



# Depleted: Water and Patience Are Running Out in Jordan

BY RACHEL DELIA BENAIM

Can Jordan learn from Syria's poor water management and oversight of droughts exacerbated by climate change before it's too late?

*Following a series of arrests of Syrians in Jordan under ambiguous circumstances, weather.com has decided to change the last names of some sources. The names are indicated by an asterisk (\*).*

## **PART I: JORDAN'S FARMERS**

In Arabic, Azraq means the blue one. The Azraq Wetlands Reserve was so named, local lore holds, because the oasis reflects the skies above, a speckle of blue in the middle of a seemingly endless desert.

The 28.5-square-mile wetlands once drew visitors from around the region to see the unique habitat it provided to water buffalo, wildcats and other species. Over the years, the lush oasis has shrunk to less than 10 percent of its original size and the number of visitors has dwindled to one or two a week. During a series of weather.com visits in fall 2017, there was only one other group of visitors: a Saudi father and his two sons.



*This stretch is all that remains of the once extensive Azraq Wetlands Reserve. (Sharon Avraham)*



*A sign on the eastward side of Jordan's Route 40 shows distances to points of interest, as captured in November 2017. (Sharon Avraham)*

Located in the eastern portion of the Hashemite Kingdom of Jordan, Azraq is about 125 miles from Iraq, less than 62 miles from Syria and 36 miles from Saudi Arabia. The village, lined with one-story sandstone structures, has

gained attention for being home to the world's first fully solar-powered refugee camp, which currently houses roughly 36,000 Syrian refugees. But Azraq has its own rich history and problems apart from the refugee camp 16 miles from its center. It's experiencing acute water scarcity issues, which in many ways foreshadow what could be in store for the Kingdom.

Azraq's rapidly changing landscape and the impact it has on its residents isn't an isolated development. Since 2008, the Middle East has experienced its **most severe drought** in 900 years, according to NASA.

The drought forcibly displaced Syrian farmers, which many have argued was a contributing factor to the country's civil war. Because farmers didn't have water to grow crops, they had to relocate to cities to find work, thus leaving the cities overcrowded with economies too weak to hold the new job seekers.

## Drought isn't the only problem for Azraq.

Over the last four decades, the Jordanian government has pumped Azraq's groundwater to Amman, the capital, to keep up with the city's growing water demand. By the 1990s a quarter of Amman's water came from Azraq, as the effects of climate change, a higher birth rate and the influx of refugees have all increased the need for water in the region.

Jordan has absorbed upwards of 657,000 Syrian refugees in the last five years, in addition to about 481,000 Iraqi refugees, and nearly 200,000 Palestinian refugees from Kuwait after the first Gulf War, according to the United Nations High Commissioner for Refugees (UNHCR).

In years past, rain refilled the basins, so the decision to pump water from Azraq did not appear to threaten the country's water resources. But as population has increased, rainfall has decreased.

Fifty-four percent of Jordan's water supply comes from underground aquifers, which are being depleted at twice the rate of recharge. Jordan now runs a water deficit of about 119 billion gallons per year, and the quality of water has **deteriorated significantly** because of pollution.

The tale unfolding in Azraq is one of climate change and mismanagement of a vital resource, and it's strikingly similar to one that unfolded in Syria just a decade ago.



*A lone olive hangs from a tree on the Shishani's groves in Azraq, Jordan. A combination of drought and frost brought about by climate change related factors have damaged many of the olive trees in the region. (Sharon Avraham)*

# THE OLIVE TREES

Depending where you stand in Azraq, there are faint smells of cardamom coffee, spices, cattle and something akin to burning rubber. Desert sand is everywhere and it's activated into a pervasive yet ephemeral dust cloud as delivery trucks from Saudi Arabia roll by.

Olive groves with short, distinct trees line the 13 miles of road connecting the northern and southern parts of Azraq.

Just two years ago, olive production in the region was abundant, with some of the larger farms producing 120,000 jugs of olive oil a year. (It takes about 331 pounds of olives to make 16 ounces of oil.) But now, trees are yellow. Dry. Withering. They died because of a cold snap in the winter of 2016.

Emad Shishani, 49, farms land in eastern Azraq purchased and originally cultivated by his great grandfather in the early 19th century. It was once abundant with trees that yielded ample olives; however, due to shifts in weather patterns, many of his trees have died, most drastically in a frost spell in November 2016.

"The frost was three nights in a row," says Osama Al-Zyoud, an agricultural engineer at Al-Zyoud Olive Oil Mill in Azraq. The mill, one of the largest in Jordan, produces about 100,000 tons of olives annually, much of which is exported to 48 countries around the globe.

Speaking at an olive grove in Azraq with his cousin and mill director Fayyad Al-Zyoud, Osama Al-Zyoud says he has noticed significant weather changes in the past four years.

It stays hotter longer and the dry summer season lasts well into fall.

"This was the first time we had such heat," says Fayyad Al-Zyoud, whose parents also worked in the olive industry. "It killed the grove. The whole area was dried up."



*Fayyad Al-Zyoud poses in front of an olive presser at the Al-Zyoud Olive Mill in Azraq, Jordan. (Sharon Avraham)*

When the frost occurred in 2016, temperatures fluctuated dramatically. It would be 71 degrees Fahrenheit at 8 p.m., at midnight it would drop to 32 degrees Fahrenheit, and then at 6 a.m. it would be 53 degrees.

According to Fayyad Al-Zyoud, who is also chairman of Jordan Olive Producers and Exporters Association, Azraq lost 800,000 olive trees to frost, as temperatures below 12 degrees Fahrenheit will kill an olive tree. The withered, yellow trees that remain along the highway stand as a testament.

## THE CLIMATE: PAST, PRESENT, FUTURE

Jordan's climate is changing. Average temperatures are increasing. Rainfall is declining. These regional trends are projected to worsen and will not be limited to progressive changes such as heat and drought.

Destabilization of climate systems is expected to make sudden and extreme weather events more common. In Jordan's case, this likely means longer and harsher summers, more severe droughts, harsher winters and an increase in flash flooding and frosts.

These factors negatively impact crops, says Lara Nassar, senior researcher at the WANA Institute, a branch of the Royal Scientific Society in Amman.



*An olive tree as seen from Route 30, a road which runs through all of Azraq, connecting its center to the farms that populate the entire area. (Sharon Avraham)*

Traditionally, the areas of Jordan with a semi-arid climate have been optimal for olive trees. Olives are generally **drought resistant** and can tolerate up to 40 percent less tissue water before they are too sick to rehydrate. If they dip below that, they can die. Younger trees' health and stamina through drought is quicker to fail than more mature trees.

Olives are also susceptible to infectious diseases. Frost removes protective and hydrating layers on the leaves, making the trees vulnerable. **Olive diseases** associated with extreme environmental factors are expected to increase because of climate change.

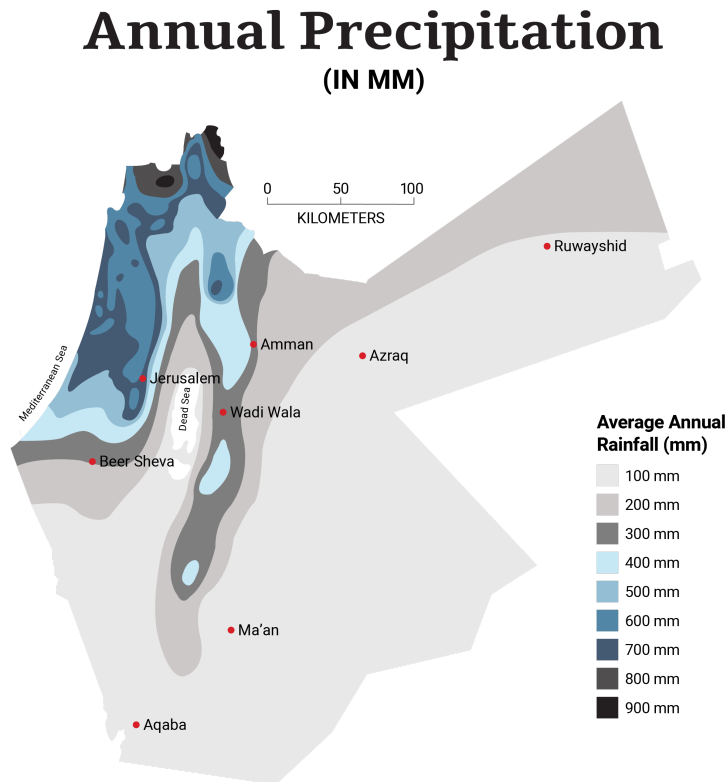
Meteorological data collected throughout the country indicate that annual precipitation is decreasing .05 inches per year while nearby sea temperatures are increasing .054 degrees Fahrenheit per year, which bodes negatively for clean water availability, according to the **United Nations Framework Convention on Climate Change**.

The wet season in the Mediterranean basin lasts from October to April. Because rainfall happens during this period and at no other points in the year, the summer is drier. It is important to differentiate between dryness and drought, especially in desert regions, notes Jos Lelieveld, director of the atmospheric chemistry department at the Max Planck Institute for Chemistry.

“When we talk about drought, it’s (a lack of) winter rains. In the summer it’s dry anyway,” Lelieveld says. “If it becomes extensively dry for a period, that’s a drought.”

Jordan, which the United Nations lists as one of the world's 10 most water-scarce countries, has been experiencing ongoing and worsening drought in recent years.

Most of the country receives less than 7.87 inches (200 mm) a year. Jordan's rainfall is not evenly distributed. It's mostly concentrated in the northwest, where rainfall historically occurs between November and May.



*Date source: Quaternary of the Levant: Environments, Climate Change, and Humans, p. 32.*

Drought is one element of extreme weather that has hit Jordan. Flooding is another.

When rain does fall, it's more intense. Floods are becoming more frequent in the region, Lelieveld says, but it's difficult to establish trends in rainfall in the Middle East. There just isn't much rainfall, and the measurements can be unreliable.

And then there's the frost.

"It was a disaster to the agricultural industry," Fayyad Al-Zyoud says of the 2016-2017 frosts.

It hurt pomegranate trees, lentils, and grape vines, though none as severely as the olive trees.



A lot is at stake. Olive oil is one of Jordan's eight top **exports** and olives are its sixth-largest agricultural product. About **60,000 families** receive the majority of their income from the olive sector. The value of investments in olives is about \$1.4 billion, and according to Agriculture Minister Akef Zu'bi, **43 percent** of the country's cultivated lands are planted with olive trees.

Olive oil production in 2017 was even less than the previous year's due to the frequent frost, the agriculture ministry says.

"Olives and the change of the environment is one of the biggest problems in Azraq," Al-Zyoud says.

## "I LOST LIVELIHOOD"

Emad Shishani is matter-of-fact as he speaks of the frost that killed 20 percent of his olive crops, his major source of income. "Yes," he says, "I lost livelihood because of it." There are no tears, no feelings of panic. Life goes on.

The damage in Shishani's nephew's grove is severe, too. In Mustafa Shishani's six-acre (25-dunham) olive grove, many of the trees are yellowing and dead.

"I do not know how much I (have lost), but it is a lot," says the 28-year-old farmer as he surveys his land.

Much like his uncle, he too speaks matter-of-factly. Mustafa Shishani manages most of his family's olive crop in the southern part of the city. It's a struggle. Because of the frost and the unpredictability of the rains, the groves are no longer producing as much, lowering profits.

It's not just smaller, local farmers being impacted. The profitability of high-production farming operations have suffered because of the extreme weather patterns.

Farmers are trying their best to adapt. Fayyad Al-Zyoud brought in experts from leading olive-producing countries like Spain and Italy to his company for advice. "They told us to prune the dead parts of the trees," he says. "And that way healthier parts will grow back with the right care and conditions."

But pruning the trees at such a large scale is a method locals have never seen. *What if they don't grow back?* Others cannot afford to wait through the season and are looking for

other work until the groves can fix themselves naturally if at all.

Farmers who don't heed Al-Zyoud's advice and those who do not walk away from their groves are resorting to other, more damaging options.



*A pile of tires is seen at a farm beside the Al-Zyoud Olive Mill in eastern Jordan. The tires are used to protect trees from sudden onsets of frost that have been devastating the area. (Sharon Avraham)*

Farmers have taken to littering their groves with tires, which they set ablaze when the temperature drops. The flaming tires keep the trees warm, protecting them from frost. It's why Azraq smells ever so faintly of burning rubber.

The burning tires are an obvious environmental hazard, releasing numerous **toxins** that have negative health impacts. But people do what they feel they must.

The Jordanian government is trying to mitigate potential weather-related threats to farmers. The agriculture ministry set up a text message service to warn about cold snaps, but several farmers weather.com spoke to had not heard of the system. The Al-Zyouds, who have access to government officials regularly, do not know how to enroll. Shishani does not know either.

"We are of the oldest farmers in the region and there is no support," Shishani says.

Shishani says many of his neighbors have abandoned their farms and have gone to Zarqa and Amman, nearby cities, looking for work.



*Withered olive trees as seen at an abandoned farm in the northern part of Azraq. (Sharon Avraham)*

“I know them by farm. Now their farms are empty,” he says. “Five of the farms next to mine are abandoned and more in the whole Azraq have left and are leaving.”

There are no official government numbers reflecting

migration from Azraq to the cities, but the reality is something many in the community note.

## NOT JUST JORDAN

Climate change is a key driver of migration and food insecurity. William Lacy Swing, the U.N. migration director general, says climate change is among the main reasons for migration from rural areas into cities globally.

Agricultural impacts of climate change are already lining up, and Jordan's olive trees are just one example in the destabilization of global agriculture.

Tunisia, for example, **expects** to see its olive crop yields halved by 2030 due to climate change factors, including drought and frost. Montana can no longer grow **malt barley** like it once did. Wildfires in Russia in 2010 brought about by a drought exacerbated by climate change destroyed about **one third of their wheat** crop. The list goes on.

Like many Middle East economies, Jordan faces extreme water scarcity and potential food insecurity.

There is a **growing global trend** of climate change prompting agricultural desperation leading to migration. There are often other steps in this breakdown. Climate change factors could lead to other forms of scarcity, too, which leads to radicalization or often conflict, thus resulting in migration. The full relationship between climate change and migration has yet to be explored, but it seems that Jordan may be seeing the early signs of this.

Not all countries collect data on internally displaced people. There are challenges with tracking internal movement. There are also questions surrounding climate that do not have standardized answers. For example, “not all climate-related hazard events become disasters, so not all climate-related hazard displacement will be recorded by datasets that track disaster displacement,” the **Overseas Development Initiative** notes.

The lack of official data sets does not negate the facts on the ground.

“Most people don’t realize how much climate affects everything, from their property values to how hard people work,” **said** Solomon Hsiang, a professor of public policy at the University of California, Berkeley.

The agriculture sector is extremely sensitive to climate change, which makes it even more challenging to produce the **60 percent more food required by 2050** to feed a growing population globally. Hsiang led a recent study that predicts that as the climate changes, the wealthy, who can afford to adapt, will benefit, while the poor will suffer.

In many ways, this is the story of Syria, it’s citizens and it’s refugees, many of whom now live in Azraq.

## **PART II: JORDAN’S REFUGEES**

Sitting on a white plastic chair overlooking Azraq’s vast fields in eastern Jordan with his two young daughters by his side, Mohammad Khalil\* can’t help but remember his home in Syria.

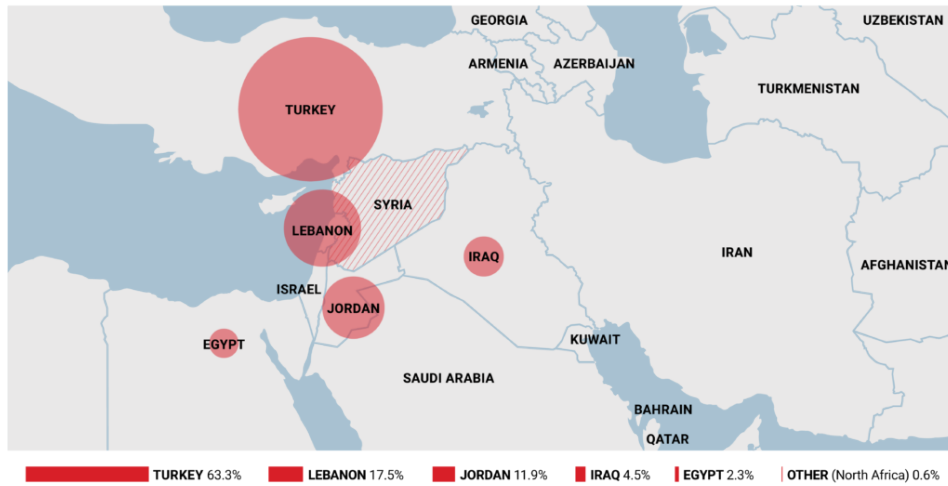
Khalil, 44, was born and raised in a family of farmers in Al-Qaryatayn in Syria’s Homs province. His brothers worked as professional industrial farmers. He helped them and ran a smaller farm on his property. He grew a fruits and vegetables, including tomatoes, eggplant, cucumbers and zucchini, until he fled his homeland for Jordan in 2014.

As he tells his story, his tone and facial expressions reveal little emotion. He reports facts, things that transpired. Events that could be perceived as emotionally charged seem of no consequence.

The civil war in Syria has driven thousands of people from their homes into neighboring countries like Jordan. The U.N.

estimates that there are more than 657,000 registered Syrians living in Jordan.

### Trajectory of Syrian Refugees in the Middle East



Source: UNHCR, July 2018

Opened in April 2014, the Azraq refugee camp has space to house up to 130,000 refugees. The **Jordanian government and the U.N. anticipated** in 2015 that it would be one of the world's most populous camps. Officially, 53,967 people are registered in the Azraq camp.

Now in early 2018, the camp houses about 36,000 refugees, according to UNHCR. The discrepancy is a byproduct of registered people leaving and not returning. Some will get permits to leave the camp to visit family or visit Amman for appointments and do not return. Others leave the camp and walk the few miles to Azraq and establish their lives in homes with some semblance of permanence. The U.N. figure does not reflect all of the Syrian refugees in the area. Others, like Khalil, never entered the camp.

Weather.com spoke to Syrian refugees residing in Azraq outside the camp. What emerged were testimonies to support the already proven claim that water scarcity exacerbated by climate change and poor water management was a **major contributing factor** in the Syrian civil war. Several countries are experiencing conflict connected to climate change, including **Iran, Myanmar, Yemen, and Kenya**.

"I was working in farming since I was very young," Khalil says. "Syria is the land of *hilwe*," an expression in Arabic roughly meaning sweet things. Or at least, it was until the weather patterns began to change.

Khalil began noticing a difference in farming conditions about 10 years ago. The peak of the Syrian **drought** from 2006 to 2010 caused a water shortage.

The drought that plagued the region in 2008 was its most severe in history, according to Yochanan Kushnir, a senior scientist at the Lamont-Doherty Earth Observatory at Columbia University,

“The greater Fertile Crescent experienced the most severe drought in the instrumental record,” Kushnir and his co-authors wrote in a 2015 paper. The Fertile Crescent refers to the swath of land between the Nile River in Egypt and the Tigris and Euphrates rivers that flow through modern day Iraq. The region includes Israel, the Palestinian territories, Lebanon, Syria and Jordan. Agriculture and animal herding began in the region nearly 12,000 years ago.

A NASA report calling the drought the worst ever used tree rings to indicate water availability in the region. The method allowed researchers to establish the possibility that the severe drought did not begin in 2008, but in 1998 with some less severe periods. According to the report, “the recent drought ... from 1998 to 2012, stands out as about 50 percent drier than the driest period in the past 500 years, and 10 to 20 percent drier than the worst drought of the past 900 years.”

There’s always been a high level of climate variability in the Middle East and North Africa, says Anders Jägerskog, senior water resources management specialist at the World Bank.

“The rainfall you get in one year is not necessarily the same the next year. You’ve had a pretty frequent cycle of the drier year on average every seven, eight years,” he says, noting this trend goes as far back as the Bible, a nod to the **shemita cycle** in which farmers are commanded to lay their farms fallow for a year on a seven-year cycle. “In the last years ... the drought has extended for longer times, extending over several years.”

The northeastern part of Syria experienced the most alarmingly low rainfall. That area produced much of the country’s wheat, and when drought struck it, bread became scarce.

Homs, where Khalil lived, is east of what scientists call the rain line, and was severely impacted by decreased rainfall and shifts in the times of year it would rain and frequency of rain.

“It would go from not raining at all to raining a lot to the point that it caused small floods,” Khalil says.

When the drought came, he says, the soil got saltier. Other than eggplant, none of his crops grew in these conditions.

Scientists have noted that this phenomenon, known as soil degradation, struck the Middle East during the drought. Salts occurs naturally within soils and can accumulate when water evaporates. After a plant absorbs water, the salt is left behind stays at the root and chokes the plant, explains Isam Bashour, professor of soil science and plant nutrition at the American University of Beirut. High salt concentrations can be toxic for crops, resulting in reduce yields or crop failure.

Different plants react differently to shifts in soil salt levels, Bashour says. Tomatoes are more resistant to salinity than lettuce. Date trees are resistant to high salts and can survive in a dry environment.

The inability of farmers like Khalil to grow their crops prompted many to leave their rural homes. Some left as early as 2008, according to Khalil and others interviewed by weather.com.

“A lot of families moved to the cities because they couldn’t work in farming,” says Khalil of his neighbors. “When the drought occurred, the government did provide support to some farmers, but only the ones in (the western part of the country). Not us.”

So people moved west in hopes of either finding new economic opportunities or to continue farming in areas where government support was perceived to be better. Others had attempted to weather the drought, but were ultimately driven out by the war. Khalil left in 2014 because his daughter was home alone during one of the bombing raids.

“There was no one home to hug her,” he says as he watches her play in a nearby field. “That was it.”

They began the process of fleeing their homeland the next day.

Ismail Mohammed al-Noury\* watched the rain in his native Homs dwindle throughout his lifetime. The 40-year-old lifelong farmer says the last 10 years before he left Syria were the most water-scarce he had ever experienced.

“My parents and grandparents and great grandparents were all farmers in Homs,” he says, “and we never had a lack of water like we did before I left.”

The personal histories of each farmers' experiences during the drought are consistently intertwined with how the Assad government grossly mismanaged the nation's water and dealt regularly in corruption.

Drought in Syria was compounded by poor governance, according to **Center For Climate and Security**, an organization focused on the intersection of climate and security.

“The Assad government has, by most accounts except their own, criminally combined mismanagement and neglect of Syria's natural resources, which have contributed to water shortages and land desertification,” it writes. “Based on short-term assessments during years of relative plenty, the government has heavily subsidized **water-intensive wheat and cotton farming**, and encouraged inefficient irrigation technique.”

In the face of both climate and human-induced water shortages, farmers sought to increase supply by turning to the country's groundwater resources. Syria's **National Agricultural Policy Center** reported an increase in wells tapping aquifers from just over 135,000 in 1999 to more than 213,000 in 2007. This pumping “caused groundwater levels to plummet in many parts of the country, and raised significant concerns about the water quality in remaining aquifer stocks.”

While four of al-Noury's five sons watch Saudi's Cartoon Network in the next room of the simple cement home he built himself, he recalls life in Syria and what happened when everyone began to leave. Back home, he was known for his pomegranates, grapes and figs.

While 2006 was the worst year for the drought, it was by no means the beginning or the end.

“In 2004-2005 we had to learn new farming methods that used less water because of the drought. We began practicing drip irrigation ... 2007-2008 was the period of chaos,” al-Noury says.

Before that, the government had put regulations on groundwater usage as well as what plants farmers could plant, he says. (While weather.com could not independently



verify this through official records, everyone with whom we spoke who worked in Syria between 2000-2012 mentioned similar regulations.) Regulations he and others describe included limiting access to ground wells, restricting the planting of certain plants and severely taxing water usage.

In 2007, “the government actually made it easier on us because they were busy with other things,” al-Noury says. More specifically, it stopped monitoring how groundwater was used. Officials used to check the wells, he says. In 2007, they stopped coming as frequently, if at all.

Restricting access to groundwater and prohibiting certain crops is not in and of itself a bad thing. When a country experiences water scarcity, it will prohibit crops that use a significant amount of water, like citrus fruits. Monitoring groundwater use could also be a way to promote resource preservation.

When the government cut the water for eight months in 2008, al-Noury recalls, “people just dug their own wells. And then they bribed any police officer who tried to hold them accountable for it.”

While this has catastrophic effects on groundwater availability and usage, it benefited the farmers in the short term. Because of the abundance of wells and access to groundwater, “we started being able to grow fruits and vegetables again, something which the government had severely limited in our region in the previous 10 years,” al-Noury says.

Wael Saeed\*, a 28-year-old former Syrian farmer now working as a teacher at the **Syria Fund**'s school in Azraq, says that in the Homs area where he lived his entire life, there was one spring with 28 tributaries. Collective memory holds that the spring had been used since the time Romans were in Syria. Now the tributaries are dry, and the spring flows only in winter and is a fraction of the size.

Farmers were unable to earn an adequate living. Food shortages drove up prices. Between 2007 and 2008, wheat, rice, and feed prices more than doubled.

Of the most vulnerable Syrians dependent on agriculture, nearly **75 percent suffered total crop** failure. Herders in the northeast lost about **85 percent of their livestock**, affecting 1.3 million people.

A 2011 study co-authored by Colin Kelley examined whether the Middle East's decreasing water trends were due to climate trend or internal, normal atmospheric trends. The study found that human-caused climate change has and will continue to dry out the Middle East.

That same year, a NOAA **study** found strong and observable evidence that the prolonged period of drought in the Mediterranean and the Middle East is linked to climate change. The study also found consistencies between observed climate impacts and future projections from climate models. A climate change impacts model on Syria by the **International Food Policy Research Institute** projects that if current rates of global greenhouse gas emissions continue, yields of rainfed crops in the country may decline 29 to 57 percent from 2010 to 2050, meaning that if and when the war ends, the ability to cultivate the land with crops native to the region could be impossible.

## IDENTITY, DROUGHT, CIVIL WAR

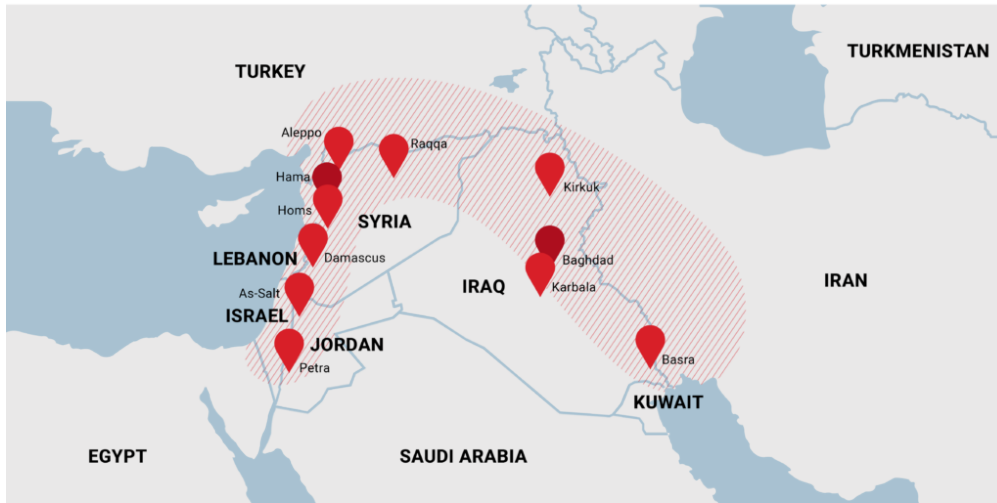
“They call it the rain line. There are the cities closer to the coast” — cities like Aleppo, Damascus — “and they get all the rain,” al-Noury says. “Then there are the eastern cities like Tadmar, which is where we lived, El Qarithe, Derizar. These are the places of the desert.”

Identity in Syria is tied up in rain. It's all about social geography: how it was created over thousands of year and how it continues to impact daily life. This argument has best been articulated by Joshua Landis, professor at the University of Oklahoma. Water scarcity exacerbated by climate change has only made more apparent what's been present throughout history.

“The identities of the Middle East can really be understood in a simple map of a big Arabian Desert around which are sprinkled those cities on the coastline, with their own ships of the sea — the camels being the ships,” he says.

Much like trade routes and port cities were established around bodies of water, so too an intricate network of trade cities existed around the Arabian Desert.

## The Fertile Crescent



The nuances of these identities can be explained through rain, Landis says.

“If you look at it over a few thousand years ... there’s a correlation.”

Speaking to [weather.com](http://weather.com), Landis breaks down the Middle East in geographic and weather terms: “The Fertile Crescent is an upside down horseshoe that spreads through Israel up through Lebanon, Syria, over to where the Kurds are and then down the Tigris and Euphrates to Basra.”

The desert cities are “a string of cities like a pearl necklace encircl(ing) the vast desert. They demarcated two different societies and ways of life: those who were settled and derived their incomes from agriculture in the rain fed regions of the Fertile Crescent and those who pursued a more nomadic existence, following seasonal rains with herds of sheep and goats as well as protecting the caravans that crisscrossed the region.”

Landis explained that “the Bedouin and their caravans were the ships of the desert, carrying goods between the cities sprinkled around the great expanse of the desert, just as the Mediterranean Sea served to connect the many city states that surrounded it. The cities served as entrepôts where goods were exchanged between the desert and sown and where the different communities came together. They were divided into quarters marked out by each community, and had Jewish, Armenian, Kurdish, Christian, Shia, and Sunni quarters.”

Then, “in the frog of the horse hoof, you’ve got Bedouin. And those Bedouin have been left out and they’re dry.”

Put differently, those east of the rain line are Bedouin Sunnis. Those west of the rain line are the region's "others" — the Alawis, a Shi'a path of Islam to which the Assad family belongs, the Druze, the Maronites, and once the Jews. They lived west of the big cities like Damascus, Homs, Hama, Aleppo, Kirkuk, Baghdad and downwards.

Al-Noury, who lived east of Homs, refers to himself and his former neighbors as "people of the desert" to differentiate between the others.

"There is a common culture that is defined by a Sunni religion," Landis says. "In Homs, the rain was never as plentiful as in Damascus, which is closer to the sea."

Climate data supports that observation. The rain in the region comes off the Mediterranean in the west and moves eastward. As the system moves eastward, it becomes weaker and less rain falls. So even when there isn't drought, Homs averages less annual rainfall than places farther west like Damascus.

Drought in the region makes it harder on those who are already in a dry climate, says the World Bank's Jägerskog.

"This is because even if the drought hit coastal areas ... where there is generally more rain, what you do have most likely, at least in the beginning, is a higher groundwater table," he says.

He adds a caveat that the higher groundwater table depends on government farming policies. Generally, getting water in drier areas requires more pumping. Coastal areas farmers rely more on rainfed agriculture.

"If there's a drought in the dry area, the effect on the farmers would be potentially pretty devastating as we've seen in some of these cases. Syria is an example of that," Jägerskog says.

He explains what is at stake for coastal farmers during droughts as well. A prolonged drought will damage the crops of farmers along the coast who are used to some of their crops being rain fed.

If farmers are relying on rainfall that usually comes at a certain time of the year and they plant crops planning for that, if the rain doesn't come at all, or if it comes at the

wrong time, “of course that’s difficult for them, especially if they don’t have supplementary irrigation,” he says.

Understanding this reality coupled with national policy is key to understanding the lead up to the Syrian civil war.

Under the tenure of Bashar al-Assad which began in 2000, Syria’s economy expanded, particularly in cities like Damascus, the capital, and Aleppo, the financial capital. Assad stripped away many socialist policies his father had implemented, like importing luxury goods — including bananas for a time — in favor of a more globalized Syria. There were new banks. There were luxury goods — BMWs and Gucci bags — making class differences visual in a way they never were before. And when the disenfranchised farmers arrived on the outskirts of these cities, for the first time they saw the chasm.

Both during the rule of Hafiz Assad and his son Bashar, the current president of Syria, the country made considerable economic and social progress. In the years leading up to the civil war, the country’s GDP was approximately \$5,000 per capita. That was nearly the same as Jordan’s, roughly double the income per capita of Pakistan, and five times the income of Afghanistan, but it is only a third that of Lebanon or Iran, according to the CIA World Factbook.

In 2010, the GDP per capita had fallen to about \$2,900, according to UN data, which directly correlates to the impacts of the drought. Before the civil war Syria’s growth rate hovered around 2 percent, according to the World Bank. (Except in 2008, the worst year of the drought, when it was zero.)

**U.N. experts** estimate up to 3 million of Syria’s 10 million rural inhabitants were reduced to extreme poverty. By late 2010, about 1 million Syrians were left extremely food insecure by droughts.

In 2011 the tension snapped, first in Dara’a, known as the cradle of the revolution, and then throughout the country.

“What happened in Dara’a broke the fear (we had),” says al-Noury speaking from his tent in eastern Jordan. “The Arab Spring made us feel more empowered, so we had all the reasons to do the same (and rebel).” Al-Noury participated in protests in 2011 in hopes of change.

The rebels began their campaigns in areas packed with the displaced, like Homs, Syria’s third-largest city where fighting

gravitated to after Dara'a. The revolution butted up against the poverty belt in the north.

Frustration and lack of change brought about by protests gave way for the **Islamic State** to begin taking hold in Syria. ISIS, which previously had been operating in Iraq, saw an opportunity to come into Syria and leverage frustrations, **just as it had done** in Iraq.

ISIS' trajectory indicates that they played into the narrative of defending Sunni interests, a **Brookings Institute** study found. At its peak, the ISIS state in 2015 pushed up against the rain line cities and took the desert cities, the cities of the Bedouin tribal Sunni part of that region. This is not a coincidence, according to Landis.

The relationship between drought and poverty helps explain why uprisings in larger cities like Syria's capital, Damascus, and its financial capital, Aleppo, happened at a slower pace. The most money in Syria was being made in those cities.

"Bad governance is part of the reason for the lack of economic growth (in the entire country), not just drought," says Landis, "although drought exacerbated things." The Assad government implemented water policies that created inequality between the desert people and the desert dwellers.

In al-Noury's Syria "we didn't feel the difference between Alawi and Sunni, but the country policies divided us; they made us see each other as different." The warring factions capitalized on it.

## **PART III: JORDAN'S CHALLENGE**

Mohammad Khalil's greenhouse is flourishing. His tomatoes, zucchini and eggplant are aromatic and top-quality. He is there from before sunrise until after sunset. Sometimes, his two daughters join him after school.

But outside his greenhouse, the land is dry.

"Azraq is very similar to where I came from," Khalil tells [weather.com](#). The weather in Syria was not unlike Azraq. The drought that struck Syria has plagued them in Jordan as well.

The ground is dry and the farmers are being forsaken, he says.

“In Syria and in Jordan there is not much help for people like us,” Khalil says, rolling his own cigarette. “In Jordan, there are a lot of challenges for farmers, but (the challenge) are being faced by the entire region. There’s no racism here — it’s just difficult for everyone.”

Jordan’s government is now mandating how people can use the water in their own wells and what they can or cannot plant.



*This well feeds most of the Shishani family's olive groves in Azraq. When weather.com visited, it was during a period of permitted pumping. The Shishani family faces the same daily question as other farmers in the area: wait for the government to mandate water extractions or pump illegally. (Sharon Avraham)*

“In Syria it was different. They wanted to keep the land a desert to receive U.N. funding, which we never saw any of,” Khalil says. “They didn’t have the people’s best interest at heart.”

He pauses.

“I don’t want to talk about politics too much.”

Most of the Syrians living in Azraq interviewed subtly note the similarities between climate shifts in Syria and those they are witnessing in Jordan. No one explicitly compares the Syria government’s responses to the water issues the last two decades and those unfolding in Jordan.

The situation facing Jordan is dire. The drought paired with a massive influx of refugees in the past 30 years and poor water management has contributed to making it the second-most water-scarce country in the world.



*Wael Saeed's\* brother in law and daughter sit east of central Azraq just outside their home, which the male family members built themselves. (Sharon Avraham)*

Saeed, the teacher, lives in a cement two-story home just off of Azraq's main road that he built himself for his family thanks to YouTube building tutorials. He lives with his wife, Khadija, their five children, his mother, his brother and his wife and their two children. Curtains

serve as doors to delineate space between nuclear families for the moment. Behind their home, Saeed is teaching his son to grow crops, just like his father did for him. They grow all of their own produce.

As Saeed was speaking to weather.com, two government water tanks came to extract water from the well next to their home.

The difference between the drought's impact in Syria and Jordan is that Jordan appeared to have dealt with it that much better. Jordan was better prepared for drought, says Jägerskog of the World Bank, because unlike Syria, it had not pumped groundwater aquifers dry. It also used treated wastewater for irrigation, an innovation.

Amit Tubi, a professor in Hebrew University's geography department, has focused his recent research to address why Jordan has not gone the way of Syria. It comes down to differences in infrastructure, governance and overall economic security.

Jordan's water issues predate the recent drought.

Agriculture is Jordan's heaviest water consumer, accounting for up to 60 percent of national water allocations. As such, agriculture accounts for more than half of the national water consumption and yet generates around 4 percent of the national GDP, as of the 2015 report.

At the time of the establishment of the modern state of Jordan in 1946, roughly 80 million gallons of water were being pumped out of Azraq. In the 1965, the Jordanian government began pumping just over 1 billion gallons of water — over 10 times more than 20 years earlier — to Zarqa and Irbid, Jordan's second- and third-largest cities, to



support their quickly expanding population. By 1985, nearly 4 billion gallons of water were being pumped to Amman. This process drained the Azraq Wetlands Reserve.



*This wooden promenade in the Azraq Wetlands Reserve once overlooked some of the most lush portions of the reserve and provided a great spot for bird watchers to wait and observe migrating birds. Now, it overlooks desolation. (Sharon Avraham)*

“If you stood in this place 20 years ago,” reads a sign in the reservation written by the Royal Society for the Conservation of Nature, “you would be submerged to the neck in water. Unfortunately, over pumping of water caused a devastating decrease in groundwater.”

Another sign in the wetlands serves as a poignant reminder as to how this all happened: “Unfortunately, while humans have relied on the oasis for centuries, it is also humans who have pushed it to the brink of destruction.”

At this point, 9.6 miles once covered by wetlands are now bone dry.

In 1978, the Royal Society for the Conservation of Nature established the Azraq Wetlands Reserve to conserve the oasis. The wetlands were created 250,000 years ago, according to the reserve’s museum, as a result of being fed by aquifers. But by 1991, 10.3 billion gallons of water were being piped to Amman, and one in every four cups of water in Amman came from Azraq. By the 1990s, the water buffalos of Azraq died, and many migrating birds, once a mainstay in the region, now migrate via the Sea of Galilee that borders Israel, Jordan and Syria instead.

In 1994, the Jordanian government began an effort to restore it. Four years later, the region was struck with the most

severe drought it has ever seen. Azraq never recovered.

The environmental disaster, as the Royal Society for Nature Conservation calls it, facing Azraq is caused by a toxic combination of water overuse and drought exacerbated by climate change.

The cold peace with Israel helps mitigate Jordan's water woes. A major stipulation of the Israel-Jordan peace treaty is connected to water. Israel, which receives more rain and shares groundwater resources, agreed to give Jordan 13.2 billion gallons of water and transfer 75 percent ownership of the Yarmuk River to Jordan.

During the winter, "Israel stores water coming from the Yarmuk river and they pump it up to the Tiberias Lake and then Israel releases it in the summer months when Jordan needs it most," Jägerskog said.

In 2013, a nonrenewable aquifer was opened, thanks to a joint project between Jordan and Saudi Arabia. The Disi aquifer, which lies beneath the desert in southern Jordan and northwest Saudi Arabia and is not without its controversy, pipes water to Amman and other cities to meet increased water needs. Disi brings 26.5 billion gallons of water annually to Amman via a roughly 202-mile pipeline.

"Bringing water from Disi in the last five years helped us face water scarcity, but I wouldn't say it's a long-term solution," says Dheaya Alrousan, a professor in the department of water management and the environment at Hashemite University.

Nasser al Zawdeh, the director of Wadi Rum Protected Area in southern Jordan, is confident that the anticipated amount of water for which Disi should be able to provide will fall short. "With the amount Amman takes, it will empty soon. Very soon," he explained with the dry desert as a backdrop behind him.

The water for Zarqa and Amman, Jordan's two largest cities, used to come from Azraq, he says. In theory, the Disi Water Conveyance Project should have decreased stress on the Azraq basin and allowed it to slowly and naturally replenish itself. Alrousan noted that Disi opened around the time mass influx of Syrian refugees began fleeing to Jordan.

The mass influx in a short amount of time put a major stress on water sources.

To avoid straining water sources, the Jordanian Ministry of Water permitted UNICEF to drill five wells specifically for refugee camps, two of which serve the **Zaatari** refugee camp and three of which serve Azraq's. These wells were drilled to local standards, says Esmaeil Ibrahim, water, sanitation and hygiene officer with UNICEF, which runs the Azraq refugee camp with UNHCR.

Another challenge presented by Jordan's influx of refugees, Alrousan notes, is the possibility of groundwater pollution. Both the al-Zaatari camp just outside of Mafraq and the Azraq camp are near major groundwater basins.

"There is a great possibility that the groundwater will be polluted by waste water from those camps," he says. "You need only one accident to destroy all the groundwater."

There is a strict waste management plan to prevent such pollution from happening, according to UNICEF's Ibrahim. Within the camp, UNICEF is adapting to put as little pressure as possible on water sources.

In the camp there are septic tanks. There is a company contracted to take the wastewater to government treatment plants. All of the systems and materials are built to Jordanian standards. The Ministry of Water and Irrigation is responsible for setting those standards.

The treated water is then used for farm feeding.

The U.N. adhering to "local standards" regarding sanitation is an ongoing problem. In countries where local standards exist more as platitudes than as enforced policies, adhering to these local standards as opposed to a unified U.N. standard has led to numerous deaths.

After the 2010 earthquake in Haiti, a combination of poor waste management standards and U.N. negligence **led to a cholera outbreak** that killed thousands, as Jonathan M. Katz chronicled while reporting for the Associated Press and in his book **The Big Truck That Went By: How The World Came To Save Haiti And Left Behind A Disaster**. Katz's investigation explains how the U.N. policy of holding systems to local standards in countries where cutting corners and corruption is commonplace is irresponsible at best and deadly at worst.

Bribes and a lack of government oversight were often mentioned in Jordan by everyone from urban professionals to rural dwellers. June 2018 saw the country's largest anti-

government protest in recent years. A series of street interviews throughout the country in July indicated that while the official incident that sparked the protests were related to a new tax law, the underlying cause for the unrest is tied to corruption and resource management, especially in light of the refugees. The protests led to the resignation of Prime Minister Hani al-Mulki.

The lack of government support for farmers has caused noticeable internal migration and has forced locals to dig personal wells. There are more than 500 illegal wells still pumping water from Azraq, the Royal Society for the Conservation of Nature estimates. This does not take into account smaller personal wells.



*Water used to flow freely here and rain always filled this 40 foot deep well, says Abdullah, a bedouin living in southern Jordan. Now, the well is less than 15 feet full and it hasn't rained in two years. (Gavi Barnhard)*

The country has been **trying to crack down** on illegal wells, though locals say with the decision of which wells to investigate and which to shut down are interwoven with money, power and corruption.

“You’re looking at at a country which is already facing challenges with its own water scarcity,” says Roelof Wentzel, water, sanitation and hygiene officer at the UNHCR’s Amman office. “And it hasn’t gotten easier since the refugees came from Syria, for good reason. The Jordanian government is working hard to solve those issues, but there’s not yet a balance.

“Natural resources are depleted, which will create issues in the future” he says.

The World Bank’s Jägerskog is more optimistic. “Not all of this is necessarily doom and gloom. There is opportunity for reuse of wastewater,” as well as other innovations, he says.

The general hope is that necessity will lead to innovation. In some ways it already has: the alternative olive farming methods that those at the Al-Zyoud Olive Oil Mill are cultivating, as well as the self-irrigation system inspired by permaculture ideology Mohammed Khalil is developing.

“This is the land where I find my happiness,” says Khalil from inside his hydroponic tent, declining a chair and sitting instead on the ground itself.

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