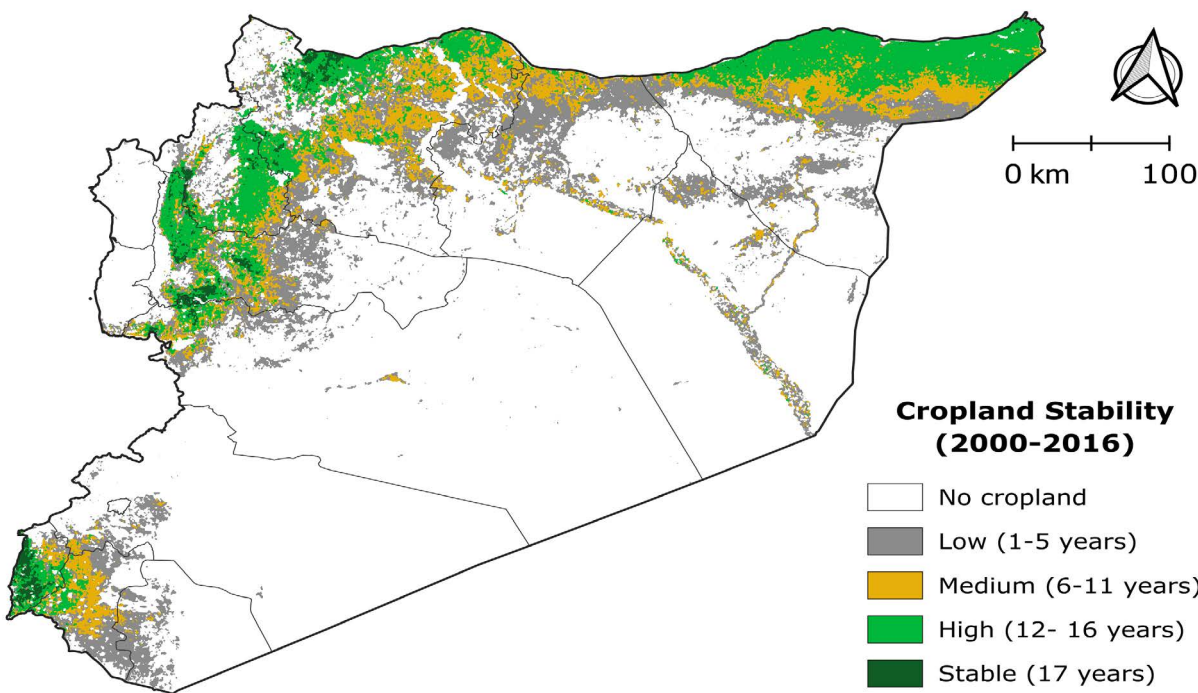


Figure 3: Map of agricultural stability in Syria based on cropping frequency over a period of 17 years (2000-2016). The cropping frequency indicates how many years in the given period an area was actively cultivated.

3. METEOROLOGICAL DROUGHT AND ITS IMPACT ON AGRICULTURE



Tents at a campsite surrounded by mountains in Idlib governorate, Syria. Photo by Ahmed Akacha, Pexels.

The term "drought" describes temporary water shortages in environmental and societal systems. The scientific literature has offered many definitions for the term but the traditional definitions of drought are based on deficit in water-related variables or water-dependent activities due to natural changes and anomalies that are out of the control of humans¹³. This is in line with the general societal perceptions that consider drought as an act of nature. Accordingly, the most frequently used drought definitions and categories include: meteorological drought, i.e. a decrease in precipitation; hydrological drought, i.e. a decrease in the amount of water in surface water and groundwater reservoirs; and agricultural drought, i.e. a decrease in soil moisture that adversely affects vegetation¹⁴. Direct analysis of hydrological and agricultural drought requires extensive data monitoring and collection, which is lacking in Syria. Therefore, this analysis approximates data on agricultural drought by conducting a combinatory analysis of meteorological indicators and their effects on cropland dynamics.

Meteorological drought is a recurring climatological phenomenon in Syria. Based on the SPEI-6 index, Syria experienced alternating cycles of drier and wetter years from 1960 until 2000. Twelve years in this forty-year period were considered dry (SPEI-6 <-0.5), while 13 years had an above-average amount of water (SPEI6 >0.5). The years 1970, 1973, 1989 and 1999-2000 saw particularly dry conditions, with SPEI-6 values below -1. However, in the following twenty-year period from 2001 until 2022 conditions were significantly drier than normal, as more than half of the years experienced drought conditions (SPEI-6 <-1) and only two years with above average water availability (SPEI6 >0.5) were observed. In contrast, the analysis of the SPI index

for the period 1981-2022 revealed drought conditions only for the years 1990 and 2008 (SPI-6 <-0.5), while all other years were classified as close to normal. As the SPI measures only precipitation, the divergence between the two indexes suggests that recent droughts were more influenced by increased temperatures rather than decreased precipitation, underscoring the critical need for further research to investigate and validate this potential shift in drought drivers.

The term "fallowness" describes normally active cropland that is inactive during a certain year. As such the term is strongly tied to land use dynamics and cropping techniques – resembling a common procedure in certain land use systems (such as, e.g., rainfed agriculture and shifting cultivation), while missing almost entirely in others (e.g. greenhouse farming and agroforestry). It can be used as a proxy indicator for land use intensity and agricultural productivity, with longer and/or more frequent fallow cycles indicating less intensive land use^{16,17}.

Syrian croplands commonly exhibit periods of fallowness. In order to better understand the impact of meteorological drought on Syrian agriculture, Eklund et al.¹¹ conducted a time series analysis of remote sensing data on cropland dynamics for the years 2000 to 2016 and linked it with the dataset of the SPEI6-index (derived from the CRU v.3.22). The analysis revealed a mean of 25% fallowness in cropland over the study period (2000-2016). Yet, the intra-annual variability was high, as in 2000 and 2008 around 50% of cropland lay fallow, while 2010 and 2013 saw high levels of cultivation with nearly 90% of cropland actively used. Overall, the period of 2000-2007 saw lower rates of fallowness than the period of 2008-2016. This can

Standardized Precipitation Index

The 6-month Standardized Precipitation Index (SPI-6) is an indicator for meteorological drought. It monitors precipitation anomalies over 6-month accumulation periods and can be used as a proxy indicator for medium-term impacts such as reduced stream flow and reservoir storage.

The indicator is calculated as an average of six months total precipitation anomalies derived from the Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS - <https://www.chc.ucsb.edu/data/chirps>). It has a spatial resolution of 0.05 decimal degrees and a temporal resolution of 5 days.

This analysis calculated the SPI-6 of the years 1981-2022 for the period from November to April, as these months capture the wet season prior to the main harvest in spring/summer.

Standardized Precipitation Evapo-transpiration Index

The 6-month Standardized Precipitation Evapotranspiration Index (SPEI-6) is an extension of the commonly used SPI-6. The SPEI is designed to take into account both precipitation and potential evapotranspiration (PET) for determining meteorological drought. Thus, unlike the SPI, the SPEI captures the main impact of increased temperatures on water availability.

Our a of the indicator was based on data from the Climatic Research Unit of University of East Anglia CRU v.3.22, acquired through PRIO-GRID 2.015 (<https://grid.prio.org/>). It has the same spatial and temporal resolution as the SPI-6.

be attributed to the earlier period being less dry (even when excluding the 2007/2008 drought) as compared to the later period.

Fallowness patterns follow dryness patterns with a certain time lag. In 2006 and 2007 – the onset of the 2008 drought – fallowness levels were below median, with only 15% and 16% respectively. At the height of the drought in 2008, fallowness spiked to 50%. Then, as the drought intensity lessened, fallowness notably decreased to 25% in 2009 (average fallowness levels) and fell to a near-record low of 10% in 2010. A similar recovery can be seen for the drought in 2000, when half of the cropland lay fallow, but bounced back to mean cropland activity levels by 2002. These findings

indicate that 1) drier periods coincide with cropland declines, but 2) agricultural production quickly recovers from impacts of drought, consistent with the results of a global analysis on agricultural drought impacts¹⁸. While detailed information on grazing and livestock dynamics in the study period is lacking, national-scale data (FAO, 2021) confirms the trends observed on cropland (Supplementary discussion 1 in Eklund et al.¹¹), which show severe decline during droughts and a rapid recovery afterwards.

Drought impacts and agricultural recovery exhibit geographical variability. While the drought in 2008 had a profound impact on croplands across Syria, the northeastern province of Al-Hassakeh, a key grain-

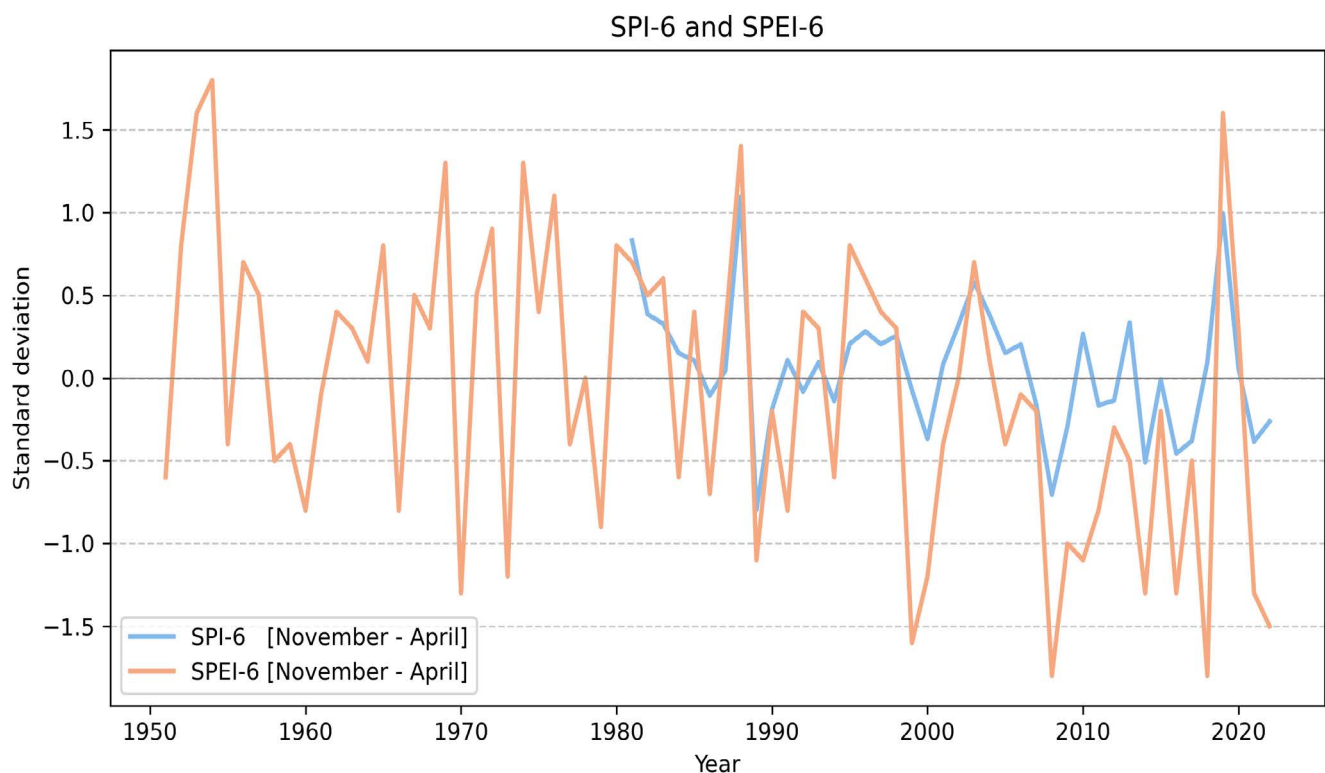


Figure 4: Estimated annual water availability as an effect of precipitation and evapotranspiration (SPEI6, 1960-2022) and precipitation anomalies (SPII6, 1981-2022).

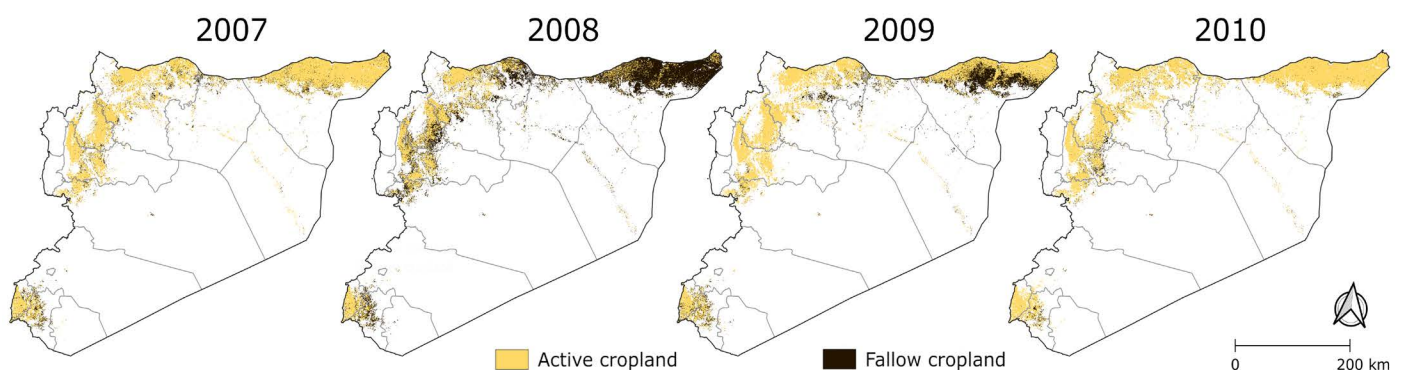


Figure 5: Fallowness patterns in the years prior to the civil war (2007-2010).

producing area, was particularly affected. In 2008 most agricultural land in this region, regardless of cropping frequency, was left fallow or suffered significant crop failures resulting in fallowness and only partially recovered in 2009. The recovery in 2009 was observed mainly in areas with higher cropping frequencies in the western regions of Syria, whereas croplands in the north-east, and especially the less frequently cropped and marginal areas, remained fallow. This suggests a prioritization of cultivation in regions practicing high-intensity farming. Furthermore, it indicates that croplands in the north-east, which had seen the most aggressive cropland expansion in the years preceding the drought, had a slower recovery from the effects of the drought.

Refuting claims of an agricultural collapse due to effects of the 2008 drought. Scholars have argued that a drought-induced collapse of Syria's agricultural sector occurred before the civil war onset³. As the understanding of collapse varies, this investigation chose to apply the Cumming and Peterson¹⁹ framework for socio-ecological collapse in testing for evidence of such collapse. The framework outlines four indicators that must be met for a system to classify as collapsed. The analysis found that the changes to the agricultural

system were indeed (1) abrupt, as indicated by the sudden increase in fallowness from 16% in 2007 to 50% in 2008, likely caused by drought-induced crop failures. However, this did not represent a (2) substantial loss compared to previous disturbances, as the analysis found similar levels of fallowness during the 2000 drought with complete recovery by 2002. The disruption of the agricultural system during the 2008 drought was further (3) not persistent, with active cropland partially recovering in 2009 and reaching a near-record high in 2010. Evidence was found for a (4) structural change of increased agricultural vulnerability towards drought after the 2008 drought, as indicated by elevated effects of the drought-indicator SPEI on fallowness for this timespan (see Figure 7).

Agricultural vulnerability towards drought has increased since 2008. Yet, this analysis suggests that the increase was caused not by the impacts of the 2008-drought alone but by the compounding effects of unsustainable agricultural practices and governance, yellow rust outbreaks in 2010 and local impacts of armed conflict in the onset of the civil war in 2011. The complexity of these impacts on Syrian agriculture and associated land use changes are examined in the following section.

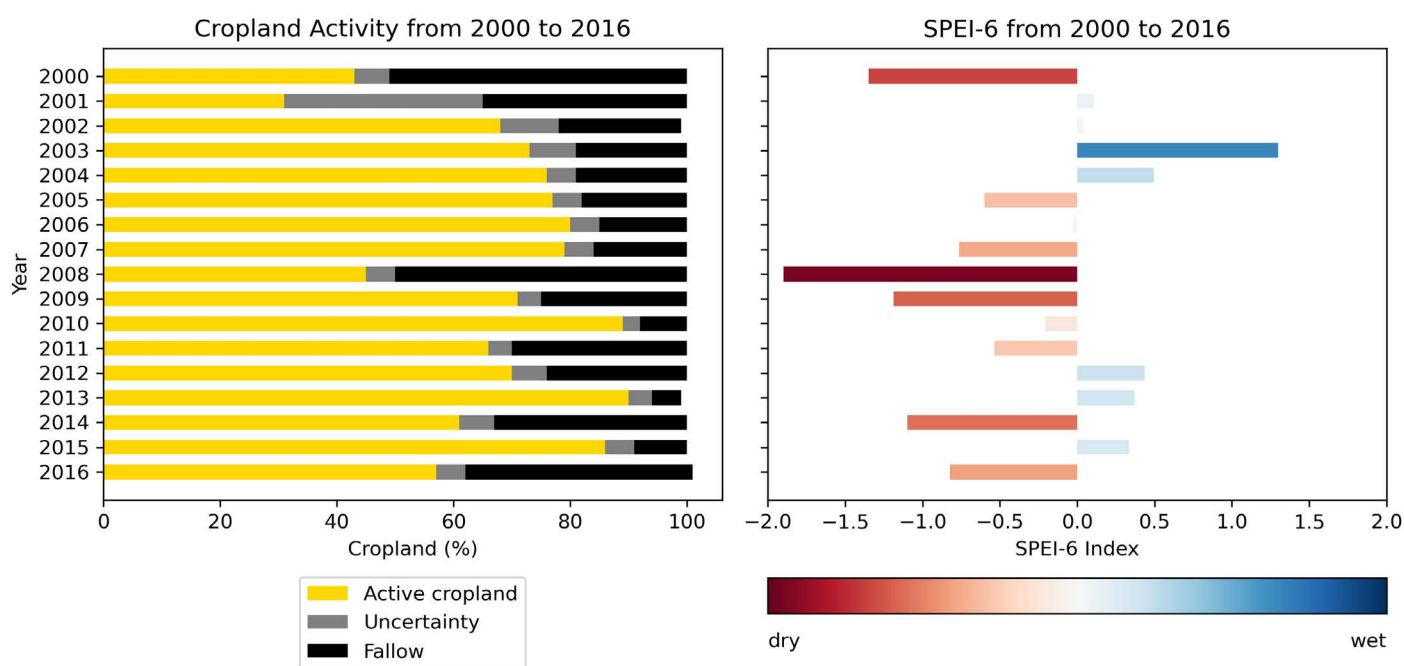


Figure 6a (left): Relative extent of active and fallow cropland between 2000 and 2016 (yellow and black bars respectively; gray bars indicate areas of uncertainty as determined by a post-classification accuracy assessment).
Figure 6b (right): Red-to-blue bars represent the annual 6-month Standard Precipitation-Evaporation Index (SPEI6, derived from CRU v.3.22) for Syria in the same time period. Below-0 SPEI indicates relative dryness, while above-0 SPEI indicates relative wetness.

Analysis of cropland fallowness¹¹

Fallowness can be analyzed through satellite remote sensing technology, allowing research in areas with limited accessibility, such as Syria. The analysis assessed fallowness based on a land-use/land-cover dataset derived from MODIS data, which covers the whole of Syria and shows annual cropland extent as well as other land covers for the period 2000–2016. To identify fallow areas, the investigation defined a “normal cropland extent” based on the most frequent land use class for each pixel over the study period. For each year this “normal cropland extent” was compared to the actively cropped land to calculate the area that was fallow or inactive.

Collapse of a socio-ecological system – Framework Criteria by Cumming and Peterson¹⁹

What defines the collapse of a system and distinguishes it from a mere short-term shock? To answer this question and unify prevailing ambiguity of the concept in research, Cumming and Peterson have established a framework that outlines four necessary conditions for a socio-ecological system to qualify as collapsing or having collapsed. The analysis¹¹ operationalizes these four indicators to assess the impacts of the 2008 drought on Syria’s agricultural system:

1. **Abruptness:** The changes in the system must occur suddenly and unexpectedly, relative to regeneration times and turnover rates of identity-defining components of the system.
→ The analysis looked for rapid changes in key variables of agricultural production, such as fallowness, which could signify abrupt disruptions due to external stressors like droughts.
2. **Substantial Loss:** The system must suffer significant losses compared to previous disturbances. The significance of these losses is determined by specific, measurable criteria that define the system’s identity and function.
→ The analysis compared current agricultural data to historical records to determine if recent changes resulted in greater losses, such as extensive crop failures, than those observed in past events.
3. **Persistence:** Changes within the system must persist longer than a single generation or much longer than the typical dynamics of the system. The longevity of disruptions distinguishes them from short-term shocks.
→ The analysis evaluated whether disruptions of the agricultural system, such as increased fallowness or reduced productivity, persist over an extended period or if the system shows signs of recovery.
4. **Structural Change:** The fundamental structure of the system must be altered, causing increased instability or a shift in system dynamics and functionality. Key actors, system components, and interactions must disappear.
→ The analysis examined changes in agricultural land use and increased vulnerability to environmental stressors that indicate a structural shift in the system.

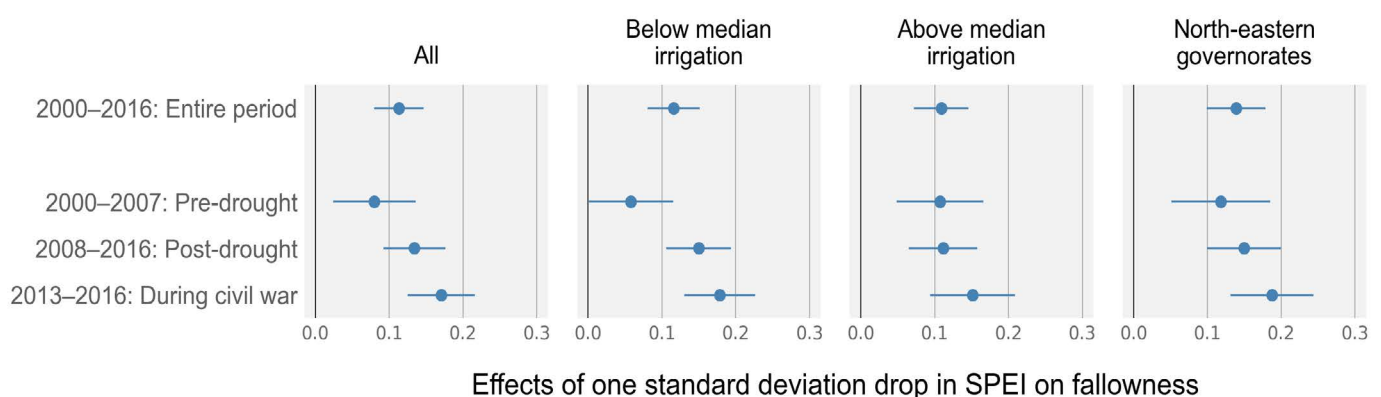
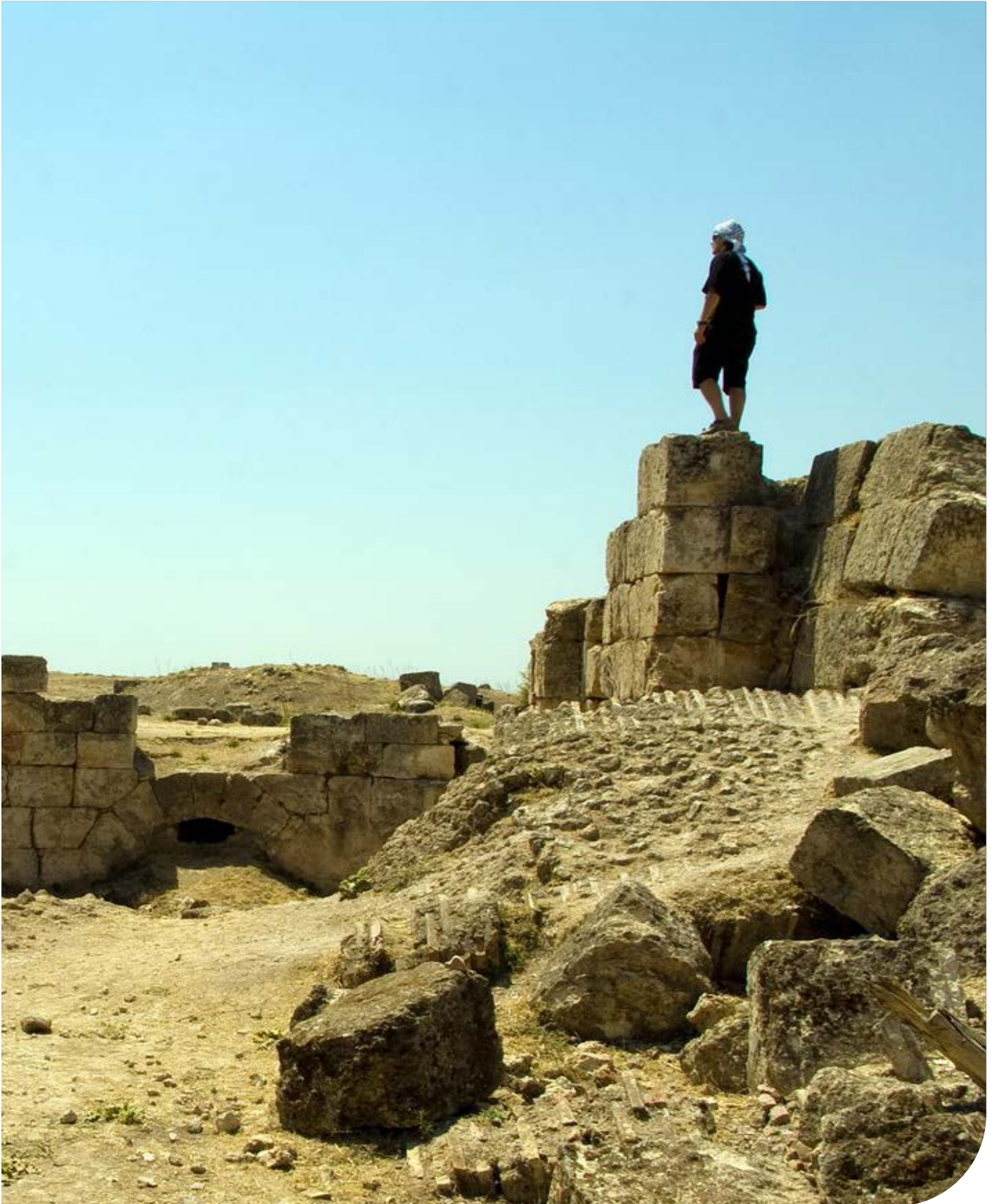


Figure 7: Effects of dryness on fallowness in different contexts and time periods. Whiskers represent 95% confidence intervals. Compared to the dryness-sensitivity before the drought (2000–2007), the time period after the drought (2008–2016) shows elevated sensitivity, i.e. a stronger increase in fallowness with SPEI-increases. The effect is observed throughout all four different contexts: 1) all cropland, 2) below-median irrigation cropland, 3) above-median irrigation cropland, and 4) cropland in the North-eastern governorates.

4. SOCIO-ECONOMIC DROUGHT, VULNERABILITY, AND LAND ABANDONMENT



Life in ruin-ancient sites shelter Syria's displaced. Photo by Isaac Álvarez i Brugada, Flickr.

The term socio-economic drought describes the societal and economic impacts of prolonged dryness.

This concept links drought events to i.e. a rise in food prices, lack of resources, and unemployment in water-dependent sectors and industries¹⁴. What determines the socio-economic impact of a drought is the vulnerability of the affected population, i.e. a combination of exposure to hazard, susceptibility to the hazard and the adaptive capacity of the affected community²⁰⁻²². The concept of socio-economic drought can be operationalized for an analytical study of drought vulnerability: While meteorological drought may be purely based on rainfall and temperature, socio-economic impacts of drought are largely influenced by the prevailing socio-political system.

Drought vulnerability is created by societal, political, and economic dynamics. Wilhite & Glantz¹⁴ specifically highlight how land use practices can create and exacerbate drought, substantiating the strong link between agricultural land use dynamics and drought vulnerability. The understanding of drought impacts as socially constructed is supported by research findings on drought impacts in the border areas of Türkiye and Syria, which were fundamentally different despite both countries sharing similar climatic and hydrological conditions in the border region⁷. This serves to highlight the significance of political and socioeconomic factors that led to increased drought vulnerability in Syria. While Türkiye was able to implement resource management strategies and adapt to water scarcity, Syria did not have the necessary adaptive capacity to support agricultural production under severe drought conditions. Research suggests that Türkiye's strategies (including dam-projects that reduced water-flow of the Euphrates into Syria) adversely impacted Syria's already stressed hydrological situation and hence reduced its adaptive capacity to drought¹⁰. However, this alone does not account for the significant differences in drought impacts

between the two countries. A more nuanced analysis is required, particularly a historical examination of agricultural development in Syria, to fully understand the underlying causes of its elevated vulnerability to drought.

Rapid agricultural development created unsustainable dependencies. The Syrian economy developed fast under the Hafez Al-Assad regime (1971–2000), and the agricultural sector benefitted from redistributive policies and state-controlled expansion plans¹. Previously reliant on crop imports, Syria was set on course to become self-sufficient in food, which came with an expansion of irrigation infrastructure through large dam projects²³ as well as price controls on strategic crops, low interest loans, economic support, and subsidies²⁴. This agricultural development model, however, created dependence of farmers on irrigation-fed agriculture and with it the exploitation of underground water reserves, entering a vicious cycle of ever-decreasing groundwater levels and hence increasing costs for diesel-pump driven irrigation^{24,25}. This dependence subsequently laid the groundwork for the economic crisis experienced by many farmers.

Economic transition towards market economy increased financial pressures. When Bashar Al-Assad took over in the 2000s he accelerated economic liberalization policies, transforming Syria from a socialist into a 'social market' economy²⁶. This had severe implications for Syria's agricultural sector, as the market was further liberalized, state farms were privatized, and subsidies were removed²⁴. The agricultural practices which they had previously adopted (irrigation-fed agriculture of water-intensive crops like cotton and wheat) suddenly became a financial problem for Syrian farmers: In May 2008 and May 2009 the government removed fuel and fertilizer subsidies, causing pumping of irrigation water to become more than three times more expensive²⁵. These

Analysis of cropland abandonment²⁹

Land abandonment describes the prolonged discontinuing of current land use practices, mostly agricultural activities, which often leads to changes in land cover and subsequent soil erosion. Thus, land abandonment can be seen as a proxy indicator for assessing agricultural vulnerability. There is a wide range of definitions of land abandonment in agricultural studies, which differ mainly in terms of consideration of land ownership and thresholds to the duration of abandonment. Due to a lack of data and official records on land ownership and tenure in Syria, this study was unable to include this dimension of land abandonment in our analysis. Instead, the report used cropland fallowness to study land abandonment.

Fallowness here acts as an indicator for land abandonment. To distinguish between short-term fallowing and long-term land abandonment, land abandonment was classified as cases in which cropland has remained fallow for at least three years. The threshold of three years was chosen based on statements by the interviewed Syrian farmers indicating that they rarely included periods of fallowness of more than two years in their cropping practices. The analysis also looked into land that has been fallow for longer than five years, after the 2008 drought.

cuts may have increased agricultural vulnerability to meteorological drought in the subsequent period, particularly in areas relying on diesel-pump irrigation. Wheat and cotton production in large parts of the country became economically unsustainable, resulting in widespread abandonment of previously cropped land^{27,28}.

Land abandonment in Syria occurred at comparatively high rates. Overall, Syria saw 19% of its cropland being abandoned, i.e. laying fallow for at least three years, during the study period of 2001-2016. Other countries in the region, like e.g. Egypt³⁰ and Türkiye³¹ showed minimal cropland abandonment but continuous agricultural expansion for similar time periods. In Ukraine, 8% of all cropland had been abandoned between 1990 and 2008, and 9% of Belarus' cropland had been abandoned between 1990 and 2003 – periods during which both countries experienced drastic political transformations after the collapse of the Soviet Union³². Overall, Syrian land abandonment can therefore be considered rather high, and similar to other countries that have undergone large changes in the political economy. As Syria's agricultural system has undergone several not just political, but socio-economic and bio-physical shifts in the past few decades this report suggest the interplay of these drivers to be the main reason for comparatively high land abandonment rates in the years before the drought.

Drought in 2008 had a low impact on land abandonment dynamics. The 2008 drought is

frequently identified in scientific literature as a major factor contributing to high land abandonment rates and resulting rural-to-urban migration in Syria (for a comprehensive overview of this discourse see Angermayr et al.⁵). However, while short-term cropland fallowness was strongly driven by the drought in 2008, cropland activity quickly recovered after the drought and even reached a record-high in 2010. The analysis



Cars and Abandoned Buildings in the Southern Syrian City of Daraa After the War. Photo by Mahmoud Sulaiman, Unsplash.

Case Study: Al-Hasakeh³⁶

Al-Hasakeh governorate was amongst Syria's regions most severely impacted by the 2007–2009 drought. The research involved surveys and in-depth interviews with 15 farmers from Al-Hasakeh who had migrated to Türkiye. This qualitative component of this research provided detailed insights into how drought and civil war influenced agricultural practices, land abandonment and migration in the region.

Drought: Al-Hasakeh experienced a strong increase in drought vulnerability. In 2001, 89% of the governorate's cropland was actively farmed, compared to just 34% across the rest of Syria. However, by 2008, at the height of the drought, active cropland in Al-Hasakeh had plummeted to just 15–20%, demonstrating the drought's immediate impact on agriculture in the governorate.

Land abandonment: In the period from 2000 to 2015, 11% of Al-Hasakeh's cropland was abandoned, with an average abandonment rate of 0.8% per year. The analysis found that land abandonment increasingly occurred close to rivers, areas that generally benefit from higher soil fertility and access to irrigation. This suggests that factors beyond water availability played a role in land abandonment dynamics. This matches with the results from the interviews, as the respondents pointed out that, apart from water availability, electricity and diesel fuel are important factors influencing the ability to maintain agricultural production.

Migration: Land abandonment in Al-Hasakeh occurred at higher rates close to the city of Al-Hasakeh, suggesting a connection to rural to urban migration. Most of the migration occurred between 2006 and 2010, with five respondents migrating internally during this period and four migrating abroad. The survey respondents referred to financial difficulties, job opportunities elsewhere, and the prolonged drought as the main reasons for abandoning their agricultural lands. Out of 15 respondents, 11 stated that their lands in Al-Hasakeh were now abandoned and fallow, while one reported their land had been occupied by an armed group. Only three said that their lands were still being used by family members.

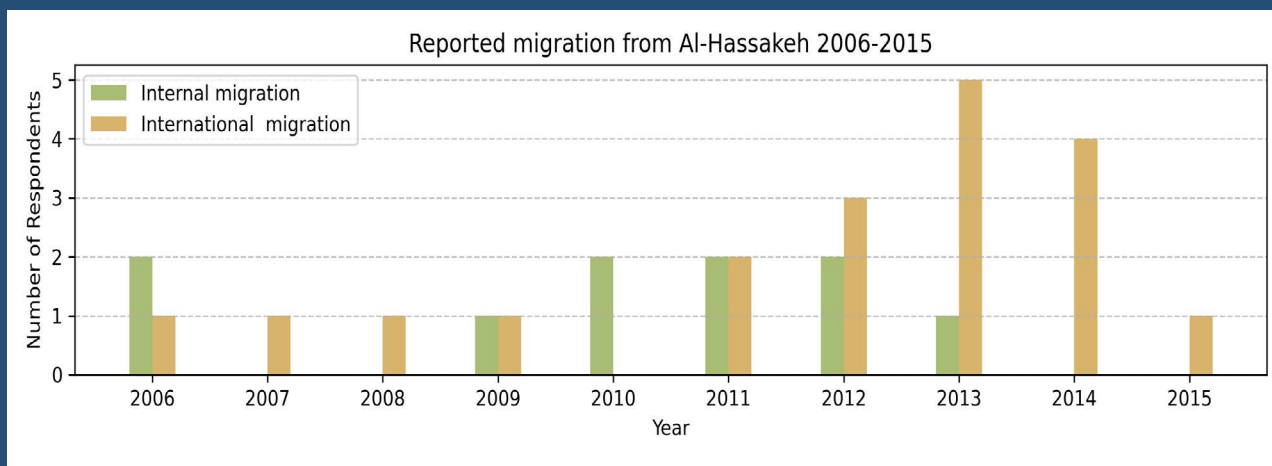


Figure 8: Internal (within Syria) and international (from Syria to another country) migration in the timeframe of 2006 until 2015 as reported by the survey respondents from Al-Hasakeh.

Complexities of the Drought-Migration Link: The study findings challenge the dominant narrative that drought was the sole driver of migration in Al-Hasakeh. Although drought was clearly a critical factor, interviews highlighted that migration patterns were influenced by a complex interplay of economic pressures. The remote sensing results also showed misalignments between perceived drought severity and agricultural drought indicators as it was found that while respondents viewed drought as a significant issue and a reason for migration, both migration and extensive land abandonment had already begun before the 2008 meteorological drought, indicating that other factors were also contributing to these movements.

Conclusion: This case study underlines the severity of the drought's impact on agriculture and livelihoods in Al-Hasakeh. While drought played a role in land abandonment and migration decisions, socio-economic factors and conflict dynamics were crucial. The findings both support and challenge the drought-migration narrative, revealing a discrepancy between the perceived severity of the drought and the agricultural drought as measured by remote sensing data.

found that only a minimal portion of land remained fallow for a longer period after the drought. Specifically, just 113 km² (0.5% of normally active cropland) of the land actively cultivated in the years preceding the drought (2006 and 2007) showed signs of abandonment, being left fallow for all subsequent five years (2008–2012).

Spikes in land abandonment in 2007 and 2011. Over the study period, two years stood out when land abandonment substantially increased: 2007 and 2011, with close to 5% and 4% of active cropland becoming abandoned, respectively. The land abandoned in 2007 corresponds with fields that were inactive during 2007, 2008, and 2009. Increased levels of abandonment thereby took place the year before the worst drought year, when most of the land was actively cultivated. The abandonment for 2007 may thus be a combination of temporary fallow followed by crop failures due to the drought, and not intentionally abandoned land. This

explanation is further supported by the rapid recovery of active cropland after the drought.

Conflict as a cause of agricultural land abandonment.

The spike in land abandonment in 2011 coincides with the start of the uprising and civil war in Syria, suggesting that the onset of the civil war caused people to abandon their lands. Armed conflict may increase land abandonment by forcing displacement, constraining accessibility, and creating a shortage of agricultural inputs and labor^{7,33–35}. However, despite land abandonment increasing in 2011, the first year of the civil war, little evidence on prolonged effects was found, as land abandonment decreased in the following years and cropland activity recovered to pre-war levels by 2013. This finding raises questions about the extent of land abandonment and associated migration of farmers in times of war, and the impacts of conflict on land use in Syria, which are explored in the following section.

5. THE NEXUS OF DROUGHT, MIGRATION, AND CONFLICT



A boy carrying plastic bottles, Idlib, Syria. Photo by Ahmed Akacha, Pexels.

Prevailing ‘drought-migration-conflict’ narrative.

Scientific research and media reports on the 2008 drought have portrayed civil war in Syria as a direct cause of migratory movements, caused by the drought in 2008 – thus attributing the drought to climate change impacts and claiming a subsequent large rural-urban migration of farmers that consequently led to social conflicts and sparked the uprising in 2011. While this perspective has been criticised as being oversimplified and leaving out important socio-economic factors^{7,24,28,37,38} the focus of the scholarly debate was mainly put on understanding the meteorological drought and claims of its attribution to climate change. Yet, a thorough analysis of the migration patterns and associated agricultural dynamics has been lacking. This report argues that the connection between drought-induced land abandonment and conflict requires a more nuanced understanding, taking into account the complex agricultural and economic conditions faced by Syrian farmers.

Land abandonment is linked to migration. The drivers of land abandonment can be both biophysical (e.g. water scarcity and soil degradation), socio-economic (e.g. changing markets and challenging conditions for livelihood sustenance) and political (e.g. impacts of governance and even conflict). These drivers are similarly associated with causes for migration. Consequently, the abandonment of cropland has been associated with migration in different contexts, e.g. with areas of outmigration in Europe³⁹, labour migration in China^{40,41} and migration due to armed conflict^{33,42}. Yet, few assessments of how migration and armed conflict interacted with land abandonment in Syria have been carried out, and longitudinal analyses of land abandonment patterns have been missing. Utilizing both remote sensing and qualitative field research, our research aimed to provide new insights into the ‘drought-migration-conflict’ nexus and its linkages with agricultural development.

Migration before 2011 was mainly internal, adaptive migration.

The period before the war (2006-2011) saw predominantly internal migration (n=29) and comparatively few external migration movements (n=13). The decisions to migrate were mainly related to financial difficulties and job opportunities elsewhere, as well as drought and water scarcity. The investigation thus finds migration patterns before the war to be short-term adaptive cycles of labour migration, rather than permanent emigration. This finding is further supported by the fact that all 13 farmers who had moved abroad during this period returned to Syria before 2011. Furthermore, although an in-depth analysis of gendered perspectives in migration was beyond the scope of this study, it is observed that migration as an adaptation strategy was predominantly undertaken by male members of the households, while female members were significantly less likely to engage in this form of adaptive migration.

Rural-to-urban migration during drought years was followed by re-migration to rural areas in 2010 and 2011.

Several researchers have claimed that migration from agricultural areas to urban centres rapidly increased during the drought in 2008 and 2009, which led to social unrest and ultimately triggered the civil war in 2011^{3,6,44,45}. However, no spatially disaggregated data on migration patterns exist for this period, which has led analyses to rely on estimates and statements from international organisations. The analysis results indicate that the rural outmigration was short-lived, and most farmers appear to have returned to their lands after the drought, as indicated by increasing cropland activity in 2009 and 2010. Such temporary adaptive movements are in line with both empirical and theoretical literature on climate-related migration, where drought periods may lead to short-term migration patterns, but not necessarily to a permanent state of exile⁴⁶⁻⁴⁸.

Survey and In-depth Interview Field Research³⁶

To understand the nexus of drought, migration and conflict in Syria, data was gathered in three empirical research categories of climate mobility research⁴³: 1. Migration focused survey methods, 2. Qualitative field studies (in-depth interviews), and 3. Land use activity data based on satellite images.

Between December 2021 and January 2022, 82 surveys were conducted with Syrian farmers who had migrated to Türkiye, in collaboration with the Development Workshop Cooperative (www.ka.org.tr). These surveys targeted Syrian farmers who had relocated to Türkiye’s southern and southeastern provinces, including Mersin, Adana, Hatay, Kilis, Gaziantep, and Şanlıurfa. The surveys consisted of 33 questions that gathered demographic information, migration experiences and outlook on returning to Syria, and data on agricultural practices and drought impacts. The surveys focus on the period between 2006 and 2022 to include years before the civil war. Earlier years were not asked for in the survey and responses on earlier years were excluded from the results to reduce recollection bias. This quantitative data helped to capture broader trends in migration and land use among Syrian farmers and to validate the remote sensing-based results of the research.

In July 2022, 17 in-depth interviews were conducted with a subset of survey respondents. These interviews provided deeper insights into personal narratives surrounding land abandonment, coping mechanisms during drought, and migration decisions. The qualitative data complemented the survey findings, offering a more nuanced understanding of the social and environmental challenges faced by Syrian farmers.

Impact of drought on migration patterns remains disputed. Despite the reported increase in rural out-migration during the drought years, the temporal coincidence cannot be regarded as a clear causal relationship and requires a differentiated consideration of the factors that lead to the abandonment of agricultural land and out-migration. The survey results show that only a small number of respondents migrated during the most severe drought years (2008 and 2009), with most migration—both internal and external—taking place in years with near-average precipitation and evaporation levels. Interestingly, despite this, the majority of respondents who migrated between 2006 and 2010 (whether internally or externally) either agreed ($n = 6$) or strongly agreed ($n = 26$) that drought played a key role in their decision to migrate. Only six respondents disagreed or strongly disagreed with this statement. Other contributing factors were also identified, such as the spike in fuel prices, which has been claimed to have led to widespread rural-to-urban migration already before the 2007–2009 drought occurred^{27,28}. The finding that relatively few people migrated during the drought align with existing literature, suggesting that climate stress can actually hinder both internal and international migration^{49–51}. Furthermore, it highlights that the perceived environmental changes often have a greater influence on migration decisions than the actual measured impacts^{52,53}.

War spiked migration, both internally and externally. The survey suggested that the first year of the war saw an increase mainly in external migration ($n=7$), which had been at a record low in the two years prior ($n=1$ for both years). Internal migration had been comparatively high in 2010 ($n=6$) and remained on a similar level in 2011 ($n=6$). In the second year of the war, as the armed insurgency erupted into a nationwide civil war, both internal ($n=12$) and external ($n=12$) migration numbers grew and together amounted to a record high in the observed migration dynamics during the study period (2006–2018). In the following years of continued warfare, external migration increased further, reached a maximum in 2014 ($n=18$), and remained at comparatively high levels until 2016. Internal migration on the other hand, declined rapidly after the initial spike in 2012 and remained below pre-war averages throughout the following years of the war. However, this finding in particular must be considered with caution, as the analysis only sampled data from farmers who had eventually migrated to Türkiye, lowering the absolute numbers of possible

internal migration movements in the dataset with increasing external migration. If one looks at the relative number of internal migration movements based on how many of the respondents were still residing in Syria (i.e. removing the respondents that had already left Syria from the total sample for each year), internal migration remained above pre-war levels throughout the war and even spiked in 2016 and 2017, with 67% and 100% of respondents still living in Syria having migrated internally.

Reasons for migration shifted due to the war.

Respondents to the survey stated that in the period prior to the war, job opportunities elsewhere, financial difficulties, as well as drought and water scarcity had been the main reasons to migrate. The war seems to have shifted migration dynamics from predominantly adaptive labour migration to forced displacement. The study findings support such a shift, as during the war ‘job opportunities elsewhere’ were not considered a strong reason for migration anymore, while both financial difficulties and water scarcity/drought remained important factors affecting the decision to migrate. Furthermore, it was found that lack of access to services such as education and healthcare, discrimination and war/conflict/security emerged as new important reasons for migration from 2011 onwards. Almost all interviewees stated that ultimately the war and the resulting lack of security were the tipping point for their decision to emigrate from Syria.

The war and its legacy continue to be a major obstacle for Syrian farmers. While the remote sensing-based analysis showed a recovery of agricultural production in the years following the onset of the civil war, the qualitative findings of the study suggested a major impact of the armed conflict on farmers’ livelihoods. Not only the reasons for migration of farmers shifted, but also the possibilities to return to their lands were drastically impacted: While more than half of the respondents at the time of surveys and interviews (i.e. before the fall of the Assad regime in Syria) desired to go back to Syria, a majority of them (67%) said they only wanted to return in case ‘there is peace and security’, ‘Bashar al-Assad dies’, or the ‘economy in Syria gets better’. With the ongoing political instability and armed conflict in the country at the time of this investigation, many of the respondents felt trapped between the desire to migrate back to Syria and the problems they would face upon returning.

6. IMPLICATIONS AND RECOMMENDATIONS

Policy decisions play a critical role in determining the severity of drought impacts and the dynamics of agricultural land abandonment. The rapid expansion of modern, water-intensive agriculture created a high dependence among farmers on fuel and fertilizer subsidies. Coupled with weak governance that permitted the overexploitation of water resources, this led to increased long-term vulnerability to environmental pressures, such as drought. Sudden policy changes such as the removal of subsidies further weakened farmers' adaptive capacity by making short-term solutions financially unsustainable, exacerbating both immediate and long-term risks.

Avoiding maladaptation in agricultural development strategies. In general, irrigation-fed agriculture in arid climates is considered less sensitive to drought than rainfed production methods are^{54,55}. In light of climate change predictions^{56,18} and documented evidence⁵⁷ expanding irrigation-infrastructure may decrease agricultural vulnerability. However, groundwater resources are already under significant strain in Syria and their exploitation has been identified as one of the leading causes of increasing drought vulnerability, underscoring the need for careful assessment of adaptation strategies. Maladaptation can occur when viable short-term solutions⁵⁸, such as, e.g., large-scale expansion of irrigation infrastructure, contribute to heightened long-term vulnerability. Avoiding maladaptation therefore requires careful consideration of long-term impacts to ensure that adaptation measures do not inadvertently exacerbate the challenges they aim to address. This involves a shift from “immediate, reactive responses to a balanced, long-term development approach [that] is necessary to address water [...] challenges”⁵⁹.

Agricultural shifts are required to foster resilience of farmers in the face of increasing droughts. Agriculture in Syria has existed despite regular occurrence of droughts since millennia and local knowledge to manage droughts and avoid exploitation of natural resources has been developed over a long period of time⁶⁰. Today's industrial agriculture based largely on pump-fed irrigation and mechanized farming differs significantly from these traditional practices, and there is yet no knowledge on its long-term viability for providing a socially stable and environmentally sustainable agricultural system⁶⁰. Thus, looking back at traditional farming systems and their adaptation mechanisms, and incorporating them into modern policy, holds the key to developing sustainable, long-term solutions for agricultural development and reducing drought vulnerability.

Traditional water management approaches may increase resilience. When assessing the history of agriculture in the Al-Hasakeh region, research found that rain-fed agriculture was long-term sustainable in case of stable climate conditions and when sufficient time was allowed for recovery of arable land from over-exploitation or drought⁶⁰. To support rain-fed agriculture, the traditional method of rainwater harvesting^{61,62} can be implemented to increase resilience against periods of drought and recharge aquifers⁶³. One type of rainwater harvesting, the “floodwater spreading system”, involves diverting water during floods to an area of infiltration basins where the water is allowed to percolate into the soil and form groundwater^{64–66}. This nature-based solution reduces the risk of flooding and improves soil quality, as sediments that accompany the water are added to the soil. Studies have shown clear increases in crop yields and a potential for improving the economic situation of local farmers^{67,68} and reducing the risk of migration and water-related conflicts⁶⁴.

Changing cultivation systems and crops. Tackling agricultural vulnerability entails more than changing the water supply systems, as addressing the issue of high-water demand is similarly important. The cultivation of drought-resistant crops, direct planting techniques, and crop rotation systems for higher crop diversity have been shown to reduce climate vulnerability in arid farming systems^{26,69,70}. The design and implementation of these measures pose



A girl blowing bubbles in Idlib, Syria. Photo by Ahmed Akacha, Pexels.

challenges, especially because of the ongoing conflict which halted several development projects, such as the International Centre for Agricultural Research in the Dry Areas (ICARDA) that developed drought-resistant varieties of cereals and vegetables prior to the war^{71,72}.

Conflict presents additional challenge for Syrian farmers. Despite the finding of this research suggesting that Syrian agriculture generally recovered well after the onset of the civil war in 2011, there remain significant challenges for farmers related to the conflict. The war not only drove internal and external migration of farmers but also continues to be a major obstacle for their return to their country and agricultural lands. Despite the regime change in Syria in December 2024, the country remains unstable with significant political, economic, and infrastructural challenges that severely impact daily lives and livelihoods. The return of internally displaced Syrians and those who sought refuge outside of Syria is being discussed, but implementing this idea requires stability in the region, which is currently lacking. Conflict-sensitive agricultural and water management strategies are needed that focus on cooperative, local-scale governance structures, and ensure sustainable agricultural practices amidst the ongoing challenges.

Positive development in transnational water resource management despite longstanding challenges. The ongoing construction of dams in the Euphrates upstream of Syria, as part of Türkiye's Southeastern Anatolia Project (GAP), continues to adversely affect the water flow of streams in the Euphrates-Tigris basin⁷³. The war in Syria and instability in the region have significantly



The Worst Drought in Decades Hitting Syria's Recovery. Photo by Jurgen, Flickr.

impacted the bilateral water management agreements between Syria, Türkiye, and Iraq, further exacerbating water scarcity in Syria^{10,74}. Despite these challenges, recent agreements between Türkiye, Syria, and various Kurdish political actors may bring positive changes⁷⁵. These agreements aim to address water management issues and foster cooperation, potentially improving the situation in the region.

Further research is needed to understand causal links between drought and agricultural vulnerability.

The study findings indicate a need to investigate the relative contributions of temperature increases versus precipitation deficits in driving recent drought dynamics in Syria and neighbouring areas, as indicated by the divergence between the two drought indices in the results, where one is based only on precipitation, and the other includes temperature as well. Additionally, a deeper focus on the social and economic aspects of the drought, including gendered impacts, is required, considering how socio-political and economic factors shape agricultural vulnerability towards drought. This includes further exploring how policy changes, such as subsidy cuts and water governance challenges, exacerbate vulnerability and contribute to land abandonment, as well as how traditional practices may be integrated to enhance resilience of farmers and the agricultural system as a whole. To achieve this, more local data from the ground is needed at local, regional, and national scales. Collaboration with NGOs and local organizations is crucial to ensure the voices of farmers are heard and their needs are addressed effectively.



Climate linked drought adding to Syria's misery. Photo by Joel Bombardier, Flickr.

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APPENDIX I. DATA AND METHODS

This report presents a summary of the findings of four consecutive research papers ^{11, 29, 36, 76}, each forming the basis of one of the report's main sections: 1. Meteorological drought and its impact on agriculture, 2. Socio-economic drought, vulnerability, and land abandonment, 3. Nexus of drought, migration and conflict, and 4. Implications and recommendations.

As such, this report does not comprise any primary research elements, but offers a comprehensive and accessible consolidation of existing research. It presents key insights, cross-cutting patterns, and policy-relevant findings from the foundational studies, further complemented by an extensive literature review.

The core methodological approaches applied in the original papers are briefly summarized in designated method boxes throughout the report. For a complete understanding of the methodologies employed, however, readers are encouraged to consult the original publications.

All figures and maps presented in this report have been newly designed to visually communicate key findings. These visualizations are primarily based on the data and analyses from the original studies, with selective use of external sources to enhance cartographic clarity. A detailed list of sources used in each figure is provided below:

- a. Figure 1 (Topographic map): Elevation data: Aster GDEM v3⁷⁷; Boundaries, cities, rivers, and roads of Syria: OpenStreetMap⁷⁸; Created using QGIS 3.34.0.
- b. Figure 2 (Climate classification map): Climate data: GloH2O Global 1-km Köppen maps¹²; Boundaries of Syria: OpenStreetMap⁷⁸; Created using QGIS 3.34.0.
- c. Figure 3 (Cropland stability map): Data: Figure 2B in Eklund et al.¹¹; Boundaries of Syria: OpenStreetMap⁷⁸. Created using QGIS 3.34.0.
- d. Figure 4 (SPI and SPEI): Figure 1 in Eklund⁵.
- e. Figure 5 (Fallowness map): Figure 2A in Eklund et al.¹¹. Boundaries of Syria: OpenStreetMap⁷⁸; Created using QGIS 3.34.0.
- f. Figure 6 (Cropland extent vs. SPEI): Figure 2C in Eklund et al.¹¹. SPEI-data: Climatic Research Unit of University of East Anglia CRU v.3.²², acquired through PRIO-GRID v. 2.015.
- g. Figure 7 (Effects of SPEI): Figure 3 in Eklund et al.¹¹.
- h. Figure 8 (Migration): Figure 5 in Eklund et al.²⁹.

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