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CLIMATE VULNERABILITY ASSESSMENT IN THE KURDISTAN REGION OF IRAQ

DATA COLLECTION PERIOD: SEPTEMBER – DECEMBER 2023

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Clouds forming during the late autumn season over the mountain ranges in Erbil Governorate, Kurdistan Region, Iraq. © 2022/Raber AZIZ

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INTRODUCTION

Iraq is currently facing a wide variety of challenges linked to climate change and environmental degradation, including rising temperatures,[1] changing rainfall patterns,[2] more severe droughts,[3] growing water scarcity[4] and more frequent sand and dust storms.[5] These issues are exacerbated by water management policies at the national and transnational levels, broken or inefficient water infrastructure, population growth, increasing demand for water and resource-intensive irrigation practices.[6, 7, 8] While this topic is receiving growing attention,[9, 10] a lack of dedicated data and analysis on the Kurdistan Region of Iraq (KRI) has hampered understanding of the specific challenges confronting the region, despite its distinct climate, topography and practices compared to central and southern Iraq.[11] Given KRI's reliance on rain-fed agriculture,[12] changing rainfall patterns linked to climate change are compromising the ability of farmers, livestock rearers and fishers to sustain their livelihoods.[13, 14] Reduced rainfall may decrease agricultural yields and herds, causing economic losses and forcing some families to abandon these livelihoods altogether.[15] To fill this information gap and support data-driven, targeted programming, the International Organization for Migration's (IOM) Displacement Tracking Matrix (DTM) in Iraq developed a rapid, multi-sectoral assessment of challenges related to displacement, environmental hazards, irrigation water supply, livelihoods, coping strategies and tension and conflict over natural resources. Data collection for this assessment took place between September and December 2023 in 804 locations across 3 governorates, 20 districts and 71 subdistricts in KRI.

METHODOLOGY

Data for this assessment come from key informant (KI) interviews conducted by IOM's Rapid Assessment and Response Teams (RARTs), who are deployed across Iraq (20% of enumerators are female). IOM RARTs collect data utilizing a large and well-established network of KIs, including community leaders, mukhtars,[16] local authorities and security forces (90% of KIs are male).

The baseline for this assessment comes from the Master List exercise.[17] Data are collected at the local level, an area that corresponds either to a village for rural areas or a neighbourhood for urban areas (i.e. fourth official administrative division). Locations assessed are those hosting internally displaced persons (IDPs) and returnees displaced by the 2014-2017 crisis with the Islamic State in Iraq and the Levant (ISIL).

The questionnaire for this assessment is derived from the report, *Drivers of Climate-Induced Displacement in Iraq: Climate Vulnerability Assessment*, published in October 2023 [hereafter referred to as the 'Central and Southern Iraq CVA'].[18] The Central and Southern Iraq CVA included all locations which have recorded climate-induced displacement, as measured by IOM DTM's Climate-Induced Displacement monitoring tool.[19] All locations meeting this criterion were found in central and southern Iraq. The questionnaire for the Central and Southern CVA spanned a wide range of themes, including environment hazards, water access, services and infrastructure, livelihoods, coping strategies and tension and conflict. The KRI CVA questionnaire represents a truncated version, drawing on key insights from the Central and Southern CVA but adapted to the KRI context. Given these methodological differences, particularly with respect to location selection, the two assessments are not directly comparable.

Data collection took place between September and December 2023 in 804 locations across 3 governorates, 20 districts and 71 subdistricts in KRI. Of these 804 locations, 53 per cent are in Sulaymaniyah Governorate, 28 per cent are in Erbil Governorate and 20 per cent are in Dahuk Governorate. Just under one third of locations assessed are rural (30%), while the remaining share are either urban (69%) or peri-urban (1%). Dahuk Governorate had a larger share of rural locations assessed (46%) compared to Erbil (27%) or Sulaymaniyah (25%). At the district level, Makhmur in Erbil Governorate, Amedi and Sumel in Dahuk Governorate and Dokan and Sharbazher in Sulaymaniyah Governorate had a relatively higher proportion of rural locations assessed.

CHALLENGES AND LIMITATIONS

In order to assess a large number of locations in a short time frame and at low-cost, DTM leveraged its existing data collection activities related to conflict-induced displacement and incorporated a short questionnaire focusing on the impacts of

1 Between 1970 and 2004, Iraq's yearly average temperature has risen by 1-2 degrees Celsius. World Bank Group, *Iraq: Systematic Country Diagnosis* (n.p., 2017).

2 Rainfall is expected to drop 25 per cent by 2050. Theodore Karasik and Jacopo Spezia Depretto, 'Climate change is exacerbating Iraq's complicated water politics,' *Climate Diplomacy* (Berlin, 2019).

3 Based on the World Resources Institute's Water Stress Index, Iraq has an 'extremely high' baseline water stress level. Samantha Kuzman et al., '25 countries, housing one-quarter of the population, face extremely high water stress', *World Resources Institute* (n.p., 2023).

4 Ibid.

5 United Nations Country Team in Iraq, Joint Analysis and Policy Unit, *Sand and Dust Storms Fact Sheet* (Baghdad, 2013).

6 Iraq's drinking, sanitation and irrigation water comes almost entirely from the Tigris and Euphrates rivers. By 2030, flows in these rivers are anticipated to fall by 50 per cent, largely as a result of water management practices in neighbouring countries such as Türkiye and the Islamic Republic of Iran. Pieter-Jan Dockx, *Water scarcity in Iraq: From inter-tribal conflict to international disputes*, Institute of Peace and Conflict Studies (n.p., 2019).

7 Tobias Von Lossow, *More than infrastructures: water challenges in Iraq*, Planetary Security Initiative and Clingendael (n.p., 2018).

8 IOM, *Drivers of Climate-Induced Displacement in Iraq: Climate Vulnerability Assessment* (Baghdad, 2023).

9 United Nations Development Programme (UNDP), 'Climate change is the biggest threat Iraq has ever faced, but there is hope to turn things around' (Blog post), *UNDP* (New York, 2024).

10 Winthrop Rodgers, 'The cradle of civilization is drying up', *Foreign Policy* (Washington D.C., 2023).

11 UNDP, *Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region* (Baghdad, 2011).

12 Food and Agriculture Organization of the United Nations (FAO), *Global Information and Early Warning System on Food and Agriculture (GIEWS) Update – The Republic of Iraq – Drought in the Northern Parts of the Country* (Baghdad, 2021).

13 Hailu Regassa Bedane et al. The impact of rainfall variability and crop production on vertisols in the central highlands of Ethiopia, *Environmental Systems Research*, 11:26 (n.p., 2022).

14 Given the historic abundance of rain in KRI, farmers did not cluster around rivers and streams in the same manner as those in central and southern Iraq. As a result, farms in KRI may not be situated near rivers and streams, thus creating challenges in accessing other sources of irrigation water. Interview with Ali Shawket, Specialist in migration, environment and climate change in Iraq, IOM, Baghdad, 2 May 2024

15 IOM, *Drivers of Climate-Induced Displacement in Iraq: Climate Vulnerability Assessment* (Baghdad, 2023).

16 The head of the local government or a town. Merriam Webster, 'Mukhtar,' *Merriam-Webster* (n.d., 2024).

17 IOM, Master List Methodology (Baghdad, n.d.).

18 IOM, *Drivers of Climate-Induced Displacement in Iraq: Climate Vulnerability Assessment* (Baghdad, 2024).

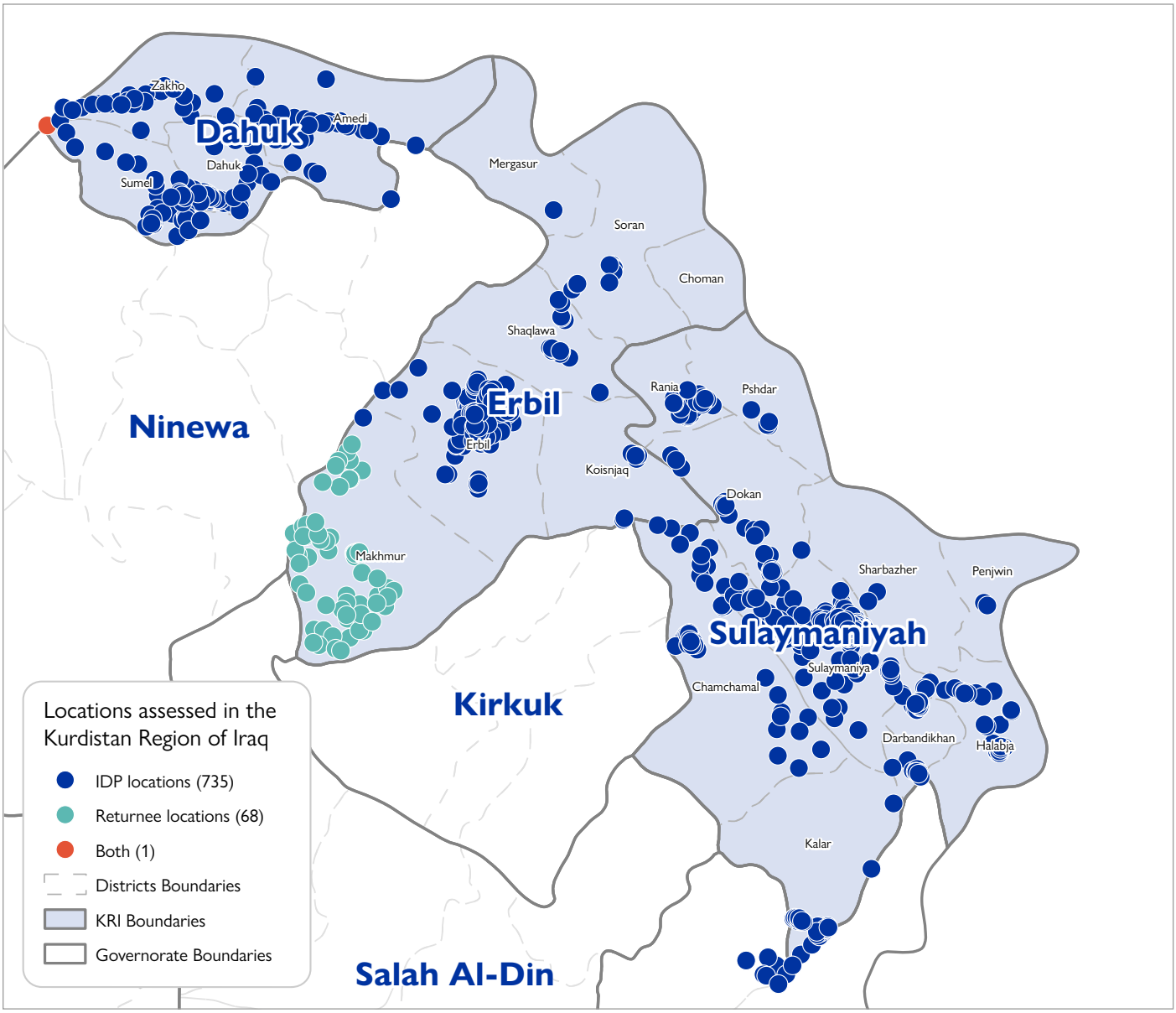
19 All of IOM DTM's Climate-Induced Displacement reports can be found here.

climate change and environmental degradation on families in the location. As a result, the list of locations assessed was not informed by environmental indicators. Given the relationship between land ownership and farming, displaced populations may be less likely to engage in climate-sensitive livelihoods than those who never displaced. Moreover, based on the Return Index Round 20[20] and Displacement Index Round 8,[21] the majority of locations assessed (70%) have low severity living conditions, while 30 per cent present high severity conditions. Given the role of preexisting vulnerabilities in determining the impacts of climate change and environmental degradation,[22] locations with low severity conditions are expected to be more resilient to these phenomena. Consequently, the assessment may not have included the most affected locations and as such, could potentially understate the effects on climate change and environmental degradation on KRI. Thus, this project should be considered a pilot to inform future data collection activities.

Moreover, all data for this assessment were collected at location level. This means that KIs were interviewed about the conditions faced in locations of displacement or return among those who left their locations of origin due to the 2014-2017 ISIL crisis. While this approach allows extensive coverage over a short period of time, it often relies on one informant per location. These KIs are mainly mukhtars and community or local council representatives who report on the views and experiences of a potentially large and diverse population, which might lead to limited representation for smaller groups with distinct characteristics, or discrepancies caused by social desirability bias. Additionally, key household characteristics including sociodemographic indicators (i.e. number of family members) and vulnerability factors (i.e. gender of the head of household or number of members living with a disability) are not accounted for in the datasets.

A specific challenge of location-level data with regards to climate indicators is the complexity of the variables (e.g. the concept of land degradation) and the subjectivity of perceptions with regard to changes in the climate (e.g. unseasonal variations in the temperature). Moreover, the season in which data collection took place (winter), along with the time-bound nature of certain questions asked of KIs, may have influenced the impacts observed.

Map 1: Locations assessed in KRI



20 IOM, DTM Iraq – Return Index Round 20 Dataset (Baghdad, 2024).

21 IOM, DTM Iraq – Displacement Index 8 (Baghdad, 2024).

22 Omar-Dario Cardona et al., Determinants of Risk: Exposure and Vulnerability. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* (Christopher B. Field et al.) A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, (Cambridge and New York, 2012).

KEY FINDINGS

The impact of climate change is less noticeable and more localized in KRI than in central and southern Iraq.[23] No climate-induced displacement, secondary displacement or failed returns were recorded in KRI this round. Additionally, the environmental hazards are largely confined to sand or dust storms and increased temperatures. Sand or dust storms can reduce water quality and disrupt agricultural activities,[24, 25] while increased temperatures heighten rates of evapotranspiration[26] and raise demands for water.[27] Moreover, 1 in 10 locations, mostly in Sulaymaniyah, witnessed drought.

With respect to irrigation water sources, KRI relies mainly on rainfall, boreholes/wells and rivers/streams. This dependence on precipitation renders KRI vulnerable to climate change as rainfall patterns change.[28] Among locations with an irrigation water source, 40 per cent indicated that the supply of such water decreased within the last year, largely due to decreased rainfall and, to a lesser extent, population growth/agricultural intensification and costs of water trucking.

Climate-sensitive livelihoods like farming, livestock rearing and fishing are among the top livelihoods in roughly two fifths of locations assessed (43%). This is lower than the share observed in central and southern Iraq and may explain the more limited climatic impacts observed in KRI.[29] The effects of climate change on livelihood activities in KRI remain fairly contained, with consequences more widely reported in Erbil than Sulaymaniyah. However, in rural locations where climate-sensitive livelihoods are among the top activities, 45 per cent indicated a loss of crop production, livestock deaths or reduced fishing yields in the past year due to environmental factors. Adoption of coping strategies was concentrated in a small number of districts. The most common strategies are conserving water and, to a lesser extent, diversifying livelihoods and changing agricultural activities.

Tension and conflict over natural resources revolved around access to arable land. This issue is concentrated in four subdistricts, most notably in Bazyan and Bakrajo in Sulaymaniyah District. Disputes occurred between local residents and factory owners, as well as groups engaged in the same livelihood activities and members of the same tribe.

GEOGRAPHIC AREAS OF VULNERABILITY

While Dahuk Governorate had a higher share of locations engaged in climate-sensitive livelihoods, no locations indicated a reduction in irrigation water or negative impacts on livelihoods due to changing environmental conditions. In Erbil Governorate, climate-related issues were mostly reported in **Shaqlawa** and **Makhmur** districts and **Rawanduz** subdistrict in Soran District. In Sulaymaniyah Governorate, **Sharbazher District** and the subdistricts of **Aghjalar** in Chamchamal District, **Kulajo** in Kalar District and **Bazyan** and **Bakrajo** in Sulaymaniyah District witnessed some of the most significant impacts reported in KRI.

A larger share of locations experienced a decrease in irrigation water supply in Erbil than in Sulaymaniyah. In Erbil, this was mostly driven by decreased rainfall, while a wider range of issues were highlighted in Sulaymaniyah, including population growth/agricultural intensification, costs of water trucks, broken or inefficient water infrastructure and groundwater exploitation. Decreases in production and abandonment of climate-sensitive livelihoods were more common in Erbil than in Sulaymaniyah governorates. Rates of abandonment were particularly high in the subdistricts of Gwyer, Markaz Makhmur and Qaraj in Makhmur District and Harir in Shaqlawa District. However, adoption of coping strategies was flagged in a greater share of locations in Sulaymaniyah than in Erbil. Additionally, families in Erbil adopted a broader range of coping strategies like diversifying livelihoods and changing agricultural activities. Lastly, tension or violence over natural resources was exclusively reported in Sulaymaniyah, mostly in Bazyan and Bakrajo subdistricts in Sulaymaniyah district.

These findings suggest that **climactic impacts are more widespread in Erbil than Sulaymaniyah governorates but families in Erbil have been slightly more able to adapt by employing a wider range of coping strategies like diversifying livelihoods and changing agricultural activities**. On the other hand, **the wider range of water-related issues reported in Sulaymaniyah, such as agricultural intensification and broken or inefficient water infrastructure, offer numerous entry points for programmatic interventions**.

Figure 1: Key findings

	78% of locations witnessed increased temperatures in the past 12 months
	47% of locations encountered sand or dust storms in the past 12 months
	45% of rural locations where families depend on climate-sensitive livelihoods saw a loss in crop production, livestock deaths or fishing yields in the past 12 months
	40% of locations with an irrigation water source experienced a reduction in available water from these sources in the past 12 months
	In **43%** of locations, the top livelihoods include climate-sensitive activities
	In **13%** of locations, families abandoned agriculture, livestock rearing and fishing livelihoods in the past 120 days
	In **12%** of locations, families adopted coping strategies because of environmental factors

23 IOM, *Drivers of Climate-Induced Displacement in Iraq: Climate Vulnerability Assessment* (Baghdad, 2023).

24 Majid Galoie et al., Prediction of water quality under the impacts of fine dust and sand storm events using an experimental model and multivariate regression analysis, *Environmental Pollution*, 336 (2023).

25 FAO, *Sand and Dust Storms: A Guide to Mitigation, Adaptation, Policy and Risk Management Measures in Agriculture* (Rome, 2023).

26 Wossenu Abtew and Assefa Melesse, Climate Change and Evapotranspiration, *Evaporation and Evapotranspiration,* Springer (Dordrecht, 2013).

27 Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2007: Impacts, Adaptation and Vulnerability*, Working Group II Contribution to the Fourth Assessment Report of the IPCC, Cambridge University Press (Cambridge, 2007).

28 Kevin E. Trenberth, Changes in precipitation with climate change, *Climate Research*, 47:123-138 (2011).

29 IOM, *Drivers of Climate-Induced Displacement in Iraq: Climate Vulnerability Assessment* (Baghdad, 2023).

CONTEXT

The Kurdistan Region of Iraq (KRI) is a federal region in the north of Iraq.[30] It is composed of three governorates, namely Dahuk, Erbil and Sulaymaniyah.[31] The region borders the Syrian Arab Republic to the west, Türkiye to the north and the Islamic Republic of Iran to the east.[32] With the northern range of the Zagros Mountains passing through the region, the topography of KRI is largely mountainous, although it also encompasses the northern plains of the Tigris River.[33] The region has a Mediterranean Climate (Csa), characterized by hot, dry summers and cool, wet winters. However, in the southwestern plains, the climate is considered semi-arid (BSh).[34, 35] Average temperatures range from a low of 2 degrees Celsius (35.6 degrees Fahrenheit) in the winter to a high of 43 degrees Celsius (109.4 degrees Fahrenheit) in summer, with temperatures occasionally reaching 50 degrees Celsius (122 degrees Fahrenheit). Temperatures in winter (December-February) tend to be lower than the national average (11.1 degrees Celsius/51.98 degrees Fahrenheit), particularly in the mountains.[36, 37] Rain mostly occurs between November and March, with annual precipitation ranging between 375-724 millimeters, exceeding the national average.[38, 39, 40] The region benefits from numerous rivers, streams and springs, the most notable of which include Khabour, Greater Zab, Lesser Zab, Sirwan and Awa Spi rivers. An estimate 40 per cent of surface water comes from outside the region, including neighbouring countries such as Türkiye, the Islamic Republic of Iran and the Syrian Arab Republic, which means damming and river diversions beyond KRI affect the region's water supply.[41] Unlike central and southern Iraq, rain is the primary source of irrigation water for agriculture in KRI.[42] As a result, changing rainfall patterns due to climate change have a direct impact on agricultural productivity in the region.

DEMOGRAPHIC DEVELOPMENTS

Rapid population growth and urbanization in KRI are impacting the supply of available water through increased demand.[43] According to the Kurdistan Region Statistics Office (KRSO), the region's population has grown 41 per cent between 2013 and 2023, from 4,662,000 to 6,556,752.[44, 45] Moreover, KRI also hosts significant displaced populations originating from outside the region, including internally displaced persons (IDPs) and refugees. As of January 2024, 591,227 internally displaced persons (IDPs) reside in KRI, according to IOM DTM.[46] Over half (58%) arrived in KRI between June and August 2014, coinciding with the capture of Mosul and Sinjar by ISIL.[47, 48] Most IDPs reside in private settings, although a fifth live in camps, mostly in Dahuk Governorate.[49] KRI also has a notable refugee population (276,119), compromised largely of Syrian nationals (93%).[50] Additionally, 63,510 returnees from displacement can be found in KRI, mostly in Makhmur District, Erbil Governorate (99%).[51]

Around four in five people in KRI live in urban settings (82%), although this share is lower in Dahuk Governorate (74%).[52] Various, interrelated factors such as economic development, administrative autonomy and other political developments have contributed to the growth of cities in the region.[53] More distinctly, KRI has also experienced 'war urbanization,' whereby conflict-induced displacement spanning back to 1960s has spurred relocation to urban centres.[54] For example, during the 2014-2017 conflict, around half of IDPs to KRI moved to Erbil District (39%) and Sulaymaniya District (19%).[55]

This demographic transformation, in combination with the effects of climate change and environmental degradation, has reduced the water supply in the region. In Erbil city, the capital of the region, the Ministry of Municipalities and Tourism indicated that the groundwater levels have fallen 500 meters in the last 20 years.[56] As a result, 300 wells across the city ran dry in 2022, prompting the directorate to construct 138 new wells.[57]

30 The Constitution of the Republic of Iraq, Article 117 (Baghdad, 2005). Translated from Arabic by the United Nations' Office for Constitutional Support and approved by the Government of Iraq.

31 Kurdistan Regional Government, 'Kurdistan Factsheet' (Erbil, n.d.)

32 Ibid.

33 UNDP, *Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region* (Baghdad, 2011).

34 Ibid.

35 Huner Abdulla Kak Ahmed Khayyat et al., Assessing the Impacts of Climate Change on Natural Resources in Erbil Area, the Iraqi Kurdistan Using Geo-Information and Landsat Data. In: *Environmental Remote Sensing and GIS in Iraq* (A. Al-Quraishi and A. Negm, eds.), Spring Water (Cham, 2020).

36 Climate Change Knowledge Portal, 'Iraq Country Page,' *World Bank Group* (Washington D.C., 2021).

37 Kurdistan Region Presidency, 'Kurdistan Region' (n.p., n.d.)

38 Ibid.

39 Climate Change Knowledge Portal, 'Iraq Country Page,' *World Bank Group* (Washington D.C., 2021).

40 Lisa Binder et al., *Climate Risk Profile Iraq*, Weathering Risk, Potsdam Institute for Climate Impact Research & adelphi (Potsdam/Berlin, 2022).

41 UNDP, *Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region* (Baghdad, 2011).

42 FAO, *Global Information and Early Warning System on Food and Agriculture (GIEWS) Update – The Republic of Iraq – Drought in the Northern Parts of the Country* (Baghdad, 2021).

43 Alessandro Tinti, *Water Resources Management in the Kurdistan Region of Iraq*, the American University of Sulaimani, Institute of Regional and International Studies (Sulaimani, 2017).

44 Magued Osman, *Kurdistan Region of Iraq: Population Analysis Report*, KRSO (Erbil, 2021).

45 KRSO, 'Population,' KRSO (Erbil, 2024).

46 IOM, DTM Iraq – Master List IDP 131 Dataset, (Baghdad, 2024).

47 Ibid.

48 IOM, *Iraq Displacement Crisis: 2014-2017*, IOM (Baghdad, 2018).

49 IOM, DTM Iraq – Master List IDP 131 Dataset, IOM (Baghdad, 2024).

50 KRSO, 'Population,' KRSO (Erbil, 2024).

51 IOM, DTM Iraq – Master List Returnee 131 Dataset, IOM (Baghdad, 2024).

52 Magued Osman, *Kurdistan Region of Iraq: Population Analysis Report*, KRSO (Erbil, 2021).

53 M. Khalis Raouf Hassan, Factors affecting urbanisation in Iraq: A historical analysis from 1921 to the present, *Urbanisation*, 8(1):61-78 (2023).

54 Ibid.

55 IOM, DTM Iraq – Master List IDP 131 Dataset, IOM (Baghdad, 2024).

56 Rudaw, 'Erbil underground water levels decreased 500 meters over 20 years,' *Rudaw* (18 June 2022).

57 Ibid.

TRANSBOUNDARY WATER MANAGEMENT

Developments further upstream have also decreased the water levels in KRI. Through the Southeastern Anatolia Project (*Güneydoğu Anadolu Projesi*), Turkiye constructed 22 dams along the Tigris-Euphrates basin since the 1970s, for a total of 635 large dams across the country.[58, 59] Damming by the Islamic Republic of Iran along tributaries of the Tigris, such as Sirwan and Little Zab, also has a significant impact on the quantity of water in KRI, particularly in Sulaymaniyah.[60] Additionally, through the use of the Nawsud water tunnel, the Islamic Republic of Iran can fully divert the Sirwan River, with important implications for the supply of drinking and irrigation water in Sulaymaniyah.[61] KRI, for its part, has three large dams and 20 small and medium-sized dams, with a further 11 being built.[62] The construction of dams appears to be a strategic priority for the Kurdistan Regional Government (KRG), with official statements highlighting the benefits of dam construction for 'agricultural irrigation, potable water supply, electricity generation [through hydropower], industrial applications and tourism development.'[63] Dams can also store runoff and mitigate against floods.[64, 65] However, potential downsides of dam building include ecosystem damage, displacement of affected communities and changes in water quality.[66] Moreover, damming in KRI may negatively the water supply in central and southern Iraq.[67] The Great and Little Zab rivers, which pass through KRI, contribute to half of the Tigris' flows south of Baghdad.[68] This critical geographic position of KRI along waterways reflects the importance of studying the climate-related impacts confronting the region, as these effects will likely have consequences for other parts of Iraq.

CLIMATE CHANGE IMPACTS AND PROJECTIONS

Despite the distinct climates and geography of the Kurdistan Region, research and analysis on climate change in Iraq does not always consider the unique challenges confronting the region, especially the socioeconomic dimensions of environmental changes. As with central and southern Iraq, KRI is confronting increasingly severe droughts, elevated levels of evapotranspiration and growing demands on existing water resources.[69] However, changing rainfall patterns are also contributing to floods in the region, which have resulted in deaths, injuries, evacuations and temporary displacement, damage to assets and infrastructure and disruption of services.[70] Moreover, given the region's reliance on rain-fed agriculture, extreme precipitation levels directly impact agricultural productivity.[71]

Khayatt et al. (2020) highlight the widespread semi-aridization of KRI, reflecting increasing temperatures and decreasing rainfall. In Erbil Governorate, the study reports a 51 per cent decrease in vegetation cover, driven largely by climate change and, to a lesser extent, the build-up of urban areas, particularly in Erbil District. Nasir et al. (2022) confirm this finding, indicating at 52.1 per cent change in land use/land cover in KRI over three decades (1990-2020).[72] Additionally, droughts have contributed to significant deforestation in the region, according to Bahram Khidir, advisor to KRG President Nechirvan Barzani.[73] Moreover, analysis of 2023 rainfall anomaly data from the the World Food Programme's Climate Explorer reveals below average rainfall in KRI from January to early April, particularly in Dahuk and Erbil.[35] During the reporting period (September – December 2023), rainfall was above average, especially in Dahuk, which may have influenced the assessment's findings, particularly considering the time frame of certain questions asked of KIs.

In terms of projections, the northeast of Iraq is predicted to have the highest increase in air temperature and the average annual number of 'very hot' days (that is, days with a maximum temperature of 35 degrees Celsius or more).[36] While there is greater uncertainty regarding future rainfall levels, precipitation is expected to slightly decrease in northwestern Iraq.[37] Lastly, rates of evapotranspiration are poised to increase significantly in northern Iraq.[38]

58 Ministry of Industry and Technology, Southeastern Anatolia Project Regional Development Administration, 'The Southeastern Anatolia Project (GAP),' *GAP Regional Development Administration* (Karaköprü, 2015).

59 International Rivers, 'Turkey,' *International Rivers* (Oakland, n.d.)

60 Save the Tigris Campaign, *Damming the Kurdistan Region of Iraq: Structural Gaps in the KRG Dam Construction Policies*, Save the Tigris Campaign (n.p., 2020).

61 Kakalaw Abdulla and Dler Abdulla, 'Iraqi Kurdistan faces water "catastrophe" as Iran cuts off rivers,' *Middle East Eye* (3 September 2020).

62 Rudaw, 'Water levels significantly higher in Kurdistan's dams,' *Rudaw* (13 April 2024).

63 Department of Media and Information, 'Kurdistan Region Boosts Water Resources with 13 New Dams,' *Kurdistan Regional Government* (12 October 2023).

64 Austin Corona, 'How Mangled Dam Diplomacy is Shaping Iraq's Water Crisis,' *The Washington Institute for Near East Policy*, Fikra Forum (Washington D.C., 2020).

65 Sardar Sattar, 'Dams in Kurdistan: A Blueprint for Water Security and Economic Growth,' *Kurdistan Chronicle* (18 November 2023).

66 Save the Tigris Campaign, *Damming the Kurdistan Region of Iraq: Structural Gaps in the KRG Dam Construction Policies*, Save the Tigris Campaign (n.p., 2020).

67 Ibid.

68 Ibid.

69 Lisa Binder et al., *Climate Risk Profile Iraq*, Weathering Risk, Potsdam Institute for Climate Impact Research & adelphi (Potsdam/Berlin, 2022).

70 International Federation of the Red Cross and Red Crescent Societies, *Iraq: Floods – March 2024* (n.p., 2024).

71 FAO, *Global Information and Early Warning System on Food and Agriculture (GIEWS) Update – The Republic of Iraq – Drought in the Northern Parts of the Country*, FAO (Baghdad, 2021).

72 Salam Mahmood Nasir et al., Change in land use/land cover in Kurdistan Region of Iraq: A semi-automated object-based approach, *Remote Sensing Applications: Society and Environment*, 26 (April 2022).

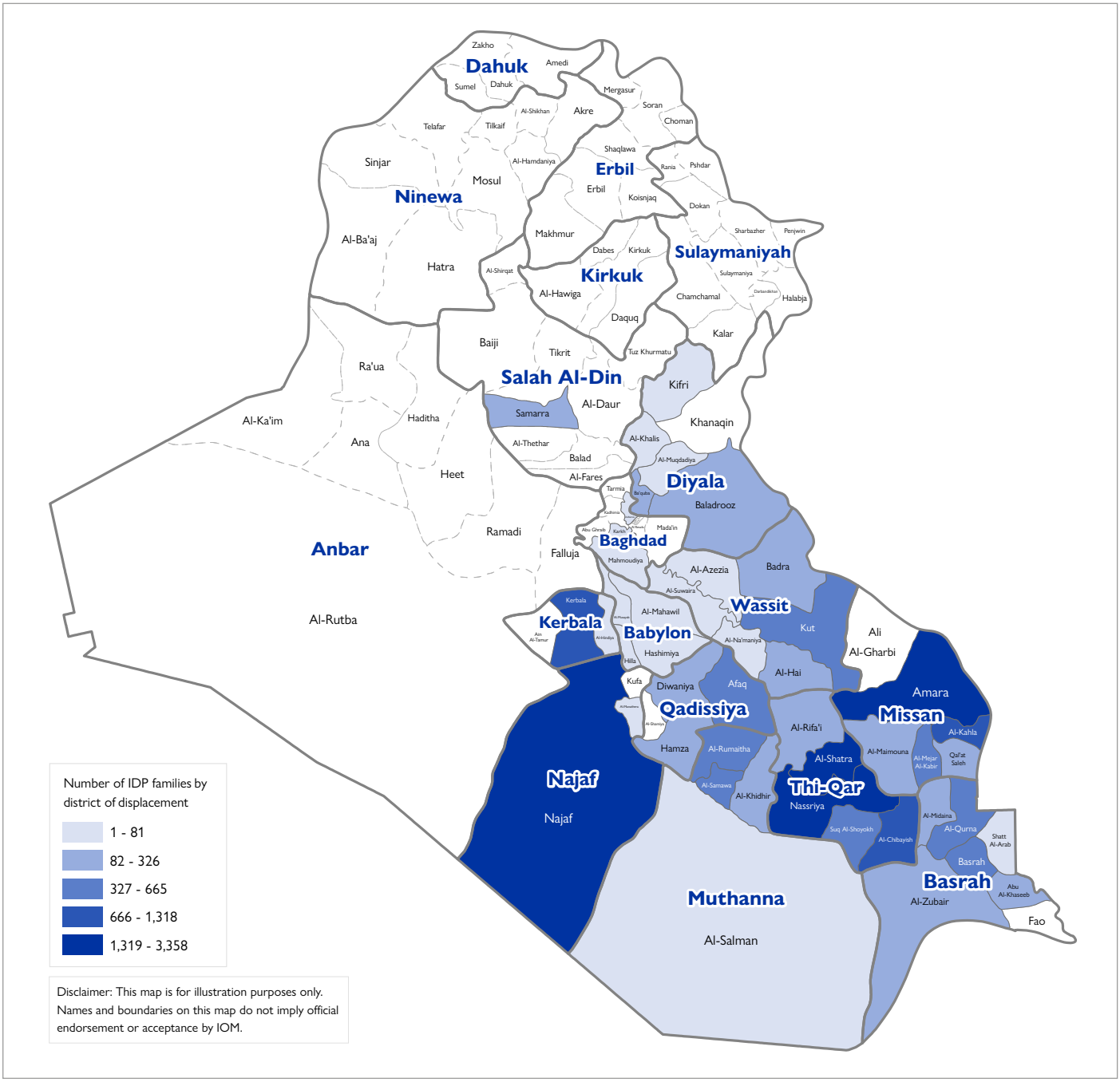
73 Rudaw, 'Half of Kurdistan Region's trees lost to climate change: Advisor,' *Rudaw* (2 December 2023).

MOBILITY

Across the 804 locations assessed in KRI, none had witnessed climate-induced displacement to the location. Furthermore, environmental factors did not contribute to secondary displacement[74] or failed returns[75] in KRI during this round of data collection. Therefore, climate-induced displacement appears to be confined to central and southern Iraq as of December 2023.[76] However, this does not rule out the possibility that climate change may be indirectly influencing other forms of movements within and to KRI, such as economically-motivated rural-to-urban migration or seasonal migration.[77] Indeed, in response to environmental factors, families in a minority of locations assessed (1%) sent household members to another location to make money, as noted in the Coping Strategies section.

Moreover, temporary relocations in response to environmental hazards have occurred in KRI. For example, the International Federation of Red Cross and Red Crescent Societies (IFRC) reported that 7,440 people relocated due to flash floods in mid-March 2024.[78]

Map 2: Districts of origin for climate-induced displacement in Iraq as of December 2023[79]



74 Secondary displacement refers to 'individuals displaced more than one time and arriving from another location of displacement.' IOM, Master List Methodology (Baghdad, n.d.)

75 Failed returns refer to 'individuals arriving from their area of origin after a failed attempt at return.' Ibid.

76 IOM, *Climate-Induced Displacement – Central and Southern Iraq (December 2023)* (Baghdad, 2023).

77 Richard Black et al., The effect of environmental change on human migration, *Global Environmental Change*, 21(1):S3-S11 (December 2011).

78 International Federation of Red Cross and Red Crescent Societies (IFRC), *Iraq Pluvial/Flash Flood 2024 – DREF Operation MDRIQ016*, IFRC (Baghdad, 2024).

79 The map depicts the top 15 flows from their district of origin to their district of displacement. Intradistrict displacement is shown as a circular arrow. IOM, *Climate-Induced Displacement – Central and Southern Iraq (December 2023)* (Baghdad, 2023).

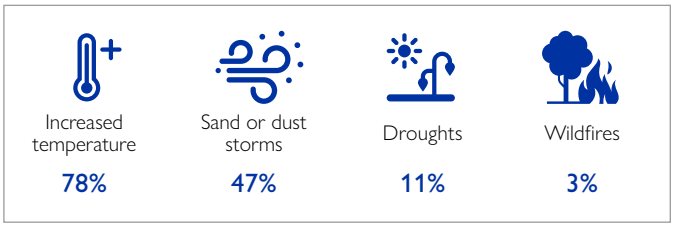
ENVIRONMENTAL HAZARDS[80]

This section assesses the prevalence of different environmental hazards across KRI. Key informants were asked whether the following environment events occurred in the location in the last 12 months: drought, sand or dust storms, increased water salinity, soil degradation/desertification, increased temperature, biodiversity loss, landslides, floods, wildfires or other hazards.

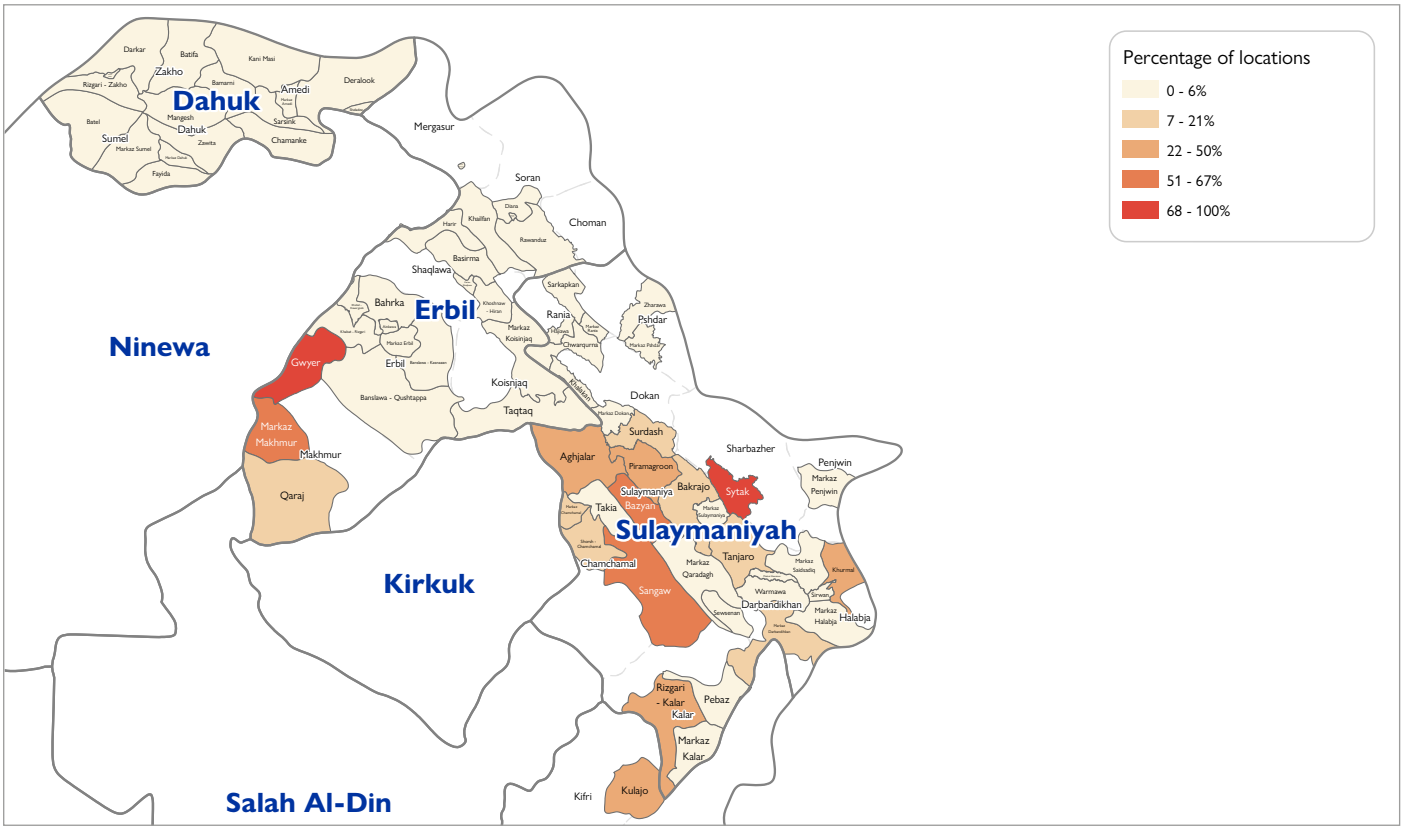
A relatively narrow range of environmental hazards were reported in the Kurdistan Region of Iraq compared to central and southern Iraq.[81] The most widespread hazard was **increased temperatures**, as witnessed by four in five locations (78%) in the past 12 months. Additionally, **sand or dust storms** struck roughly half of the locations (47%). This may be linked to decreasing vegetation cover and desertification across Iraq.[82] Finally, 1 in 10 locations experienced **drought**.

The environmental hazards reported vary somewhat by governorate and district. **Dust or sandstorms** were widely reported in **Dahuk and Erbil** (100% and 98% of locations, respectively) but not in Sulaymaniyah (0%). On the other hand, **increased temperatures** were mostly indicated in **Erbil and Sulaymaniyah** (99% and 96% of locations, respectively). **Drought** is a more localized phenomenon, concentrated in two districts in **Erbil** Governorate and seven districts in **Sulaymaniyah** Governorate, as illustrated in the corresponding map. **Sharbazher District** in Sulaymaniyah Governorate and **Makhmur District** in Erbil Governorate had a higher share of locations experiencing drought (100% and 46%, respectively). Outside of these districts, drought conditions were widespread in **Sangaw subdistrict**, Chamchamal District (60% of locations); **Bazyan subdistrict**, Sulaymaniyah District (53%); **Rizgari subdistrict**, Kalar District (50%); **Aghjalar subdistrict**, Chamchamal District (45%) and **Kulajo subdistrict**, Kalar District (44%). Beyond the three hazards mentioned above, **wildfires** were also common in **Amedi District** in Dahuk Governorate.

Figure 2: Most prevalent environmental hazards in the 12 months prior to assessment, by percentage of locations



Map 3: Subdistricts by the percentage of locations which experienced drought in the last 12 months



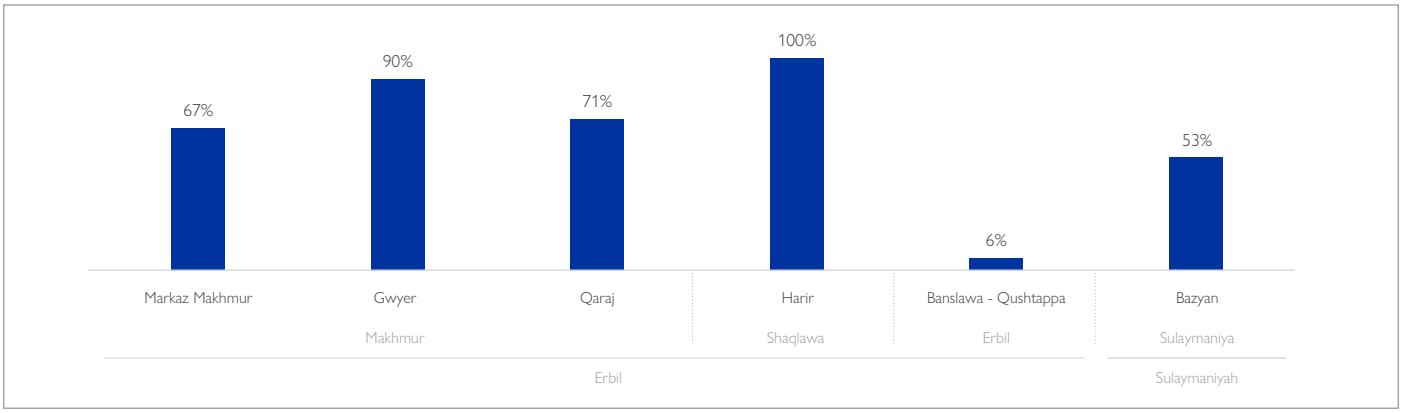
On average, assessed locations in KRI experienced 1.44 different environmental hazards in the past 12 months, with a minimum of one hazard and a maximum of four. Most locations (94%) witnessed one or two hazards with a small percentage (6%) experiencing three or four. **Bazyan subdistrict** in Sulaymaniyah Governorate is one of the most affected areas with 17 locations experiencing between three and four different hazards in the past 12 months, followed by **Markaz Makhmur subdistrict** in Erbil Governorate (15 locations).

80 A 'hazard' refers to a 'process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.' For the purposes of this report, the term 'environment hazard' encompasses certain 'hydrometerological hazards of atmospheric, hydrological or oceanographic origin' (e.g. floods and droughts), 'geological or geophysical hazards originat[ing] from internal earth processes' (e.g. landslides) alongside 'environmental hazards includ[ing] chemical, natural and biological hazards' (e.g. soil degradation and biodiversity loss). The complete list of hazards assessed can be found in the introductory box. United Nations Office for Disaster Risk Reduction (UNDRR), 'Hazard,' *UNDRR* (n.p., n.d.)

81 IOM, *Drivers of Climate-Induced Displacement in Iraq: Climate Vulnerability Assessment* (Baghdad, 2023).

82 Lisa Binder et al., *Climate Risk Profile Iraq*, Weathering Risk, Potsdam Institute for Climate Impact Research & adelphi (Potsdam/Berlin, 2022).

Figure 3: Percentage of locations experiencing three or more environmental hazards in the past 12 months by governorate, district and subdistrict



WATER ACCESS

This section considers the sources of irrigation water across KRI, whether the supply of available irrigation water has decreased in the past 12 months and the reasons for the reduction.

Most assessed locations (60%) do not have an irrigation water source, although almost all of these locations are urban. Out of the remaining locations that have an irrigation water source (40%), the majority (81%) rely either on two or three sources. **However, a small minority (6%) depend on a single source. The lack of diversification in irrigation water sources may render these locations more vulnerable to changes in the availability of water.**

The most common irrigation water source was **rainfall** (indicated by 90% of locations), followed by **boreholes/wells** (73%) and **river/streams** (44%). Climate change directly and indirectly impacts water levels from all three sources by, inter alia, raising temperatures, changing rainfall patterns, accelerating rates of evapotranspiration and increasing the frequency and intensity of drought.[83, 84, 85, 86]

Irrigation water sources vary to some extent by governorate. Irrigation canals are a relatively common water source in Dahuk Governorate, reported by a third of locations (36%). Additionally, in Erbil Governorate, nearly half of locations (48%) use tap water for irrigation. In Sulaymaniyah, by contrast, very few locations get irrigation water from river/streams (8%), depending instead of rainfall (94%), boreholes/well (90%) and, to a lesser extent, water trucking from private suppliers (16%).

Notably, five locations in Markaz Sumel subdistrict in Sumel District and three locations in Rizgari subdistrict in Zakho District **rely entirely on rainfall for irrigation**. Given the impact of climate change on rainfall patterns,[87] these locations are especially vulnerable to changing environmental conditions.

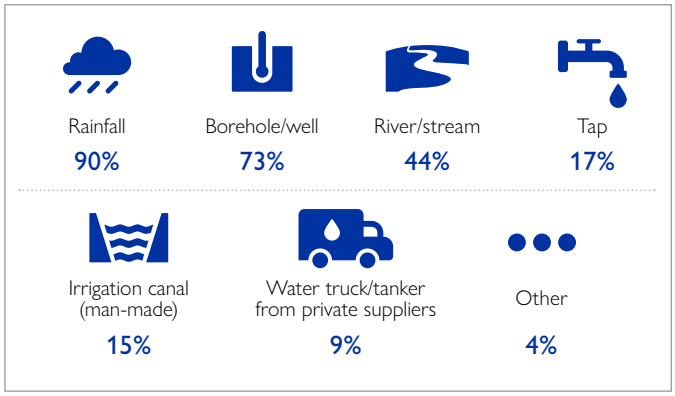
Moreover, Bazyan subdistrict in Sulaymaniyah District, Khurmal subdistrict in Halabja District and Gwyer and Markaz Makhmur subdistricts in Makhmur Districts rely to some extent on **water trucking** from private and public suppliers. This may indicate a degree of water stress, as water trucking can be an expensive source of irrigation water. In fact, locations which used water trucking were more likely to report a reduction in available irrigation water than those who did not (97% vs. 34%, respectively).

REDUCTION IN IRRIGATION WATER SUPPLY

Among locations with an irrigation water source, two in five (40%) witnessed a drop in the supply of water in the last 12 months. However, the issue varies significantly by governorate. Half of locations in Sulaymaniyah Governorate witnessed a reduction, along with around two thirds of locations in Erbil Governorate. By contrast, no locations in Dahuk Governorate saw a decline in irrigation water. This may reflect the higher than average rainfall recorded in the governorate during the reporting period.

In Erbil Governorate, **Shaqlawa** and **Makhmur** districts, along with **Rawanduz** subdistrict in Soran District, had the largest shares of locations indicating a reduction in available irrigation water. In Sulaymaniyah Governorate, this issue was concentrated in **Sharbazher**, **Chamchamal** and **Sulaymaniyah** districts, as well as **Khurmal** and **Markaz Halabja** subdistricts in Halabja District, **Rizgari** subdistrict in Kalar District and **Pyramaqrun** subdistrict in Dokan District.

Figure 4: Most common water sources for irrigation, by percentage of locations



83 International Groundwater Resources Assessment Centre (IGRAC), Groundwater & Climate Change, *IGRAC* (Delft, n.d.)

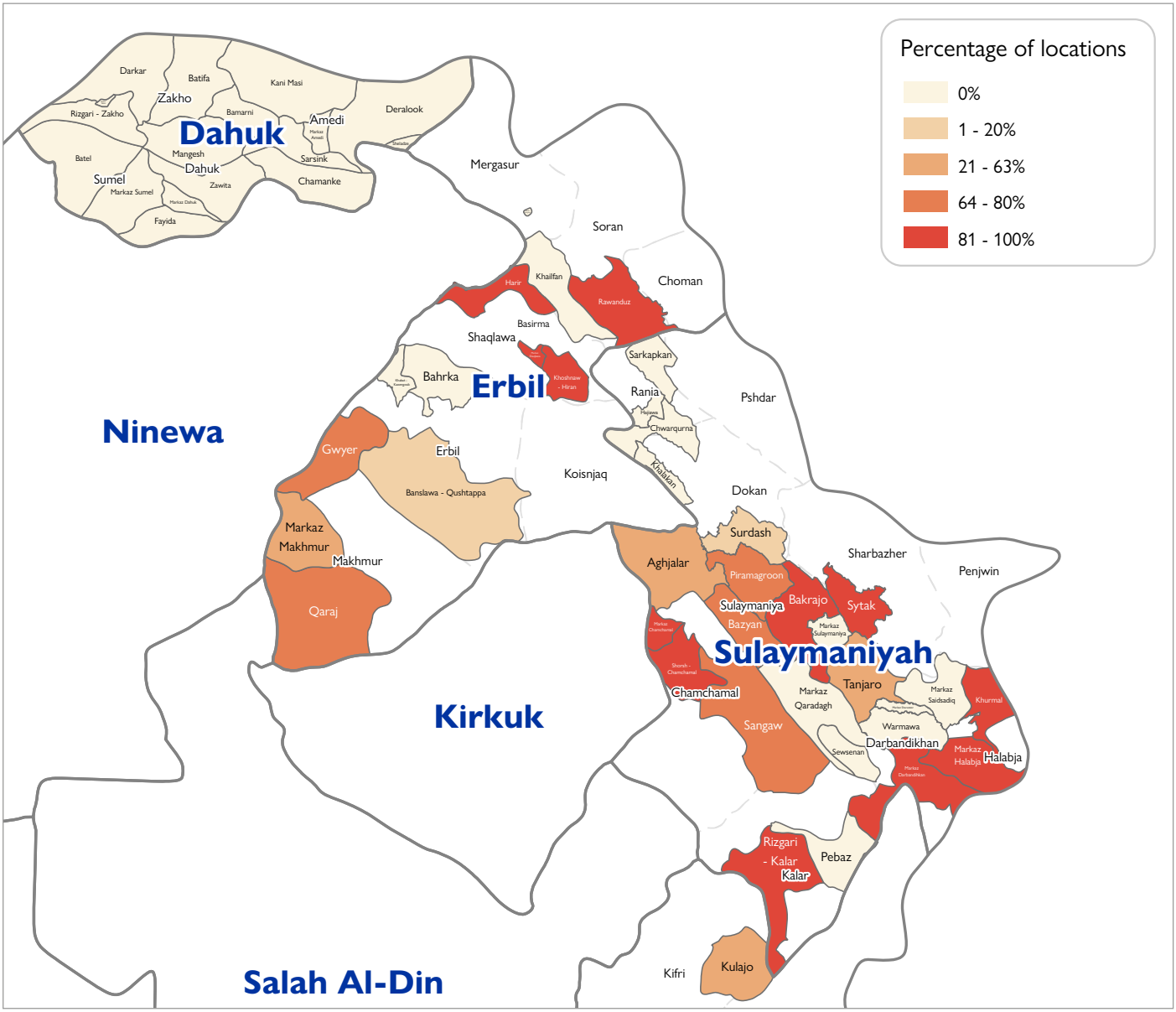
84 Veeraswamy Davamani et al., A Critical Review of Climate Change Impacts on Groundwater Resources: A Focus on the Current Status, Future Possibilities and Role of Simulation Models, *Atmosphere*, 15(1):122 (2024).

85 Hong Wang et al., Anthropogenic climate change has influenced global river flow seasonality, *Science*, 383:1009-1014 (2024).

86 Laura E. Condon et al., Evapotranspiration depletes groundwater under warming over the contiguous United States, *Nature Communications*, 11(873) (2020).

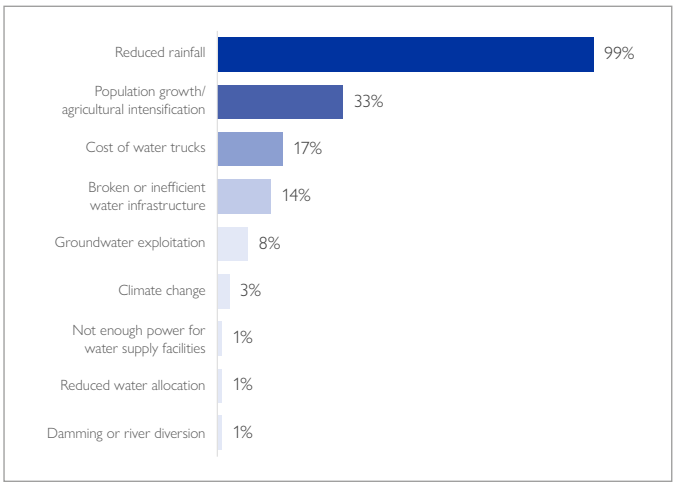
87 Kevin E. Trenberth, Changes in precipitation with climate change, *Climate Research*, 47:123-138 (2011).

Map 4: Percentage of locations experiencing a reduction in irrigation water in the last 12 months by subdistrict



Almost all locations (99%) cited **reduced rainfall** as the reason for the decrease in available irrigation water. Other common factors include **population growth/ agricultural intensification** and the **cost of water trucks**. Notably, only 3 per cent of locations highlighted climate change as the reason for reduction. This may reflect limited awareness of the impacts of climate change on the irrigation water supply.

Figure 5: Reasons for the reduction in available water sources for irrigation



In Erbil Governorate, reduced rainfall was the primary factor cited (98% of locations). In Sulaymaniyah Governorate, a wider range of factors were indicated, including reduced rainfall (100% of locations), population growth/agricultural intensification (64%), cost of water trucks (34%), broken or inefficient water infrastructure (28%) and groundwater exploitation (16%).

Population growth/agricultural intensification was highlighted by seven subdistricts in Sulaymaniyah Governorate, namely Aghjalar (100% of locations), Sangaw (100%) and Shorsh (100%) in Chamchamal District; Khurmal (100%) in Halabja District; Kulajo (100%) in Kalar District and Bazyan (100%) and Bakrajo (50%) in Sulaymaniya District.

Additionally, Bazyan subdistrict in Sulaymaniya District and Pyramaqrun subdistrict in Dokan District cited the **cost of water trucks** as a reason contributing to the decrease in available irrigation water.

Broken or inefficient water infrastructure appears to be a challenge in Shorsh subdistrict in Chamchamal District and Bazyan subdistrict in Sulaymaniya District.

Lastly, **groundwater exploitation** is contributing to a reduction in irrigation water in four subdistricts: Markaz Chamchamal in Chamchamal District, Markaz Halabja in Halabja District, Sytak in Sharbazher District and Tanjaro in Sulaymaniya District.

LIVELIHOODS

This section first considers the primary livelihood activities in each location. As part of this analysis, livelihoods were classified as climate-sensitive if they directly depend on land, water or forests. Specifically, commercial farming, smallholder farming, livestock rearing, poultry rearing, transhumance, forestry, fishing and fish farms were all deemed climate-sensitive livelihoods.

The assessment then examined the impact of climate change on these livelihoods. KIs were asked whether livelihoods were negatively impacted by changes in the environment in the past 120 days. To understand more concrete consequences of these changes, the tool assessed whether in the past 120 days or in the last agricultural season, families experienced a loss of crop production, livestock deaths or reduced fishing yields due to environmental factors. Lastly, KIs indicated the proportion of households who in the past 120 days had abandoned agriculture, livestock rearing and fishing as a source of livelihoods because of environmental factors. Responses were based on the following categories: 'Most or all families (76-100%)', 'More than half (50-75%)', 'Around half (25%-49%)', 'Some families (1%-24%)' or 'None.'

The most common sectors of work in KRI include **informal or sporadic daily labour** (86%), **public service** (73%), **education** (63%), **wholesale and retail trade** (59%) and **transportation** (45%). Roughly one third of locations indicate smallholder farming (37%) and livestock rearing (33%) as primary livelihoods. Additionally, just under 2 in 10 locations (18%) engage in commercial farming. A minority of locations indicate fishing, fish farms, forestry and transhumance among their top livelihoods. As the data on livelihoods were collected at the location level, sex- and age-disaggregated figures are not available.

Overall, families in around two in five locations (43%) rely on climate-sensitive livelihoods, compared to more than four in five locations assessed in central and southern Iraq. Within KRI, the shares of locations dependent on climate-sensitive livelihoods vary by governorate. **Dahuk Governorate** has the largest share of locations engaged in climate-sensitive livelihoods (66%), followed by Erbil (43%) and Sulaymaniyah (34%). In Dahuk, key districts practicing these activities include **Amedi** (100% of locations), **Sumel** (80%) and **Zakho** (71%). In Erbil Governorate, **Shaqlawa** (100% of locations), **Mergasur** (100%) and **Makhmur** (87%) are the primary districts performing these livelihoods. In Sulaymaniyah, the main districts include **Sharbazher** (100% of locations), **Pshdar** (100%), **Dokan** (63%) and **Chamchamal** (51%). Families in almost every rural location assessed engage in climate-sensitive activities (>99% of locations), although those in a minority of urban locations (17%) also practice such activities.

Disaggregating by specific livelihood activities, a greater share of locations in Dahuk compared to Erbil and Sulaymaniyah engage in **smallholder farming** (62% vs. 35% and 29%, respectively), **livestock rearing** (60% vs. 32% and 24%, respectively) and **commercial farming** (29% vs. 10% and 18%), respectively). However, forestry is slightly more common in Sulaymaniyah, particularly in Pshdar and Sharbazher districts, and transhumance in Erbil.

Figure 6: Primary livelihood activities by percentage of locations

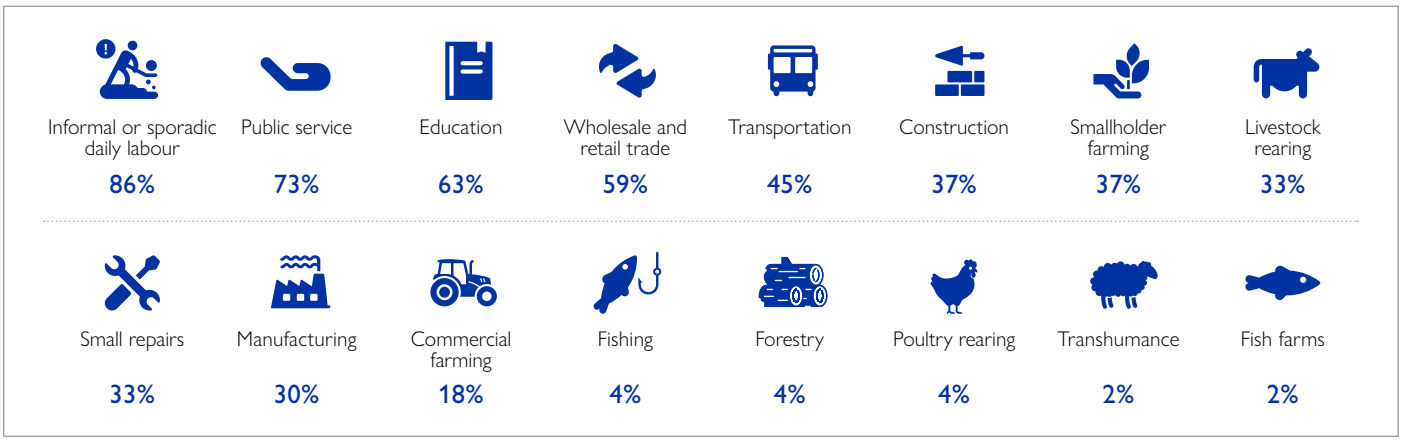
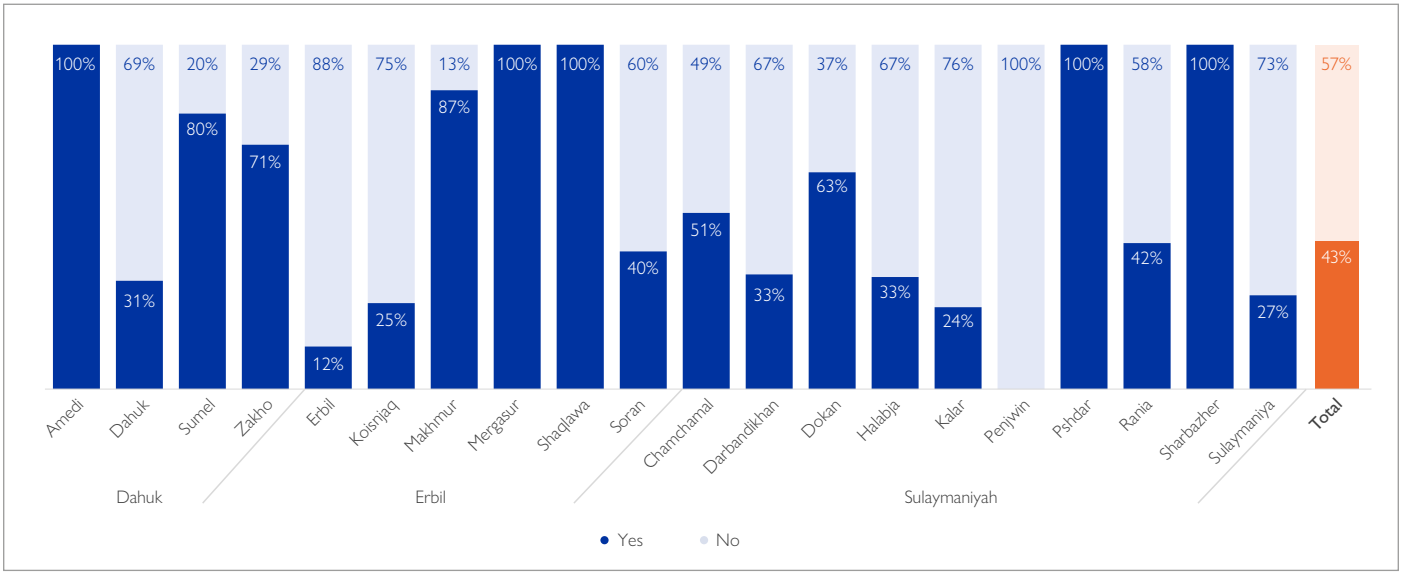


Figure 7: Percentage of locations with climate-sensitive activities among the top livelihoods by governorate and district



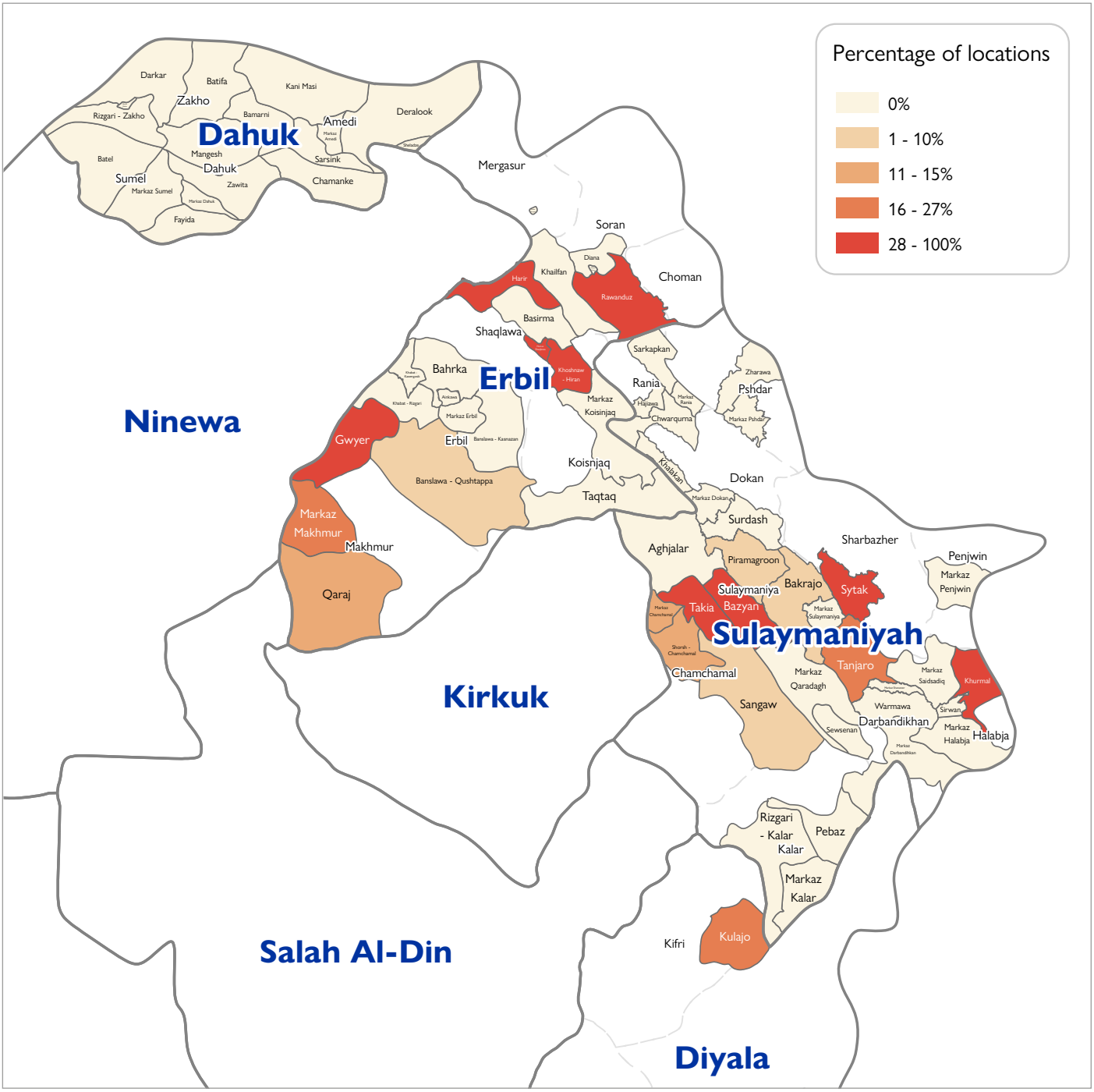
THE IMPACT OF CLIMATE CHANGE ON LIVELIHOODS IN KRI

Climate change had a negative impact on livelihoods in 1 in 10 locations assessed. In locations where climate-sensitive livelihoods are among the top activities, this share rises to 20 per cent.

Despite the higher prevalence of climate-sensitive livelihoods in Dahuk Governorate, **climate change had a more widespread impact on livelihoods in Erbil and Sulaymaniyah Governorate compared to Dahuk.** In particular, KIs in 14 per cent of locations in Erbil and 11 per cent in Sulaymaniyah said climate change had negatively affected the top livelihoods in the location in the past 120 days. No KIs in Dahuk reported that climate change had adversely impacted livelihoods.

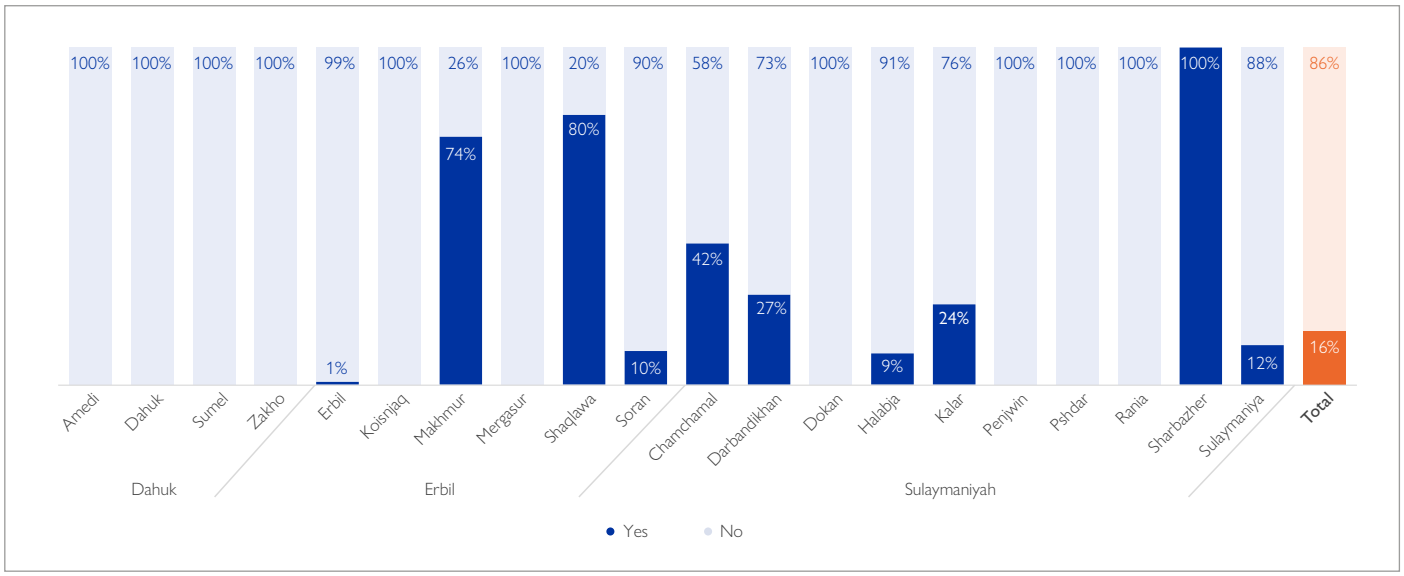
At the district level, climate change had the most widespread consequences for livelihoods in **Sharbazher District** (100% of locations affected) in Sulaymaniyah Governorate and **Shaqlawa District** (80%) in Erbil Governorate. Beyond these areas, other notable subdistricts affected include **Rawanduz** (100% of locations) in Soran District and **Gwyer** (80%) in Makhmur District, both in Erbil Governorate, along with **Takia** (100%) in Chamchamal District, **Khurmal** (80%) in Halabja District and **Bazyan** (66%) in Sulaymaniyah District.

Map 5: Percentage of locations by subdistrict reporting livelihoods had been negatively affected by changes in the environment in the past 120 days



The livelihoods most likely to report negative effects from climate change are those which depend on land, water or forests. In particular, a third of locations engaged in **forestry** indicated livelihoods were adversely impacted by climate change, followed by **commercial farming** (32%), **poultry rearing** (26%), **smallholder farming** (21%) and **livestock rearing** (18%).

Figure 8: Percentage of locations where families experienced loss of crop production, livestock deaths or reduced fishing yields due to environmental factors in past 120 days or agricultural season by governorate and district



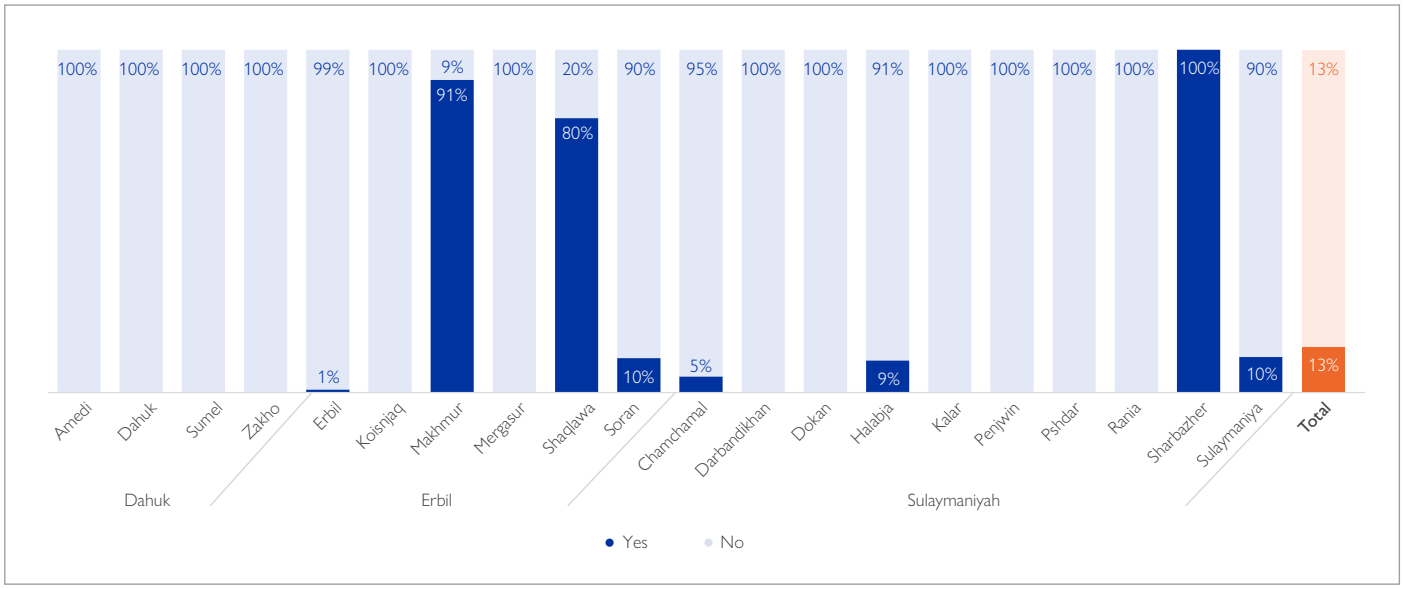
In the past 120 days or agricultural season, herds and yields decreased in around one in six locations assessed (16%). Among locations engaged in climate-sensitive livelihoods, more than a third (37%) reported such losses. In rural locations with these activities, the share reporting losses climbs to 45 per cent.

At the governorate level, **Erbil had the greatest share of locations reporting reduced production** (29%), followed by Sulaymaniyah (15%). No families in Dahuk experienced a loss in production in the past 120 days or agricultural season.

Sharbazher District (100% of locations) in Sulaymaniyah Governorate and **Shaqlawa** (80%) and **Makhmur** (74%) districts in Erbil Governorate appear to be particularly affected by this issue. Outside of these districts, the subdistricts of **Rawanduz** (100%) in Soran District, **Kulajo** (100%) in Kalar District and **Aghjalar** (91%) in Chamchamal District experienced widespread losses.

Locations where families engage in **poultry rearing** (65%), **transhumance** (60%) and **commercial farming** (41%) were the most likely to witness reductions in production.

Figure 9: Percentage of locations where families have abandoned agriculture/livestock rearing/fishing as a source of livelihoods because of environmental factors in past 120 days by governorate and district



In the past 120 days, at least some families abandoned agriculture, livestock rearing or fishing in around one in seven locations assessed (13%). Filtering on locations where families practice climate-sensitive livelihoods, more than a quarter (28%) reported at least some abandonment. Abandonment was especially prevalent in **Erbil Governorate**, with climate-sensitive livelihoods abandoned in a third of locations assessed, especially in **Makhmur** (91%) and **Shaqlawa** (80%) districts. Additionally, abandonment was indicated in 7 per cent of locations in Sulaymaniyah, most notably in **Sharbazher District** (100% of locations). As with other climate-related impacts on livelihoods, no KIs in Dahuk reported abandonment of these activities.

At the subdistrict level, the issue appears particularly severe in **Gwyer, Markaz Makhmur** and **Qaraj** in Makhmur District and **Harir** in Shaqlawa District, all in Erbil Governorate. In these subdistricts, around half or more than half of families abandoned these activities in the majority of locations.

COPING STRATEGIES[88]

This section of the report considers whether households in the assessed location adopted any coping strategies because of environmental factors in the past 120 days. It then examines the specific coping strategies adopted, which range from diversification of livelihood activities to reducing meal size and taking children out of school.

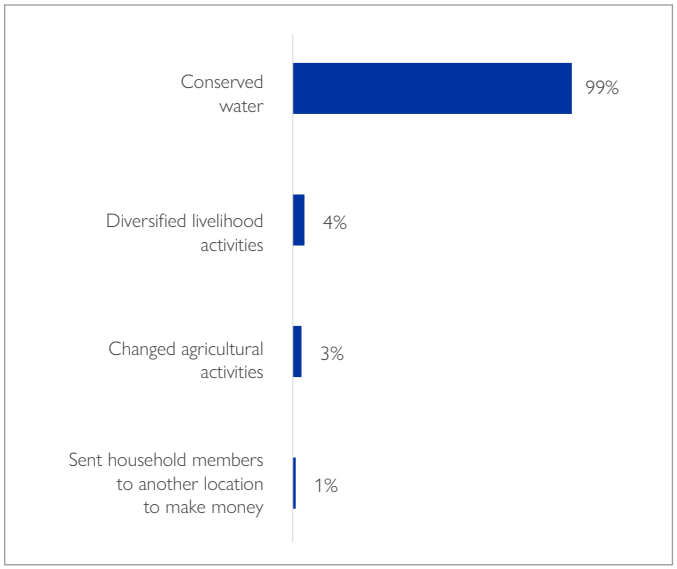
In 12 per cent of locations, families adopted coping strategies because of environmental factors in the past 120 days. The most common coping strategy was conserving water, reported by nearly all locations where families adopted such strategies. Additionally, in a small minority of locations, families diversified livelihood activities (4% of locations adopting coping strategies), changed agricultural activities (3%) or sent household members to another location to make money (1%).

Although environmental factors had a more widespread impact on livelihoods in Erbil, the adoption of coping strategies was more common in Sulaymaniyah (19% vs. 6% in Erbil). At the district level, a greater portion of locations in **Dokan** (56%), **Kalar** (43%), **Darbandikhan** (20%) and **Sulaymaniyah** (19%) in Sulaymaniyah Governorate, as well as **Shaqlawa District** (80%) in Erbil Governorate, reported the adoption of coping strategies. Additionally, in all locations of **Rawanduz** subdistrict, Soran District, families engaged in these strategies.

Families in Erbil Governorate appear to have adopted a slightly broader range of coping strategies than in Sulaymaniyah Governorate. While all locations reported that families were conserving water, they also diversified livelihood activities in 29 per cent of locations and changed agricultural activities in 21 per cent of locations. By contrast, families in Sulaymaniyah mostly conserved water.

Despite the negative effects of climate change on livelihoods in Erbil, the low share of locations where families adopted coping strategies, along with the broader range of strategies employed, suggests that **people in Erbil have been better able to adapt to changes in the environment than in Sulaymaniyah**.

Figure 10: Coping strategies by percentage of locations



TENSION AND CONFLICT

This section considers the extent to which tension and violence between groups in the past 120 days were related to natural resources. It then explores which natural resources (e.g. arable land, grazing land, water, livestock, etc.) are contributing to tensions and the groups involved in these incidents.

KIs in 12 locations (1% of the total) cited access to natural resources as either the main driver or a contributing driver of tension or violence between groups.

Most incidents of tension or conflict over natural resources were reported in Bazyan subdistrict and, to a lesser extent, in Bakrajo subdistrict, both in Sulaymaniyah District. In particular, people in a quarter of locations assessed in Bazyan (25%) and 5 per cent in Bakrajo subdistrict experienced tension or conflict over natural resources. No locations in Dahuk or Erbil Governorates witnessed resource-related tension or violence.

Arable land was the sole resource involved in such disputes. In Bazyan and Bakrajo subdistricts, incidents were often between residents and factory owners,[89] groups practicing the same livelihoods and members of the same tribal groups. In other locations, tension or violence over natural resources involved members of the same tribal groups. These incidents suggest local-level tensions are occurring over the use and ownership of agricultural land.

88 This report employs the following definition of a coping strategy: 'an action taken by individuals within a household when shocks, such as natural disasters and conflict, push them beyond the difficulties faced in normal times.' While this term was developed as a measure of food insecurity, a broader, multi-sectoral approach is adopted here. Oxfam, *Measuring Household Stress: Introducing the Multi-Sector Coping Strategy Index for Afghanistan*, Oxfam (Afghanistan, 2018).

89 In these cases, factories reportedly used the land of residents, who requested compensation or work in the factories. The tension resulted in protests and closure of roads, according to the RARTs in Sulaymaniyah.

RECOMMENDATIONS AND AREAS FOR FURTHER ASSESSMENT

This assessment provides baseline information on the impacts of climate change and environmental degradation on KRI. By examining a diverse range of community-level vulnerability factors, the project supports needs-based intervention design. Moreover, through its assessment of more than 800 locations, the CVA allows for comparison of conditions across the region, thus enabling targeted programming in high-severity geographic locations. Finally, the findings shed light on thematic and geographic areas of concern for further research and evaluation. Key programmatic insights are summarized below:

- Irrigation Water Access: Areas which rely entirely on rainfall or depend on water trucking may require support to diversify the sources of water available. This includes the subdistricts of **Markaz Sumel** in Sumel District, **Rizgari** in Zakho District, **Bazyan** in Sulaymaniyah District, **Khurmal** in Halabja District and **Gwyer** and **Markaz Makhmur** in Makhmur District. Moreover, **Bazyan** subdistrict in Sulaymaniyah District and **Shorsh** subdistrict in Chamchamal District need assistance to rehabilitate or develop improved water infrastructure. Lastly, in areas where groundwater exploitation and high costs of water trucking are reducing the irrigation water supply, such as **Bazyan** in Sulaymaniyah District, **Pyramaqrun** in Dokan District, **Markaz Chamchamal** in Chamchamal District, **Markaz Halabja** in Halabja District, **Sytak** in Sharbazher District and **Tanjaro** in Sulaymaniyah Districts, interventions are needed to conserve and diversify water sources.
- Livelihoods: Given the high degree of lost production and abandonment of climate-sensitive livelihoods reported in **Sharbazher**, **Shaqlawa** and **Makhmur** districts, families residing there may require support to sustain or diversify their livelihood activities. Other areas of concern include the subdistricts of **Rawanduz** in Soran District, **Kulajo** in Kalar District, **Aghjalar** and **Takia** in Chamchamal District, **Khurmal** in Halabja District and **Bazyan** in Sulaymaniyah District.
- Coping Strategies: Families who adopted coping strategies may be struggling to adapt to changing environmental conditions. This was primarily indicated in the districts of **Shaqlawa, Dokan**, **Kalar**, **Darbandikhan** and **Sulaymaniyah**, as well as the subdistrict of **Rawanduz**. Further assessment is needed to understand the levels of stress families are experiencing and to tailor assistance to their needs.
- Tension and Conflict: The subdistrict of **Bazyan** in Sulaymaniyah District and, to a lesser extent, **Bakrajo** in Sulaymaniyah District, **Khurmal** in Halabja District and **Shorsh** in Chamchamal District may benefit from the development or strengthening of conflict resolution mechanisms related to land disputes.

AREAS FOR FURTHER RESEARCH

As this assessment is quantitative and location-based, more qualitative and household or individual-level data may further nuance these findings. In particular, more information is needed on the adaptation process, including the specific practices adopted and the corresponding effect these changes have on household and individual wellbeing. This includes identification of any positive adaptation strategies, which can support the development of best practices. Additionally, when families abandon climate-sensitive livelihoods, it is important to understand which activities they shift toward in order to support livelihood-related programming. Moreover, qualitative and individual data could shed light on the impacts of climate change on marginalized groups, such as women, youth and people with disabilities. Lastly, further research should be conducted on the impacts of climate change on sectors not covered by this assessment, such as health and access to services.

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