CASE STUDY 4.1
USING BIG DATA AND AI TO SUPPORT CONFLICT ANALYSIS ON WATER SCARCITY IN YEMEN

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Before the current conflict in Yemen, more than 70 percent of households depended on agriculture to sustain livelihoods, despite Yemen being one of the most water-insecure nations. Water scarcity was further compounded by "development projects," which encouraged groundwater abstraction using diesel-reliant operations at the expense of traditional spate irrigation systems. This occasionally contributed to local water conflicts.[82] In 2014, following the removal of diesel subsidies, the price of groundwater abstraction became too costly for many Yemenis, leading to protests and grievances which, in turn, contributed to the seizure of power by Houthis.[83]

The importance of agriculture for rural livelihoods and food security means water security is vital to conflict dynamics and peacemaking in Yemen. During the conflict, agricultural and water infrastructure was deliberately targeted, and access to agricultural inputs, transportation systems, and diesel for water pumps was limited. At the institutional level, the collapse in governance disrupted traditional local water management structures and led to a loss of monitoring capacities for water wells. Consequently, previously productive agricultural areas showed signs of degradation and unsustainable management.[84]

To compensate for the lack of diesel fuel, solar power was deployed throughout the country to extract groundwater resources. At first glance, this alternative bypassed diesel costs, reduced CO2 emissions and supported decentralized energy systems. However, this growth in solar power came with the risk of unchecked and unsustainable water extraction.

The methodology for the conflict analysis on water scarcity used water data from diverse sources of Earth observation. For example, terrestrial water storage, comprising surface water, soil water and groundwater, was obtained from NASA's Gravity Recovery and Climate Experiment mission.[85] Groundwater data was derived, albeit with substantial uncertainty, from the surface and soil data using the European Space Agency's (ESA's) Copernicus Climate Change Service combined with soil moisture data.[86]

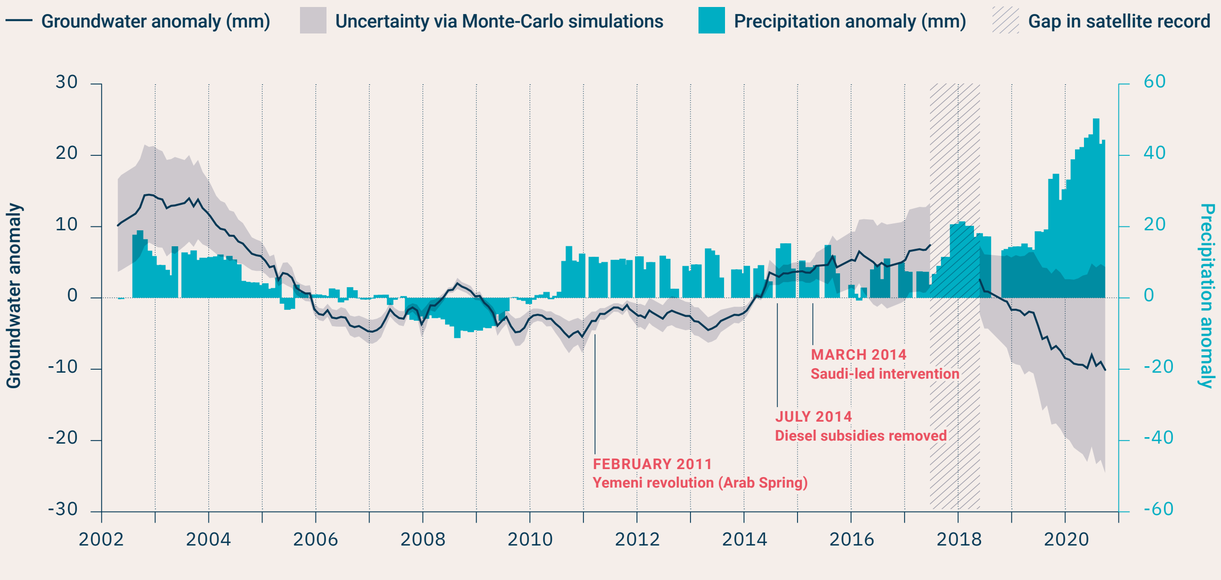
To establish the drivers of the observed groundwater changes, other big data sets were incorporated into the analyzes, including data on precipitation, vegetation, night-time lights, conflict events, agricultural statistics, diesel prices, and trade data. This holistic approach allowed hypotheses to be defined, which were then tested and enhanced via expert interviews.

The analysis results indicated that between 2018 and mid-2020, groundwater dropped across western Yemen to the lowest level based on satellite-derived records, despite above-average rainfall (FIGURE 4.2).[87] The investigation suggested that the growth of solar-powered irrigation was the driving factor, a hypothesis supported by local studies on the ground.[88] Given the lifesaving benefits of solar power, this unintended consequence requires careful management on the part of all stakeholders, from well owners and communities to development agencies and local authorities.

The water crisis in Yemen is a major challenge embedded in a humanitarian catastrophe following years of war. In this context, human security and conflict resolution directly depend on water security and sustainable management. Digital technologies have a significant role to play in supporting peace practitioners to tackle water security. However, they also face important limitations. Continued monitoring of groundwater from space is required, but since this method is limited to governorates (regions) in terms of spatial scale, measurements on the ground are also essential. Low-cost sensors and citizen science could hold promise for monitoring individual wells. However, introducing these technologies in a conflict setting should be done with caution. In the context of Yemen, it is fundamental that water users own the process and the monitoring technology.

FIGURE 4.2: GROUNDWATER AND PRECIPITATION ANOMALIES IN WESTERN YEMEN FROM APRIL 2002 TO SEPTEMBER 2020.

24 month moving mean of anomaly (baseline 2004-2009). Groundwater calculated from NASA GRACE gravimetry and Copernicus C3s soil moisture products. Changes in millimeters detected from space equate to changes in the scale of meters in individual wells.



Source: CEOBS 2021.