WASH Cluster
Water Sanitation Hygiene

IRAQ - WASH Remote Sensing Activities 2019 - 2020

December 2020

Introduction

Although military operations against the so-called Islamic State of Iraq and the Levant (ISIL) have been concluded and Iraq has entered a post-conflict recovery phase, in 2021 the country will likely continue facing challenges of addressing both the short and long-term consequences of mass population displacements, including restoring access to essential services and addressing basic needs in vast areas of territory. The Humanitarian Needs Overview (HNO) 2020 estimates that 2.3 million people across Iraq will remain in critical need of sustained, equitable access to safe and appropriate "Water, Sanitation Hygiene" (WASH) services[1]. As outlined in the HNO, around 500,000 people continue to require some level of specialised WASH support in camps, especially since sanitation coverage is still below minimum standards. This is especially important, as water scarcity and rising salinity are increasingly understood to pose threats to human security and state stability in Iraq moving into 2021[2].

In Iraq, to provide a detailed evidence-base on needs, access to and functionality of WASH services and infrastructure, REACH has produced multiple remote sensing studies in 2020 that have identified longer term challenges to durable WASH solutions, such as a volatile water supply, water shortages, and flooding, raising a new set of cross-sectoral issues with implications for WASH interventions. Water shortages have been tied to major public health risks as highlighted in the Humanitarian Response Plan (HRP 2020) and may have a negative impact on sustainable livelihoods, agricultural lands, social tensions, and future displacement patterns.

List of Products

English

Long-term Precipitation Pattern in the Euphrates-Tigris Basin (February 2020)
Surface Water Occurrence Change Between 1984-2018 (May 2020)
Land Cover Change and Livelihoods in the Mesopotamian Marshes (September 2020)
Water Pollution Assessment of the Canals in Basrah City (October 2020)
Flood Hotspots in Iraq October 2018-March 2019 (October 2020)
Water Treatment Plant WebApp

Arabic

Long term Precipitation Pattern in the Euphrates-Tigris Basin (February 2020)
Surface Water Occurrence Change Between 1984-2018 (May 2020)

Vision for the Future

REACH's work alongside the WASH Cluster highlights the need for more information and further research within water management, specifically in regards to water quality, flood control, and long-term impacts of the restoration of the marshes in southern Iraq, as well as information on water treatment plants providing clean water to Iraqis. REACH recommends further research on:

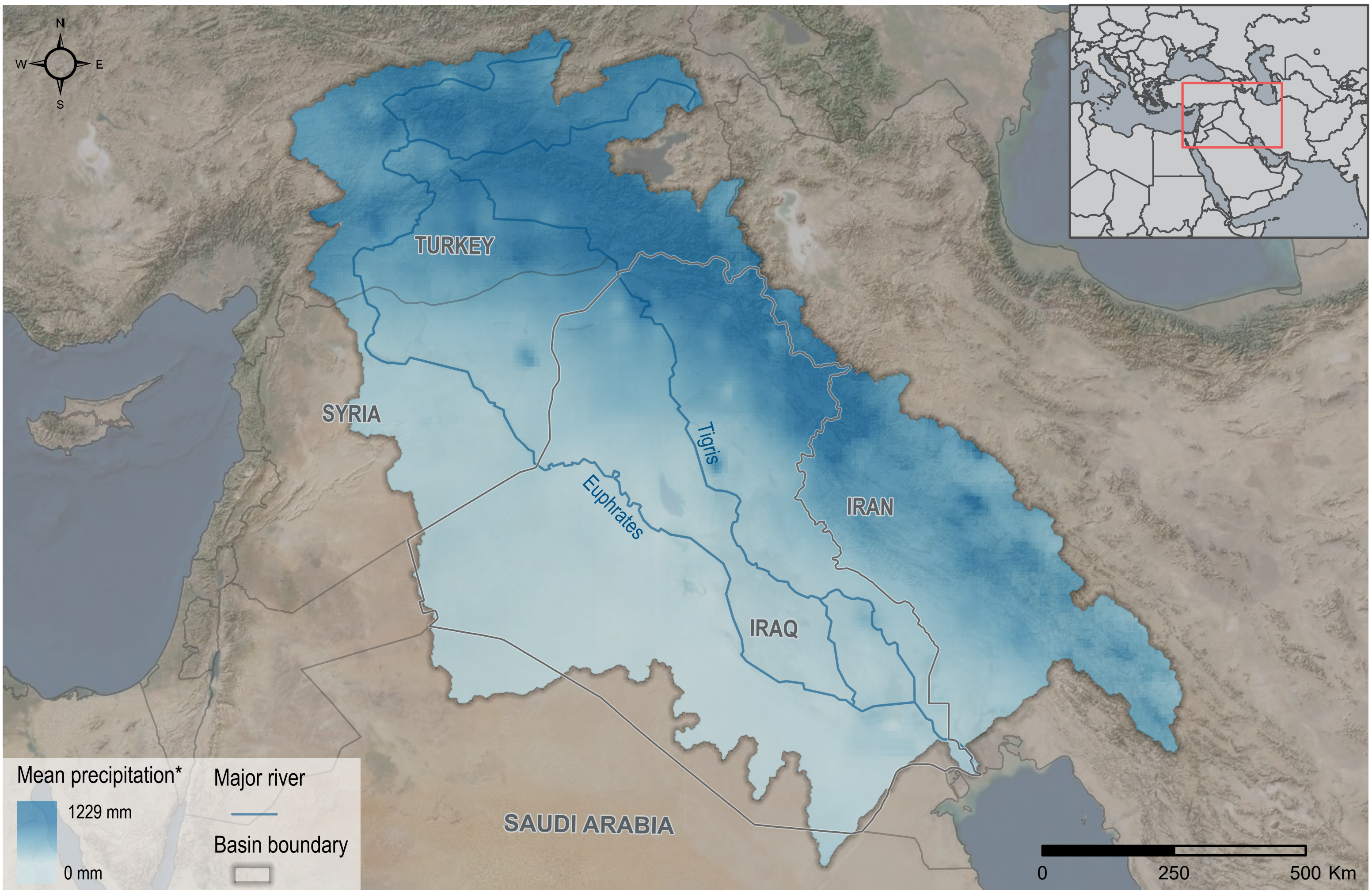
- A remote sensing study on detailed flood risk vulnerability of vulnerable populations, mainly in formal camps, informal sites, and other high-risk areas.
- A groundwater flow assessment measuring access to boreholes and springs using remote sensing.
- A remote sensing study on the impacts of water pollution on agriculture and water quality.
- A household assessment on the impact that the restoration of the marshes had in the livelihoods of Marsh Arabs since 2006 and their current water, economic and environmental needs.
- A water quality and WASH needs household assessment for Basrah City.

[1] OCHA HNO November 2019 https://reliefweb.int/report/iraq/iraq-humanitarian-needs-overview-2020-november-2019-enarku

[2] OCHA HRP January 2020 https://www.humanitarianresponse.info/en/operations/iraq/document/iraq-2020-humanitarian-res

Long-term Precipitation Pattern in the Euphrates-Tigris Basin

Iraq, February 2020



*Long-term annual mean precipitation for the period from 1981 - 2019

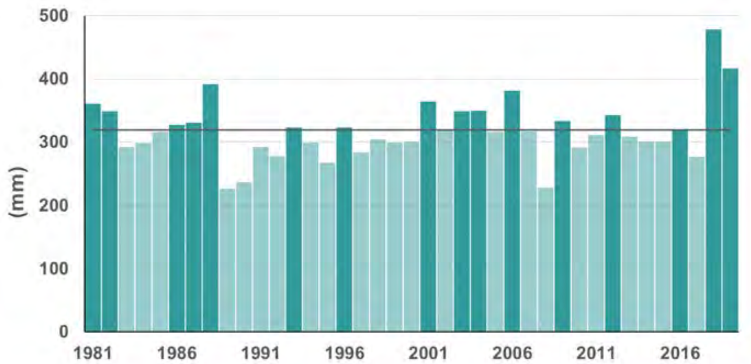
Background

In Iraq, various long term challenges related to water shortages and flooding have raised a new set of cross-sectoral issues with implications for WASH interventions, yet detailed information on water surface areas is limited. To support the WASH Cluster in Iraq in the coordination of strategic planning regarding the emergency risk response, REACH conducted a preliminary precipitation analysis of the Euphrates-Tigris Basin, as part of a wider water surface change analysis.

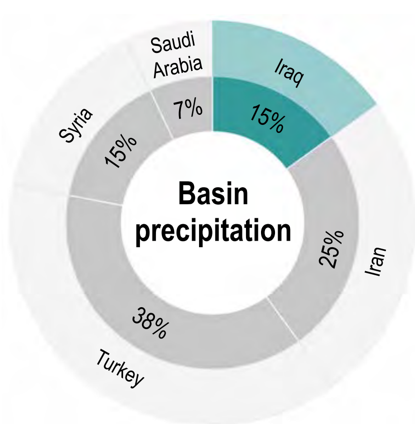
Basin precipitation distribution

Despite Iraq covering nearly half of the Euphrates-Tigris basin (47%) the country receives just a small fraction (15%) of the annual basin precipitation. Furthermore, the long-term precipitation pattern reveals that incoming rainfall is mostly concentrated in the northern areas whereas the south of the country often remains dry. In contrast, neighbouring countries such as Turkey, Iran and Syria overall receive the main share (85%) of the annual basin precipitation, which is distributed over just 53% of the basin area. The Turkish part of the basin in particular receives the highest share of the annual basin precipitation (38%) while Turkey covers only 21% of the total basin area.

Annual mean basin precipitation (1981-2019)



Annual mean basin precipitation by country



River flow

It is estimated[1] that Turkey contributes approximately 89% and Syria 11% of the annual flow of the Euphrates. The annual flow of the Tigris originates for approximately 51% in Turkey and 10% in Iran. Despite the fact that the remaining 39% originates in Iraq, all the tributaries that feed the Tigris within Iraq originate in either Turkey or Iran. In addition, dams along both rivers and their tributaries control the inflow into Iraq and within Iraqi territory.[1]

Methodology

Basin boundary was extracted with Arc Pro using USGS HydroSHEDS digital elevation model. Satellite precipitation data (Climate Hazards Group InfraRed Precipitation with Station data) was processed in Google Earth Engine for the period between 1981 - 2019.

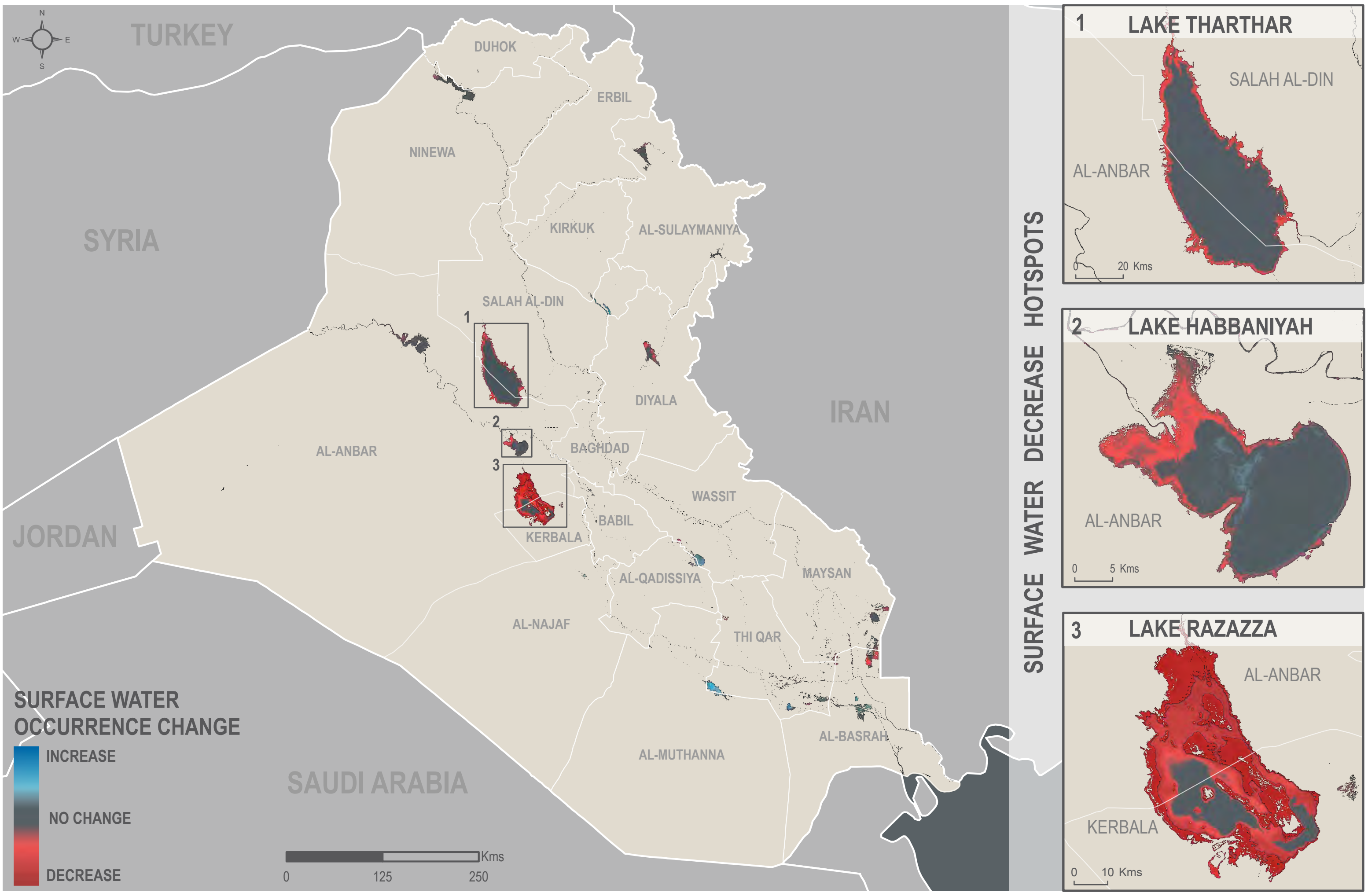
1 FAO (2009) Irrigation in the Middle East region in figures

WASH Cluster
Water Sanitation Hygiene

Long-term Surface Water Dynamics in Iraq

May 2020

SURFACE WATER OCCURRENCE CHANGE BETWEEN 1984 - 2018

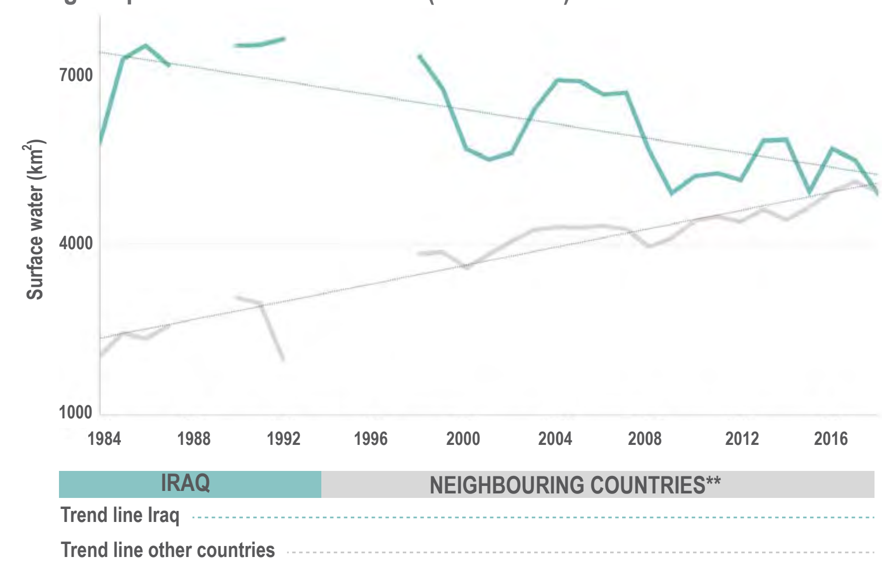


The Water Occurrence Change map provides information on where surface water occurrence increased, decreased or remained the same between the two epochs: 1984-2004 and 2005-2018. The intensity of the color represents the degree of change. For example, dark red areas show greater loss of water than light red areas.

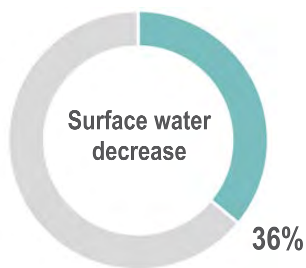
Background

Water availability in Iraq undergoes large annual and inter-annual fluctuations caused by factors such as variations in precipitation and temperature, and upstream and in-country water management.[1] Various long term challenges related to water shortages and flooding have raised a new set of cross-sectoral issues with implications for Water Sanitation and Hygiene (WASH) interventions. However, detailed information on surface water area trends is limited. To inform the WASH Cluster in Iraq on needs for sustainable and preparedness-focused interventions, REACH conducted a comprehensive long term surface water change analysis. In general, the analysis suggests that Iraq's surface water experienced a downward trend during the years 1984-2018, while neighbouring countries experienced a surface water increase during the same timeframe.

Change in permanent* surface water (1984 - 2018)



Reduction of permanent surface water (1992 - 2018)***



*Permanent surface water refers to areas which are underwater throughout the year.

**Neighbouring countries refers to areas of the Euphrates-Tigris basin outside of Iraq.

***1992 marks the completion of the marshland drainage works and the inauguration of the Attaturk dam along the Euphrates river.[2]

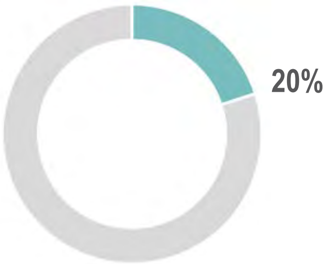
[1] REACH (February 2020). Long-term Precipitation Pattern in the Euphrates-Tigris Basin
[2] UNEP (2001). The Mesopotamian Marshlands - Demise of an Ecosystem

CASE STUDIES OF SURFACE WATER DECREASE

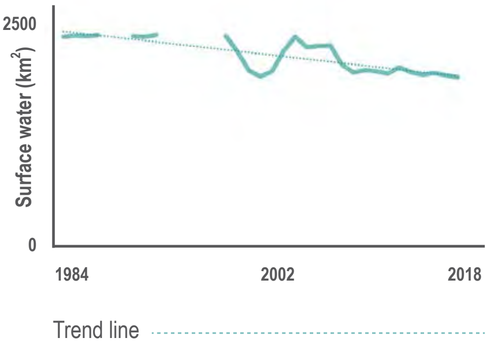
LAKE THARTHAR

Year of construction: 1965[3] **Purpose:** flood protection (Tigris river)[3] **Water loss since 1984:** 495km²

Percentage decrease



Change over time

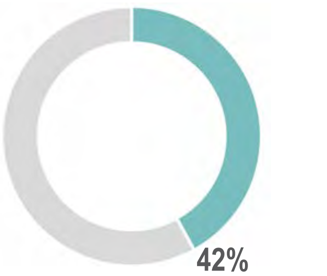


Comparison between 1984 and 2018

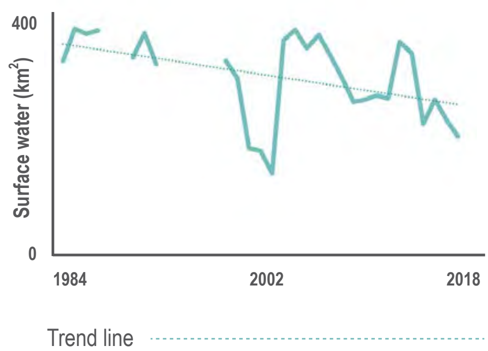
LAKE HABBANIYAH

Year of construction: 1940[4] **Purpose:** flood protection (Euphrates river)[4] **Water loss since 1984:** 139km²

Percentage decrease



Change over time

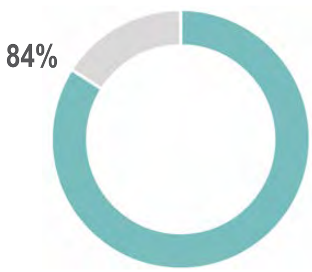


Comparison between 1984 and 2018

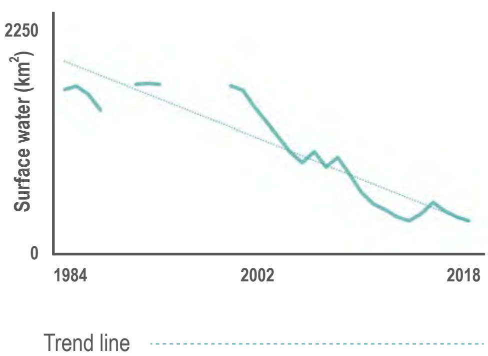
LAKE RAZAZZA

Year of construction: 1969[5] **Purpose:** flood protection (Euphrates river)[5] **Water loss since 1984:** 1362km²

Percentage decrease



Change over time



Comparison between 1984 and 2018

[3] Sissakian (2011). Genesis and Age Estimation of the Tharthar Depression, Central West Iraq

[4] Abdullah et al. (2019). Water Resources Projects in Iraq, Reservoirs in The Natural Depressions

[5] Abdulwahhab et al. (2012). The Study of the surface area change of lake Al-Razzaza using geographic information system (GIS) and using remote sensing

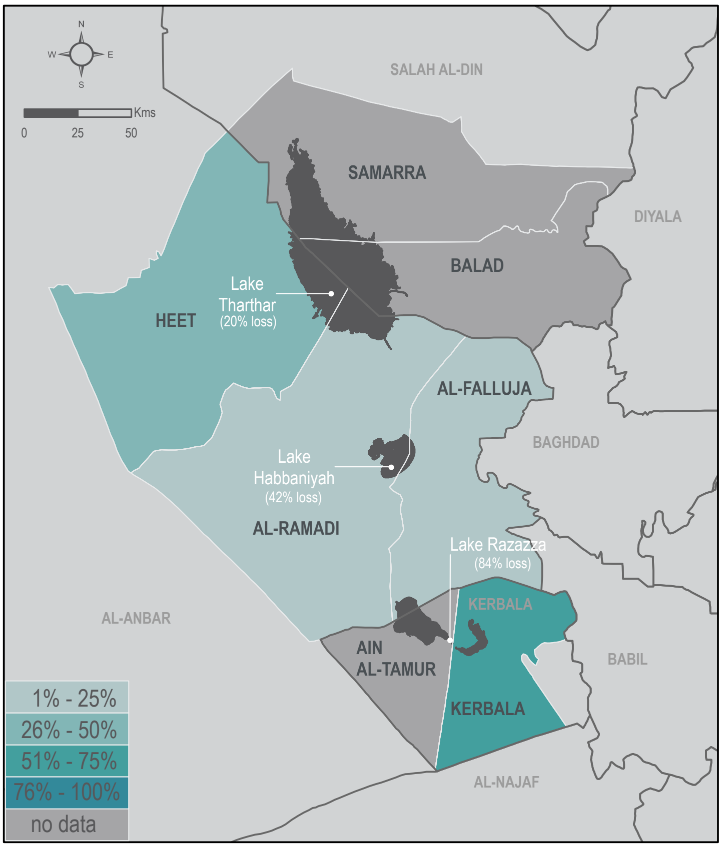
POTENTIAL IMPACTS ON DRINKING WATER

Integrated analysis of household-level indicator and surface water data

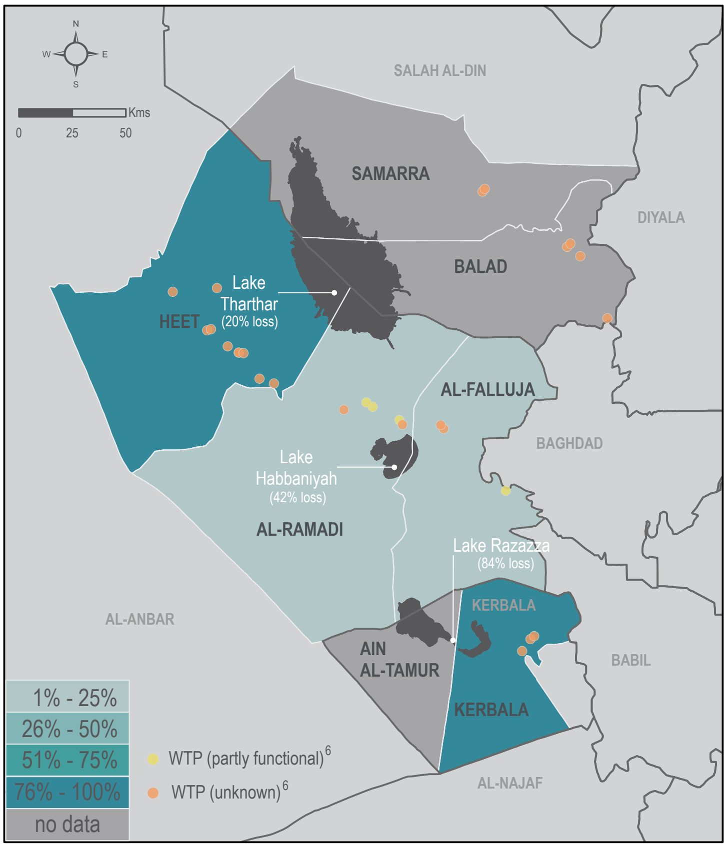
Findings indicate that high levels of turbidity in drinking water may correlate with the previously discussed decreases in surface water. In districts surrounding the three reservoirs, a relatively large proportion of households reported their drinking water being turbid or unclear (59%) compared to households in other areas (47%). Such reports were particularly high in Kerbala district, on the southeastern shore of Lake Razazza, where 100% of households reported their drinking water being turbid or unclear. The reason for this localised turbidity may be that, as the shoreline recedes and reservoir water becomes more concentrated, silt and other particulates may become more prevalent, thus increasing water turbidity.

Therefore, it is not surprising then to see that the majority of households in the area reported bottled water as their main drinking water source (74% in Kerbala district). High turbidity increases the need for water treatment, while simultaneously reducing the effectiveness of water treatment plants (WTPs),[6] even disabling them when the turbidity levels are too high. With all documented WTPs in the vicinity of the three reservoirs only at partial or unknown functionality,[6] this highlights the urgent need for further investigation.

% of household reported using bottled water as primary source of drinking water



% of household reported turbidity as reason for water treatment



Surface water extent of 2018 is shown on the maps

Methodology

Change in water occurrence between two epochs (1984-2004 and 2005-2018) was calculated by exploiting the Yearly Water Classification History (v1.1) of the Global Surface Water dataset from the Joint Research Center (JRC) of the European Commission.[7] The dataset represents the spatial and temporal variability of global surface water and its long-term changes and was created by using the entire multi-temporal orthorectified Landsat 5, 7 and 8 archive spanning the last 32 years. For this study, the data was accessed and computed using Google Earth Engine. In order to map the change in surface water occurrence, two similar periods of time had to be identified to enable accurate comparison of data. The timeframes for each epoch were chosen under consideration of having an equal amount (n= 14) of valid observations (VO) per epoch.* First, surface water occurrence (SWO) layers, capturing intra-annual variability, were computed for each selected timeframe. To compute the SWO, the water detection per pixel for all VO was determined ranging from 0%-100%. Pixels with 50% SWO indicate water detection for 7 VO for the respective pixel. Second, by computing the difference between the SWO layers the change in water occurrence was retrieved, indicating the direction and magnitude of change in %. Pixels with -50% surface water occurrence change would indicate a decrease of water occurrence by 50% compared to the previous epoch.

To provide evidence on the potential impact of surface water trends on households' WASH needs, SWO data was complemented with household-level data derived from a recent REACH assessment, which sought to provide information on the WASH needs, gaps, and priorities for out-of-camp households residing in Iraq.[8] In total, 90,090 households were surveyed across the country between 22 September and 31 December 2019. Findings are statistically representative with a 90% confidence level and 10% margin of error for each population group at district level.[8]

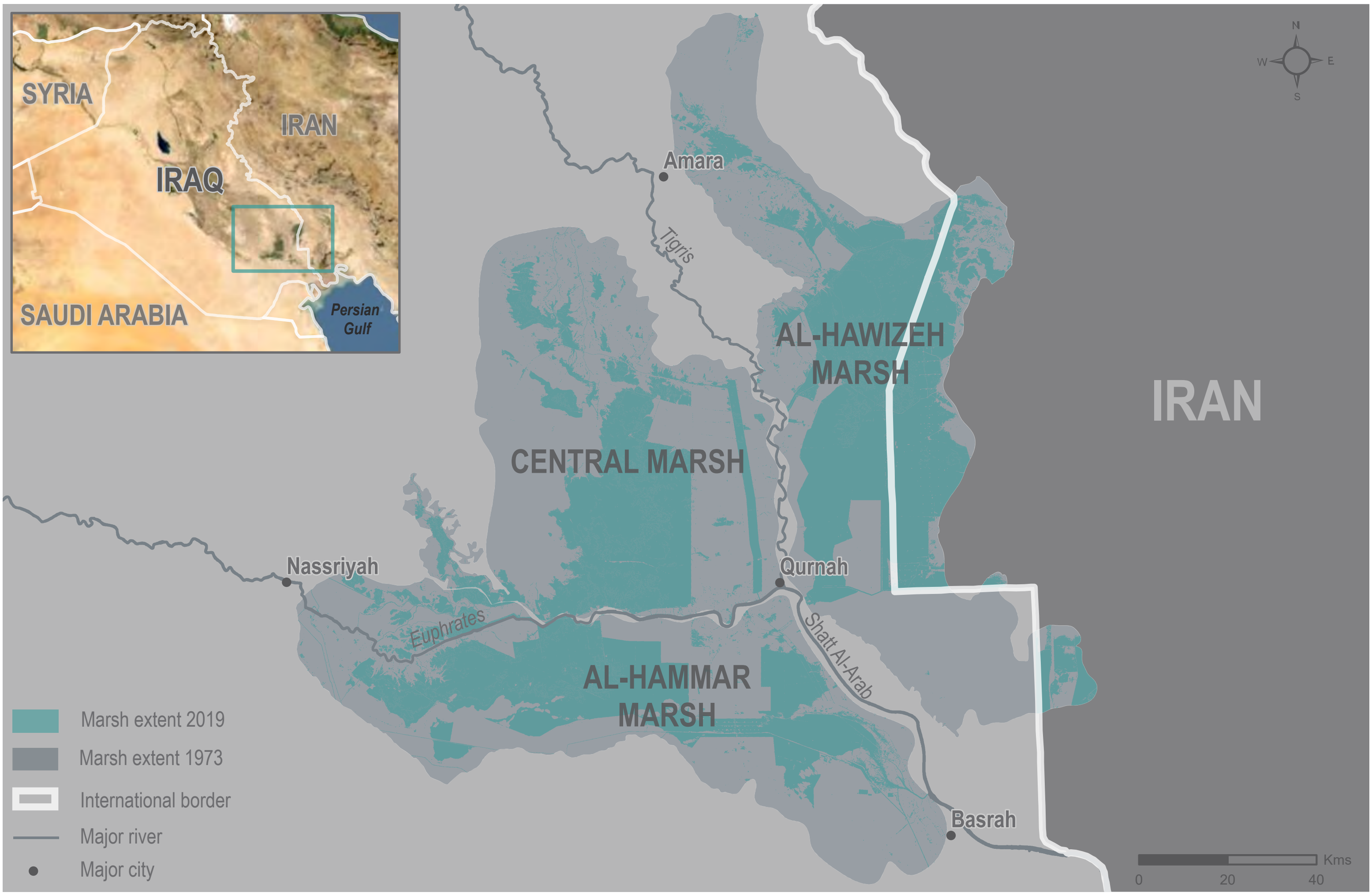
6 WASHapp - Iraq Water Treatment Plant Monitoring System (https://reach-info.org/irq/wash2020/)
7 Pekel et al. (2016). High-resolution mapping of global surface water and its long-term changes
8 REACH (2019). Iraq Out-of-Camp WASH Needs

*No VO for the years 1988-1989 and 1993-1997 were available

WASH Cluster
Water Sanitation Hygiene

Land Cover Change and Livelihoods in the Mesopotamian Marshes | September 2020

HISTORICAL AND CURRENT EXTENT OF THE MARSHES



Background

Until the mid-20th century, the Mesopotamian marshes represented a source of cultural richness and biodiversity.[1] However, by 2002, the marshes were almost fully transformed into a desertscape due to conflicts, hydropower and irrigation development projects in upstream areas.[1] This transformation was accompanied by a destruction of natural habitats for a variety of bird and fish species as well as water buffalo.[2] Local communities who heavily relied upon the farming and trading of water buffalo and fishing soon experienced their livelihoods collapse because of this desertification. Soils became infertile and futile for agricultural activities.[1] In 2003, drainage structures were torn down to start the rehydration and ecological recovery of the former marsh areas.[2] The Iraq Marshlands Observation System (IMOS)[3] project, implemented by the United Nations Environment Programme (UNEP) (2003-2005), reported a recovery of 42% of the original marshland by November 2005. REACH, in close reference to the IMOS project, conducted a follow-up long-term land cover change analysis to inform the Water, Sanitation, and Hygiene (WASH) Cluster and other relevant stakeholders about the more recent progress and consequences of the marshland rehydration to further support the implementation of appropriate rehabilitation measures. For more details on the assessment, please see the methodology section on page 4.

Key findings

- After an initial increase in surface water and marsh vegetation reported by UNEP from 2003 to 2005, REACH found that the rehydration progress relatively stagnated around the peak extent measured for 2007 with some variations.
- Besides upstream water management, also climatic extremes such as drought periods in 2007/08[4] or years with extreme precipitation like 2018/19[4] appear to have had a great effect on the marshland recovery.
- The ecological status of the restored marshland area, and particularly its effects on the current livelihood situation of the Marsh Arabs, remains unclear 17 years after restoration began; additional research into the consequences of the restoration program is necessary to foster a better understanding of the sustainability of the marshlands and local livelihoods.

Timeline - showcasing major events with an effect on the marshes

1973 Marshland baseline extent (first satellite images)

1977 Start of the South-eastern Anatolia Project (step-wise water inflow reduction into Iraq due to dam and hydraulic power plant constructions in Turkey)[1]

1980 – 1988 **Iraq-Iran war** (destruction of the marshlands through development of war infrastructure)[1]

1990 – 2003 **Comprehensive marshland drainage works until almost complete desiccation.** Displacement and persecution of local Marsh Arab communities. Loss of livelihoods and biodiversity.[4]

2001 Completion of Karkheh Dam in Iran (depletion of main fresh water inflow into Al-Hawizeh Marsh)[1]

2003 **Start of rehydration of the marshlands.**[2]

2005 UNEP reports marsh rehydration of 41% of the historical extent.[3]

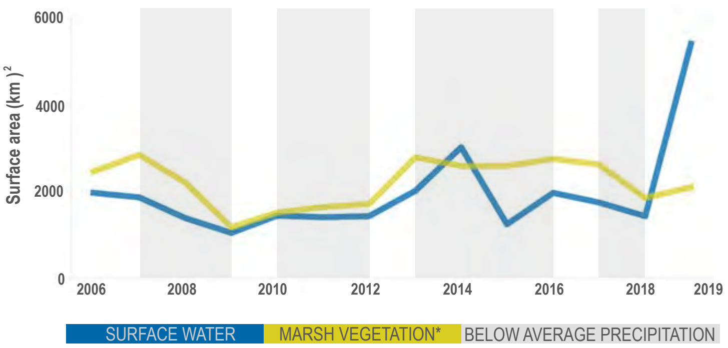
2019 Last assessed rehydration state.

1 UNEP (2001). The Mesopotamian Marshlands: Demise of an Ecosystem
2 Richardson et al. (2005). The Restoration Potential of the Mesopotamian Marshes of Iraq
3 UNEP (2005). Iraqi Marshlands Observation System UNEP Technical Report
4 REACH (February 2020). Long-term Precipitation Pattern in the Euphrates-Tigris Basin
5 Al-Handal (2014) MODIS Observations of Human-Induced Changes in the Mesopotamian Marshes in Iraq

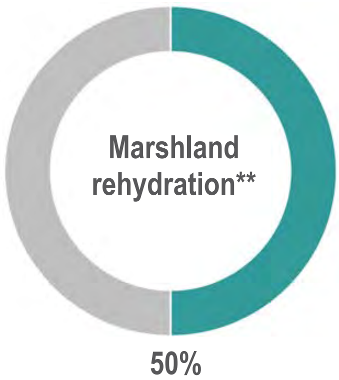
REHYDRATION PROCESS IN THE THREE MARSH UNITS

ALL MARSH UNITS   Land cover change between 2006 and 2019

Land cover change in the marshes between 2006 - 2019



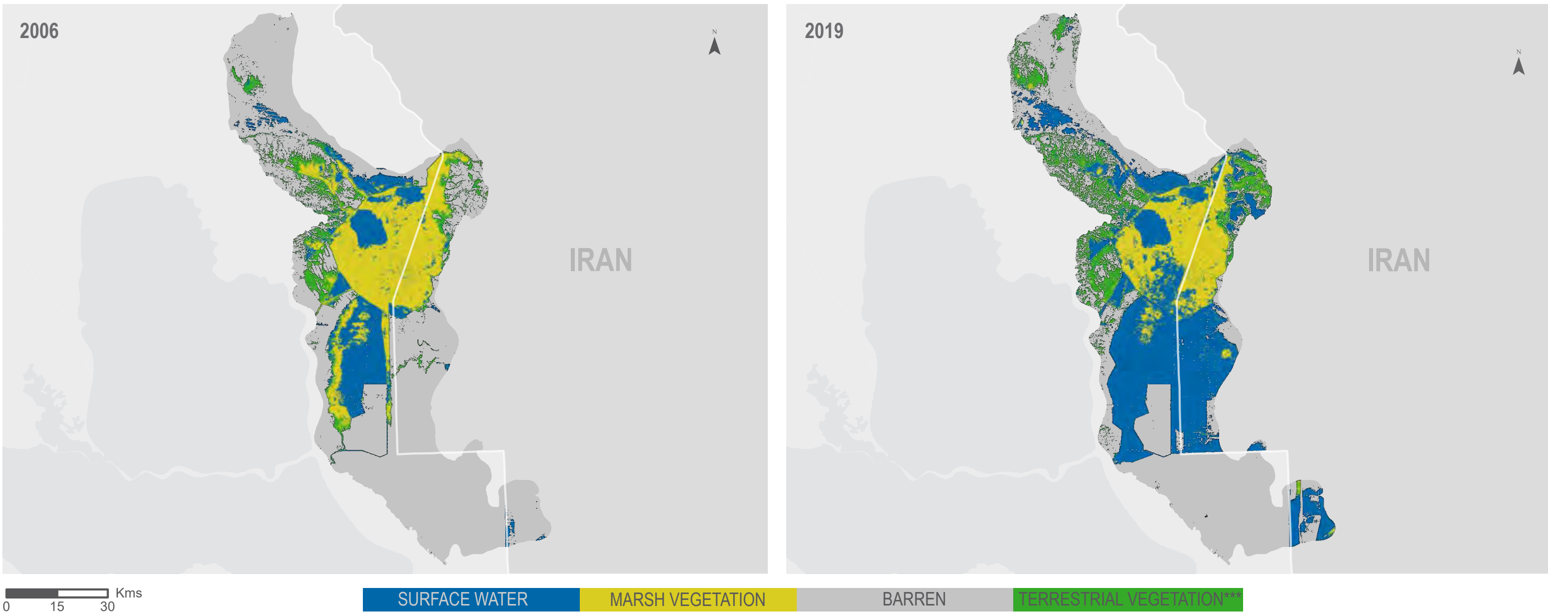
2019 marshland rehydration status in relation to desiccation in 2002



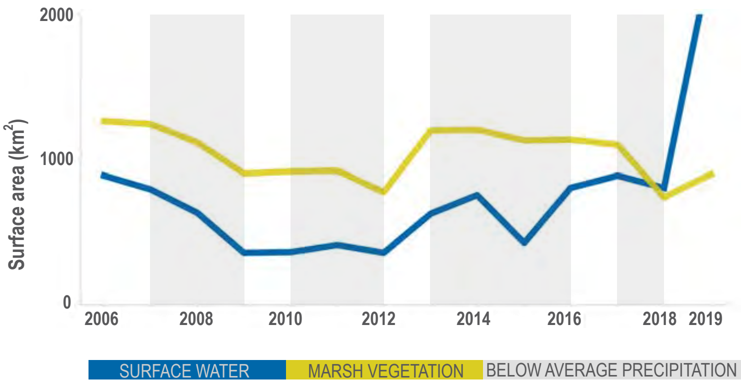
Time trend

REACH found that the nearly linear increase of the marshland extent reported by UNEP[6] in the period 2003 - 2005 continued until 2007, when the marsh vegetation growth experienced its peak in the time of rehydration. The following years of relatively low precipitation (2007-2008)[7] may have contributed to a decrease in marshland coverage. In 2013, the marsh vegetation again reached nearly the 2007 expansion, but seemed to plateau by 2017.

AL-HAWIZEH MARSH   Land cover distribution in 2006 and 2019



Land cover change between 2006 - 2019



Changes

Al-Hawizeh marsh is the only natural marsh unit that has survived the drainage works.[8] Throughout the rehydration process, the Al-Hawizeh marsh covers the largest area with a core area continuously covered by marsh vegetation. Impacts of dry years does not have a major effect in comparison to other marsh units. Consecutive dry years did not appear to have a major effect on marsh vegetation when compared to other marsh units, which could be a result of the additional freshwater supply coming from the Karkeh and Karun rivers (Iran).[8]

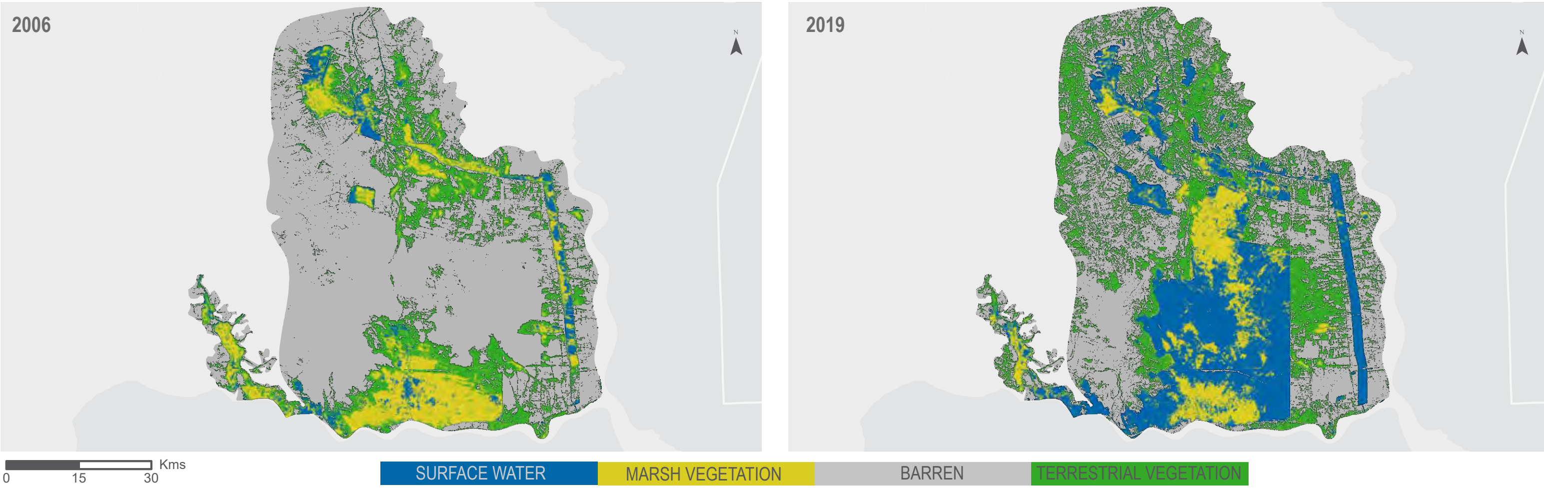
Distribution

The analysis shows that, by 2006, marsh vegetation had spread almost to all corners of the marsh. By 2019, however, vegetation seems to have only accumulated in the upper central areas. Until the drought in 2018[7] marsh vegetation always prevailed the proportion of surface water.

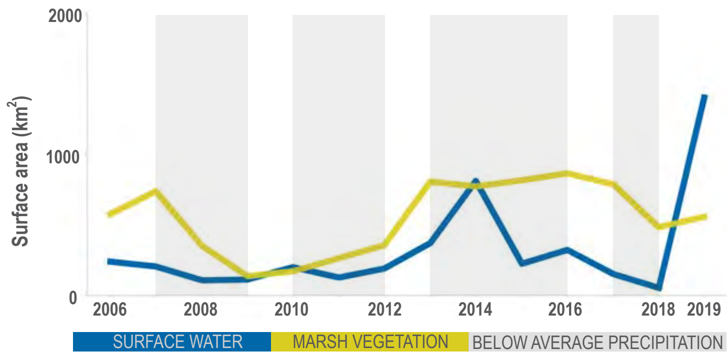
6 UNEP (2005). Iraqi Marshlands Observation System UNEP Technical Report
7 REACH (February 2020). Long-term Precipitation Pattern in the Euphrates-Tigris Basin
8 Richardson et al. (2006). Restoring the Garden of Eden: An Ecological Assessment of the Marshes of Iraq

* The definition of marsh vegetation is based on the simplified assumption that it essentially consists of either green or dry hydrophytes.
** Rehydration was measured based on extent of surface water and marsh vegetation compared to the baseline extent from 1973. Conclusions regarding the ecological recovery, status of water quality, or soil conditions cannot be drawn.
*** Terrestrial vegetation represents a combination of agricultural vegetation and natural vegetation growing in dry locations.

CENTRAL MARSH Land cover distribution in 2006 and 2019



Land cover change between 2006 - 2019



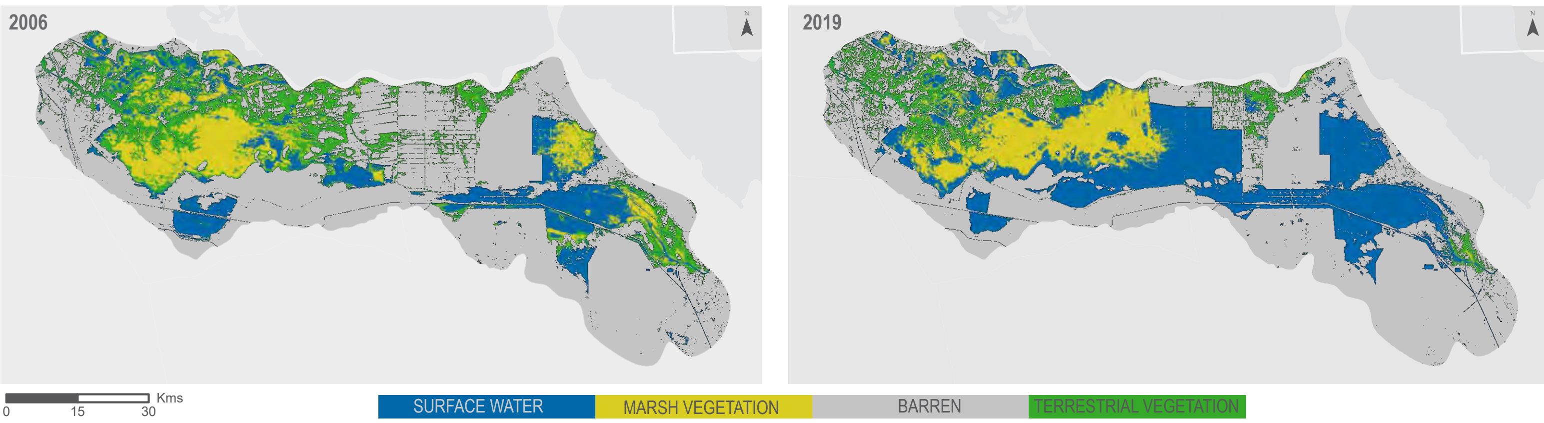
Changes

In line with the UNDP[9] findings, the analysis shows the central marsh to have the slowest rehydration progress compared to other assessed marsh units during the period 2006-2019. From 2013 onwards, vegetation growth stabilised somewhat close to the peak level in 2007 through to the drought year of 2018.[10]

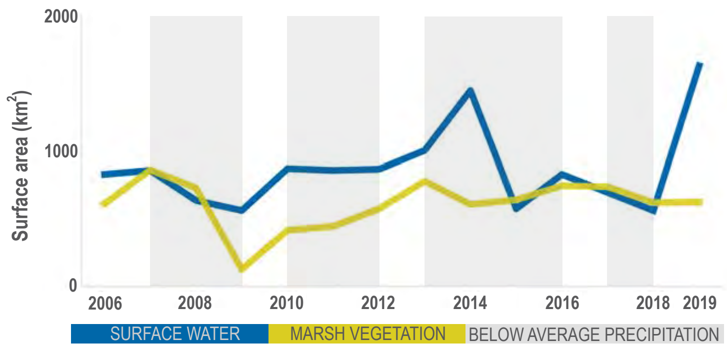
Distribution

As shown in the maps above, by 2006, areas with dense marsh vegetation could be found mostly in the southern parts of the marsh unit. In 2019, surface water was found to be most prominent particularly in the central parts.

AL-HAMMAR MARSH Land cover distribution in 2006 and 2019



Land cover change between 2006 - 2019



Changes

Following the beginning of the rehydration process in 2003, marsh vegetation growth reached its peak in 2007. Below average precipitation[10] in 2007 and 2008 may have caused almost the complete marsh vegetation in the Al-Hammar marsh to disappear. This testifies to a special sensitivity to the freshwater supply of this marsh unit.

Distribution

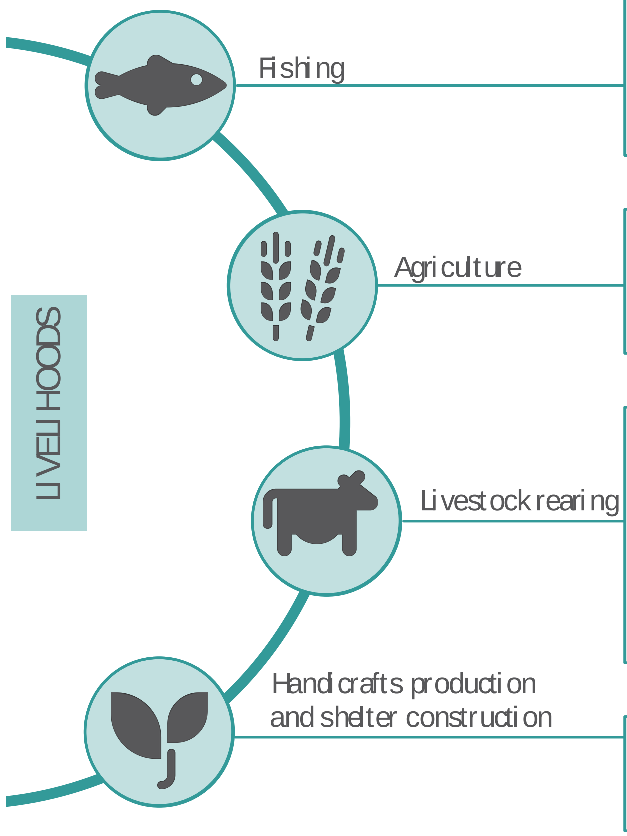
During most of the assessed years, the surface water seems to have held the greater share of the area compared to marsh vegetation. This is unique to this marsh unit and may be related to the high salt concentration[11] of the marsh water. Marsh vegetation seemingly accumulated in the western part of the region, near the freshwater inlet, while it decreased towards the east.

9 UNEP (2005). Iraqi Marshlands Observation System UNEP Technical Report

10 REACH (February 2020). Long-term Precipitation Pattern in the Euphrates-Tigris Basin

11 Richardson et al. (2006). Restoring the Garden of Eden: An Ecological Assessment of the Marshes of Iraq

TRADITIONAL LIVELIHOODS OF THE MARSH ARABS



Fishing: Fishing has been one of the livelihoods activities most heavily impacted by the degradation of marshlands.[12] Fish populations have majorly decreased, especially economic valuable fish species have been reduced in size and numbers, because of the intrusion of salt water, overfishing and invasive species.[13, 14] Fishing still occurs on a small scale where Marsh Arabs will use electronic rods to fish to eat (subsistence fishing), the quality and quantity of haulage varies and now cannot be relied upon as a livelihood.[13]

Agriculture: Before the drainage of the marshes, the Marsh Arabs traditionally used the marsh soils, enriched with nutrients during annual spring floods, for crop cultivation.[14] Nowadays, dams, dykes, and canals reduce the historical inundation pattern of the marshes.[14] This in interaction with decreased water levels in the Euphrates and Tigris rivers and a progressing soil salinization is causing soil degradation, and impedes agricultural activities.[12]

Livestock rearing: Many families living in the marshlands still own and keep animal livestock to this day.[12] However, partly due salinization, livestock rearing as a livelihood has become unsustainable and expensive.[12] Again linked back to increasing salinity, buffalo are susceptible to sickness from salt in vegetation and water, and without medical attention can become sick and die.[12] Healthy reeds that buffalo rely on are relatively expensive and commonly unavailable since not all reed species returned with the rehydration.[14] Buffalo, in turn, are becoming increasingly scarce and many are underweight, limiting milk production.[12] The United Nations Assistance Mission to Iraq (UNAMI) estimated there to be 80,000 water buffalo in the marshlands prior to the 1990s. However, by 2011, only an approximate 5000 remained.[13]

Handicrafts production and shelter construction: Traditionally, reed has been used by local populations for building boats, rafts, and shelter, as well as weaving mats and baskets for trade.[12] The decreasing availability of reeds as a result of the marsh desiccation and salinization, compared to prior the drainage, has therefore considerably impacted local handicraft production and shelter construction.[12]

Conclusion & Next Steps

The analysis revealed that the initially reported upward trend of marsh rehydration by UNEP[17] could not be sustained long-term; this has lead to a plateauing of the marsh vegetation growth over time. After promising developments in the period 2003-2007, the rehydration progress experienced a considerable setback likely due to consecutive years with below average precipitation, and the effects of upstream water management projects. This underlines the fragility of the marsh ecosystem. Furthermore, a common misconception is that rehydration equals wetland restoration. The analysis has indicated that rehydration efforts do not necessarily equal wetland restoration, and instead suggests that the sustainability and ecological recovery of rehydrated areas is a more important driver of restoration than the sheer size of the rehydrated areas. Ecological well being of the marsh areas is closely linked to the economic situation of the Marsh Arabs residing in the marshes as their livelihoods are traditionally based on the marshlands flora and fauna (e.g. reed products, fishing, agriculture, and livestock).

Analysis revealed the following data gaps which need to be filled for a holistic situation overview:

- Additional research is needed on the current livelihoods and food security conditions of the Marsh Arabs to assess the long-term impacts of the marsh rehydration process.
- Alternative livelihood sources for the Marsh Arabs with anticipation of the effects of climate change and a continued degradation of upstream water management should be investigated.
- Needs assessment should be conducted to identify overall availability of basic services (e.g. healthcare and education). Those services may be

Methodology

Land cover classification was done in Google Earth Engine (GEE) for the years 2006 - 2019. For the classification four land cover classes were defined: (I) surface water; representing water open to the sky, (II) ,marsh vegetation; representing mostly hydrophytes such as Phragmites and Typha growing in wet locations, (III) barren areas; representing areas with limited vegetation (for simplification urban and built-up areas were included in this class), and (IV) terrestrial vegetation; representing a combination of agricultural vegetation and natural vegetation. Surface reflectance products of the U.S. Geological Service Landsat 5 and Landsat 8 were used to create median composite images for each year. Images were subjected to corrections to take into account for distortions caused by sensor, solar, atmospheric, and topographic effects as well as the bidirectional reflectance distribution function.[14] For the classification Random Forest (RF) was used as supervised classification algorithm. The bands in the composites were exploited to calculate a series of covariates which were fed into the RF model. Those covariates comprised, among others, well known normalized indices such as the Normalized Difference Vegetation Index (NDVI) and the Normalized Difference Water Index (NDWI). But also more complex indices such as the Soil Adjusted Vegetation Index (SAVI) and the Enhanced Builtup and Bareness Index (EBBI) were computed. Furthermore, the Global Surface Water Mapping dataset[18] from the Joint Research Center (JRC) was used as covariate layer. As reference data 600 reference data points were collected for each class and for each year using the generated Landsat median composites. The reference data was then randomly split into training data (90%) and validation data (10%). Subsequently, the RF model was trained using the training data. With the validation data the classification accuracy was evaluated in Rstudio using the package 'e1071' by computing the overall accuracy and the Kappa coefficient. All classifications achieved values of > 0.9 in both accuracy measures. Limitations of the assessment: (I) lack of ground data for a comprehensive accuracy assessment, (II) after May 2003, the satellite Landsat 7 was subjected to an anomaly which caused the Scan Line Corrector to stop functioning.[17] Hence, classifications between 2006-20012 may show partly inhomogeneous areas.

12 Fawzi et al. (2016). Effects of Mesopotamian marsh (Iraq) desiccation on the cultural knowledge and livelihood of Marsh Arab women, ecosystem health and sustainability
13 UNAMI (United Nations Integrated Water Task Force for Iraq) (2011). Iraqi Marshlands. Managing change in the Marshlands, Iraqi's critical challenge
14 Richardson et al. (2006). Restoring the Garden of Eden: An Ecological Assessment of the Marshes of Iraq
15 Hamdan et al. (2010). Vegetation Response to Re-flooding in the Mesopotamian Wetlands, Southern Iraq
16 Pournelle et al. (2010). Travels in Edin: deltaic resilience and early Urbanism in Greater Mesopotamia
17 UNEP (2005). Iraqi Marshlands Observation System UNEP Technical Report
18 Pekel et al. (2016). High-resolution mapping of global surface water and its long-term changes

WASH Cluster
Water Sanitation Hygiene

Water Pollution Assessment of the Canals in Basrah City | Iraq, October 2020

OVERVIEW:

Trash detected: 4719 locations* **Vegetation detected:** 3029 locations **Algae detected:** 180 locations

Background

The city of Basrah is experiencing an environmental disaster in its waterways: the crisscrossed canals, which once provided an abundance of fresh water throughout the city, are now heavily polluted.[1] Located in the lower reaches of the Tigris-Euphrates basin and running right through the heart of the city, discharge from the Shatt-al-Arab River is reducing due to intensive upstream use.[2] As water levels drop, the concentration of pollutants increases, including household trash, sewage, industrial waste, pesticides, and encroaching seawater.[3] By the time the river feeds into Basrah's waterways, it contains dangerous levels of bacteria, chemicals, toxic algae and salinity.[1, 4] And as the water levels drop, the turbidity caused by high concentrations of sediment can disable aging water treatment plants. The buildup of solid waste in Basrah endangers the health and wellbeing of the local population, which is largely reliant on the water to meet their needs, conditions that are likely to be further aggravated by expected population growth and climate change.[5]

REACH Iraq conducted a solid waste assessment in the main canals of Basrah as a first step to highlight the poor state of this vital infrastructure. The information surrounding trash in the main canals is minimal and more attention to this environmental disaster is needed. This assessment was based exclusively on satellite data and secondary data, without ground-truthing by REACH. Additional in-person research is necessary to have a better understanding of the dynamics of solid waste and other pollutants in Basrah's canals. This would give insight into issues such as: the health and economic implications of this contamination; whether these issues affect certain populations more than others; if the buildup exhibits any seasonality or other pattern; and, if there are already any successful local solutions to mitigating these problems.

Methodology

Solid waste, algae and vegetation within the main channels of Basrah city was visually detected and manually digitized by the United Nation's Operational Satellite Applications Programme (UNOSAT) using WorldView-3 images. Main trash types identified were: (I) floating trash - sparse trashes on the water, (II) trash islands - big areas with dense trash, (III) trash rope - trash in rope shape connected to at least one bank, (IV) dirty bank - trash on the banks near water, (V) trash under bridge - bridges/tunnels under which trash is likely to be stuck. Detection of algae and vegetation in the canals was accomplished using the infrared channel of WorldView-3. In a false-color composite, algae appear smooth and bright red, while vegetation has a brown-red color with a coarse texture. Densities of trash and algae/vegetation were calculated as follows: Vegetation and algae density = (# of Vegetation + algae points / channel length in km); Trash density = (# of trash points/ channel length in km). The canal layer was manually digitized by REACH based on WorldView-3 imagery.

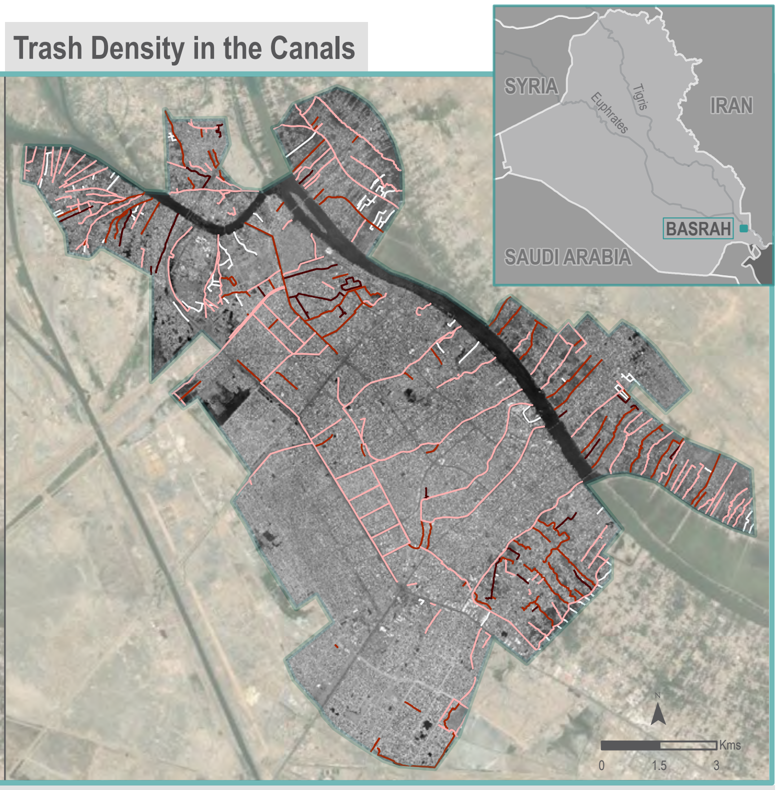
Algae and Vegetation Density in the Canals

Area of interest

Vegetation and algae detected per km of channel (# of Vegetation + algae points / channel length in km)

0 | 1-10 | 11-20 | >20

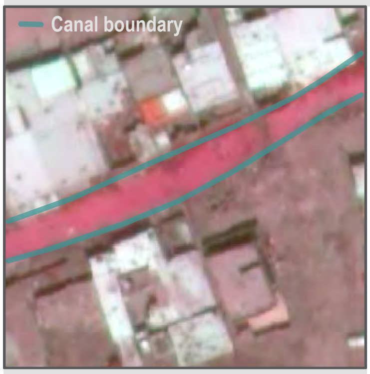
Trash Density in the Canals



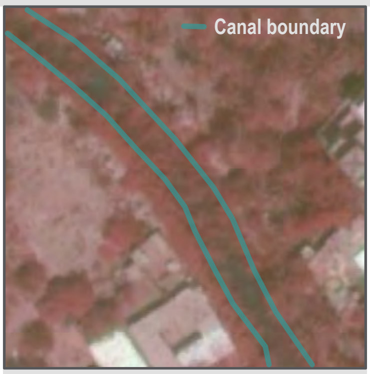
Area of interest

Trash detected per km of channel (# of trash points/ channel length in km)

0 | 1-10 | 11-20 | >20



Canal water covered with algae (bright red)



Vegetation inside the canal (red-brown)

A polluted canal in Basrah's old city[6]

Contaminated water and solid waste[6]

Satellite Imageries: WorldView-3-VNIR from 20/05/2020

Source: US Department of State, Humanitarian Information Unit, NextView License

1 Atti M. (2018). Once Iraq's Venice, Basra's waters have now turned deadly
2 Moyel et al. (2015). Water quality assessment of the Shatt al-Arab River, Southern Iraq
3 Human Rights Watch (2019). Basra is Thirsty - Iraq's Failure to Manage the Water Crisis
4 Rahi et al. (2010). Changes in the salinity of the Euphrates River system in Iraq
5 World Population Review (2020). Basra Population 2020
6 Peyre-Costa T. (2020). 'We have no options': how water scarcity is changing south Iraq

* A location represents a specific point location in a channel where UNOSAT identified trash, algae, or vegetation. Channels can have multiple of those point locations.

UNOSAT

REACH Informing more effective humanitarian action

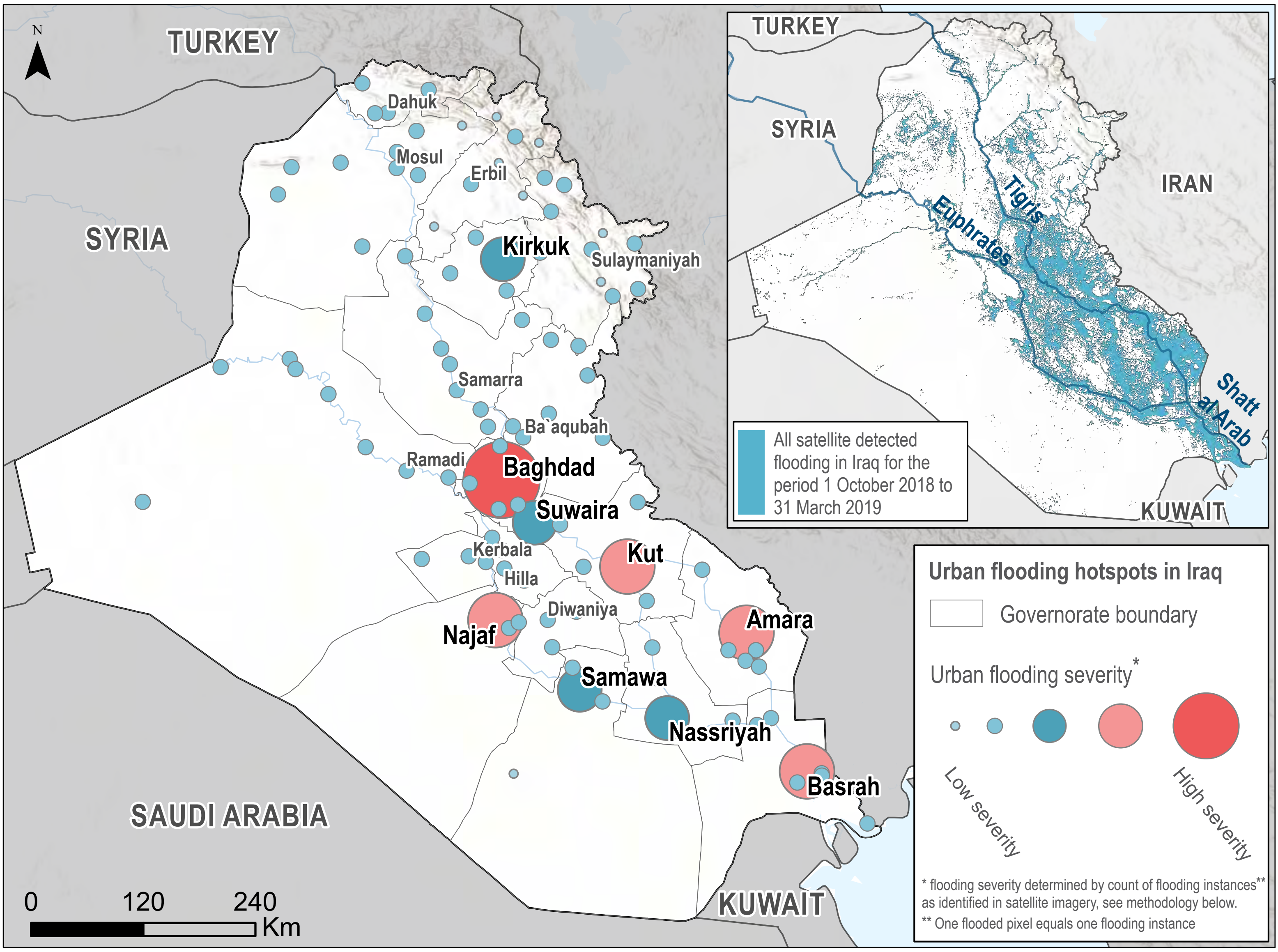
WASH Cluster
Water Sanitation Hygiene

Flood hotspots in Iraq (October 2018-March 2019)

October 2020

Background

Floods in Iraq have always caused significant loss of life and property.[1] The rising levels of the Euphrates and Tigris rivers were the main causes of flooding until Iraq started using natural depressions to divert the excess water from the urban areas in the 1950s.[1] This approach significantly improved the situation and no significant flood was reported until the early years of the last decade. Lately, floods were reported in different cities around Iraq with 2019 experiencing the most severe flooding since then.[2] Therefore, to support the Iraq Water, Sanitation, and Hygiene (WASH) cluster in identifying and targeting flood-prone areas where mitigation measures may be needed, REACH Iraq conducted a cumulative flood occurrence analysis of the floods during the 2018/19 winter season to identify flood hotspots throughout Iraq.



Methodology

The flood hotspots in Iraq were identified in two steps. During the first step, the cumulative flood occurrence for the whole of Iraq was extracted for the period 01/10/2018 - 31/03/2019 by the United Nations Institute for Training and Research Operational Satellite Applications Programme (UNITAR - UNOSAT) using Sentinel-1 Radar images. Post processing steps undertaken by REACH Iraq included the masking of permanent water bodies utilizing the Global Surface Water dataset from the Joint Research Center (JRC)[3] of the European Commission. Additionally, the Height Above the Nearest Drainage[4] dataset was used to mask out any misclassification caused by the terrain. The second step was taken to identify flooding in urban/developed areas. For this, REACH Iraq first created a 10km buffer zone around Iraq's major cities to define their boundaries. Then, to ensure up-to-date urban classification, the Urban Land-Use feature of the Open StreetMap layer was manually modified by identifying previously-unidentified urban areas on the ArcGIS World Imagery base-map and appending the Open StreetMap Layer. Next, the modified layer was clipped according to the previously set buffer zone. After this, the cleaned flooding dataset was intersected with the urban areas created to calculate urban flooding severity by adding the number of raster pixels reported as water (flood) per each urban-land-use of the major cities. This allowed the identification of cities with higher number of reported pixels of flood as flood hotspots of Iraq, which could then be visualized according to their urban flooding severity on the map above.

UNOSAT

[1] Abdullah, Mukhalad, et al. (2019). Water Resources Projects in Iraq, Reservoirs in The Natural Depressions.
[2] iDMC, Social Inquiry, and NRC. (2020). THEMATIC SERIES No matter of choice: Displacement in a changing climate
[3] Pekel, Jean-François, et al. (2016). High-resolution mapping of global surface water and its long-term changes.
[4] Nobre, A. D., et al. (2011). Height Above the Nearest Drainage – a hydrologically relevant new terrain model.

REACH Informing more effective humanitarian action

Background

Existing data sources on water treatment plant locations, capacity and functionality have been found to be dated, inaccurate and difficult to access or utilise. The WASHApp was requested directly by the WASH Cluster in Iraq, in order to fill these data gaps. Developed and managed in collaboration with the Cluster, the WASHApp is an interactive map that locates and provides real time information on all WTPs known in Iraq nationwide. The data presented through this interactive map is intended to directly informs humanitarian actors with information of WASH facilities in order to support prioritisation of needed repairs to highlight gaps in the system, and to track progress of developing new and rehabilitated infrastructure. REACH is developing and piloting an assessment to update the WASHapp with data gathered through key informant interviews (KIIs) of WTP managers. This has started and will include 22 Water Treatment Plants across Al-Hamdaniyah district before February 2021. If conducted at a larger scale, this could provide information essential for WASH partners to ensure a safe and reliable supply of drinking water throughout Iraq.