

Human Mobility in the Context of Climate Change, Environmental Degradation and Disaster Risks



The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the International Organization for Migration (IOM). The designations employed and the presentation of material throughout the report do not imply expression of any opinion whatsoever on the part of IOM concerning the legal status of any country, territory, city or area, or of its authorities, or concerning its frontiers or boundaries.

IOM is committed to the principle that humane and orderly migration benefits migrants and society. As an intergovernmental organization, IOM acts with its partners in the international community to: assist in meeting the operational challenges of migration; advance understanding of migration issues; encourage social and economic development through migration; and uphold the human dignity and well-being of migrants.

Publisher: International Organization for Migration
17 route des Morillons
P.O. Box 17
1211 Geneva 19
Switzerland
Tel.: +41 22 717 9111
Fax: +41 22 798 6150
Email: hq@iom.int
Website: www.iom.int

Cover photo: Jordan faces a range of climate change challenges that are affecting human mobility decisions, including increasing water scarcity and more frequent severe weather events. © IOM 2023/Fedza LUKOVAC

Required citation: International Organization for Migration (IOM), 2025. *Human Mobility in the Context of Climate Change, Environmental Degradation and Disaster Risks*. IOM, Geneva.

ISBN 978-92-9268-995-7 (PDF)

© IOM 2025



Some rights reserved. This work is made available under the [Creative Commons Attribution-NonCommercial-NoDerivs 3.0 IGO License](https://creativecommons.org/licenses/by-nc-nd/3.0/igo/legalcode) (CC BY-NC-ND 3.0 IGO).*

For further specifications please see the [Copyright and Terms of Use](#).

This publication should not be used, published or redistributed for purposes primarily intended for or directed towards commercial advantage or monetary compensation, with the exception of educational purposes, e.g. to be included in textbooks.

Permissions: Requests for commercial use or further rights and licensing should be submitted to publications@iom.int.

* <https://creativecommons.org/licenses/by-nc-nd/3.0/igo/legalcode>

Human Mobility in the Context of Climate Change, Environmental Degradation and Disaster Risks

Jordan Country Office

ACKNOWLEDGEMENTS

This scoping study was prepared by Al-Qaryouti Lubna and Erin K. McFee, PhD, consultants for IOM, with Rimjhim Agrawal as a contributing researcher, within the framework of the IOM project, “Human Mobility in the Context of Climate Change, Environmental Degradation and Disaster Risks in Jordan”. It aimed to explore how climate-related factors influence migration trends within Jordan and identify any direct relationship between climate change and shifts in migration that could amplify existing vulnerabilities in the country.

The study was made possible, to a large extent, by the valuable participation and contributions of all stakeholders and community members who were engaged in the project. The authors are grateful for the insights and support provided by the IOM Jordan Country Office throughout the study, specifically in terms of data collection and invaluable feedback.

We wish to thank the Ministry of Environment, particularly Mr Belal Shqarin (Engr), Director of Climate Change, and his team for their continuous support and strategic guidance. Appreciation is also extended to the Department of Statistics of Jordan and the United Nations High Commissioner for Refugees for providing raw data that informed the analysis in this report.

The study and this report owe much thanks to the generous funding support of IOM Member States through the IOM Development Fund.

CONTENTS

ACKNOWLEDGEMENTS	ii
LIST OF FIGURES	v
LIST OF TABLES	vi
ACRONYMS	vii
GLOSSARY	ix
EXECUTIVE SUMMARY	xiii
KEY FINDINGS	xiv
1. INTRODUCTION	1
1.1. BACKGROUND	1
2. METHODOLOGY	3
2.1. GEOGRAPHIC SCOPE OF THE STUDY	4
2.2. LIMITATIONS OF THE STUDY	7
3. LITERATURE REVIEW	9
3.1. CLIMATE CHANGE AND ITS IMPACTS IN JORDAN	9
3.1.1. Water	10
3.1.2. Agriculture and food security	11
3.1.3. Health	12
3.1.4. Water–energy–food security nexus	14
3.1.5. Economic development	14
3.2. HAZARDS AND DISASTER RISKS	16
3.2.1. Flash floods	16
3.2.2. Drought	17
3.2.3. Seismic hazards	19
3.2.4. Locusts	19
3.3. HUMAN MOBILITY IN JORDAN AND ITS INTERACTION WITH CLIMATE CHANGE	19
3.4. INSTITUTIONAL, POLICY AND GOVERNANCE LANDSCAPE	20
4. DATA ANALYSIS	23
4.1. SECONDARY DATA COLLECTION	23
4.1.1. Natural hazards	23
4.1.2. Migration data	24
4.2. STATISTICAL DATA ANALYSIS	24
4.2.1. Temperature and rainfall data	24
4.2.2. Population and demographics	26

4.2.3. Employment in the four governorates.	27
4.2.4. Employment in livestock and agriculture, by district	29
4.2.5. Displacement and forced migration in rural Jordan	30
4.2.6. Crop and livestock production	30
4.2.7. Livestock trend in study areas, by governorate	32
4.2.8. Historical hazards in study areas, by governorate	34
4.3. WATER AVAILABILITY AND SUPPLY	37
4.4. HEALTH SECTOR.	41
4.4.1. Correlation between pulmonary TB incidence and environmental hazards ..	41
4.4.2. Link between typhoid and paratyphoid fevers and flood events	42
4.4.3. Relationship between infectious disease incidence and internal migration patterns	43
4.5. SPATIAL ANALYSIS.	43
4.5.1. Population change detection	43
4.5.2. Identifying hotspots.	46
5. QUALITATIVE DATA ANALYSIS	49
5.1. KEY INFORMANT INTERVIEWS	49
5.1.1. Climate change and environmental impacts	49
5.1.2. Climate change–human mobility dynamics	50
5.1.3. Ongoing initiatives and coping strategies.	52
5.2. FINDINGS FROM THE STUDIED AREAS	53
5.2.1. Ajloun.	53
5.2.2. Irbid	54
5.2.3. Jerash	56
5.2.4. Mafrq	56
5.3. FOCUS GROUP DISCUSSIONS	57
5.3.1. Water scarcity and agriculture	59
5.3.2. Human mobility dynamics in urban and rural areas	60
5.3.3. Organizational initiatives and coping strategies.	61
5.3.4. Findings from focus group discussions with migrants.	62
6. RECOMMENDATIONS	63
REFERENCES	67

LIST OF FIGURES

Figure 1.	Data collection and analysis	4
Figure 2.	Most vulnerable subdistricts as at the Fourth National Communication	5
Figure 3.	Net lifetime migration rates in the governorates of subdistricts highly vulnerable to climate change	6
Figure 4.	Comparison of Jordan with peer countries along key economic and climate indicators	10
Figure 5.	Analysis of water sector vulnerability to climate change.	11
Figure 6.	Analysis of agricultural sector vulnerability to climate change	12
Figure 7.	The most visible impacts of climate change on health.	13
Figure 8.	Subdistricts in Jordan with the lowest adaptive capacities	15
Figure 9.	Flood hazard map of Jordan.	17
Figure 10.	Historical Standardized Precipitation Index (SPI), estimated by number of drought events.	18
Figure 11.	Average May–October mean temperatures in the areas under study, selected years . .	25
Figure 12.	Population by subdistrict, 2015 (enumerated) and 2022 (estimated).	26
Figure 13.	Unemployment trends in the four governorates covering the study areas, 2017–2022.	28
Figure 14.	Jordanians and non-Jordanians working on their own farms and as permanently hired employees, 2007 and 2017.	29
Figure 15.	Rural-to-urban migration, by governorate, 2023	30
Figure 16.	Wheat and barley production and rainfall levels in Irbid, Ajloun and Mafraq, 1995–2022.	31
Figure 17.	Change in cropland area size, 2001, 2011 and 2020	32
Figure 18.	Livestock mortality trends for Irbid, Ajloun, Jerash and Mafraq, 1995–2022	33
Figure 19.	Types of natural hazards and their frequencies in Irbid, Ajloun, Jerash and Mafraq, selected years	34
Figure 20.	Livestock mortality and drought incidence in Irbid, 1995–2022.	35
Figure 21.	Livestock mortality and drought incidence in Mafraq, 1995–2022.	36
Figure 22.	Livestock mortality and hazard incidence in Jerash, 1995–2022	36
Figure 23.	Livestock mortality and hazard incidence in Ajloun, 1995–2022	37
Figure 24.	Amount of water utilized for agriculture per water basin, 1995–2022	38
Figure 25.	Number of wells per water basin, 1995–2022.	38
Figure 26.	Groundwater usage for distant regions and livestock farming, by water basin, 1995–2022	40
Figure 27.	Number of wells for livestock farming, by water basin, 1996–2022	40
Figure 28.	Number of pulmonary TB cases by governorate, 1990–2022	41
Figure 29.	Typhoid and paratyphoid cases, 1989–2022.	42
Figure 30.	Population change map of rural localities, 2004–2015	45
Figure 31.	Population change map of urban localities, 2004–2015	46
Figure 32.	Rural migration hotspots	47
Figure 33.	Urban migration hotspots	47
Figure 34.	Distribution of FGDs in rural and urban areas.	59
Figure 35.	Most pressing climate issues for urban and rural populations	60
Figure 36.	Family dynamics and relocation decision-making in urban and rural areas	61

LIST OF TABLES

Table 1. Breakdown of focus group participants	4
Table 2. Highly vulnerable subdistricts as at the Fourth National Communication	5
Table 3. Water demand, supply and deficit by sector, present and future projections.	11
Table 4. Data sources for the study	23
Table 5. Sources and types of data on natural hazards	23
Table 6. Sources and types of data on migration.	24
Table 7. Percentages of Jordanians and non-Jordanians in the designated subdistricts, 2015 . .	27
Table 8. Localities with significant rural population increases, 2004–2015	43
Table 9. Localities with significant rural population decreases, 2004–2015.	44
Table 10. Localities with significant urban population increases, 2004–2015	45
Table 11. Governorates and localities of the FGDs	58

ACRONYMS

COP27	Twenty-seventh Conference of the Parties to the United Nations Framework Convention on Climate Change
DOS	Department of Statistics of Jordan
FGD	focus group discussion
GDP	gross domestic product
JRC	European Commission – Joint Research Centre
KII	key informant interview
NDCs	Nationally Determined Contributions (Paris Agreement)
NGO	non-governmental organization
TB	tuberculosis
UNFCCC	United Nations Framework Convention on Climate Change

GLOSSARY

asylum-seeker An individual who is seeking international protection. In countries with individualized procedures, an asylum-seeker is someone whose claim has not yet been finally decided on by the country in which he or she has submitted it. Not every asylum-seeker will ultimately be recognized as a refugee, but every recognized refugee is initially an asylum-seeker. (United Nations High Commissioner for Refugees (Office of the), 2024)

climate change [A] change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to other natural climate variability that has been observed over comparable time periods (United Nations, 1992: art. 1, para. 1).

**climate/
environmental
refugee** The term “climate/environmental refugee” is used to refer to a category of environmental migrants whose movement is clearly of a forced nature. The term has initially been used by academics, the media and advocacy groups to draw attention to this issue and encourage the development of forms of international protection for persons obliged to leave their homes or habitual residence because of environmental or climate change-related reasons. The term “climate/environmental refugee” has now largely been accepted as having the potential to be misleading, so the terms “environmental migrant” or “displaced person” should be used instead.

Indeed, “climate refugee” is not a term of art in international law. Individuals forced to leave their country because of environmental or climatic processes or events would not necessarily meet the definition of “refugee” under article 1A(2) of the Convention Relating to the Status of Refugees (adopted 28 July 1951 and entered into force 22 April 1954; 189 United Nations Treaty Series 137 (United Nations, 1951)). Beyond a few exceptional cases, their government is generally willing to protect them, even if it may be unable to do so, and they are not persecuted on any of the Convention’s grounds. Moreover, most of those who flee environmental degradation or disaster, including when due to climate change, do not cross an international border, which is an additional requirement for the application of the “refugee” definition.

(Adapted from McAdam, 2009.)

cross-border migration	A process of movement of persons across international borders (Anatol et al., 2023).
desertification	Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (United Nations Convention to Combat Desertification, 2022).
displacement	The movement of persons who have been forced or obliged to flee or leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters (adapted from the United Nations High Commissioner for Human Rights (Office of the), 1998: introduction, para. 2).
economic migrant	Any person who is moving or has moved across an international border or within a State, solely or primarily motivated by economic opportunities (IOM, 2019:61). This can include but is distinct from labour migration, which is defined more narrowly as the movement of persons from their home State to another State, or within their own country of residence, for the purpose of employment (ibid.:123).
environmental degradation	The reduction of the capacity of the environment to meet social and ecological objectives and needs. [...] Degradation of the environment can alter the frequency and intensity of natural hazards and increase the vulnerability of communities. The types of human-induced degradation are varied and include land misuse, soil erosion and loss, desertification, wildland fires, loss of biodiversity, deforestation, mangrove destruction, land, water and air pollution, climate change, sea-level rise, and ozone depletion. (United Nations Office for Disaster Risk Reduction (UNISDR), 2009).
environmental migrant	Persons or groups of persons who, predominantly for reasons of sudden or progressive change in the environment that adversely affects their lives or living conditions, are obliged to leave their places of habitual residence, or choose to do so, either temporarily or permanently, moving either within their country or abroad (adapted from IOM, 2019:64).

extreme weather event	<p>An event that is rare within its statistical reference distribution at a particular place. Definitions of “rare” vary, but an extreme weather event would normally be as rare as or rarer than the tenth or ninetieth percentile. By definition, the characteristics of what is called “extreme weather” may vary from place to place. An “extreme climate event” is an average of a number of weather events over a certain period of time – an average which is itself extreme (e.g. rainfall over a season). (Intergovernmental Panel on Climate Change, 2018: annex B)</p>
hazard	<p>A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social or economic disruption, or environmental degradation (United Nations, 2016:18).</p>
human mobility	<p>A generic term covering all the different forms of movements of persons. (Note: The term “human mobility” reflects a wider range of movements of persons than the term “migration”. The term is usually understood as also encompassing tourists, who are generally considered as not engaging in migration.) (IOM, 2019:93)</p> <p>As an example of the currency of this term, the member international organizations of the Advisory Group on Climate Change and Human Mobility (which was created in the context of the Conferences of the Parties of the United Nations Framework Convention on Climate Change) have started to use it to cover the full, broad range of movement types that can take place in the context of climate change. (See Advisory Group on Climate Change and Human Mobility, 2015.)</p>
human security	<p>Concerns the right of people to live in freedom and dignity, free from poverty and despair, and promotes the protection of their physical safety, economic and social well-being, and human rights. It includes the right of all individuals, vulnerable people in particular, to live free from fear and want, with an equal opportunity to enjoy all their rights and fully develop their human potential. (Adapted from United Nations, 2010 and 2012.)</p>
internally displaced person	<p>Persons or groups of persons who have been forced or obliged to flee or leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights, or natural or human-made disasters, and who have not crossed an internationally recognized State border (United Nations High Commissioner for Human Rights (Office of the), 1998).</p>

internal migration	The movement of people within a State involving the establishment of a new temporary or permanent residence (IOM, 2019:108).
livelihood	<p>At the individual and household levels, vulnerability and resilience depend largely on people's livelihoods. Livelihoods comprise the capabilities, material and social assets, and activities required to sustain a means of living. (Chambers and Conway, 1991)</p> <p>Livelihood options depend on available human, social and financial capital and on the socioeconomic, natural and political context in which people live. They determine how people occupy and use their environment; what options they have in the face of hazards; what impacts they suffer from such hazards; and how effectively they recover. (Carloni, 2005)</p>
slow-onset event	An event evolves gradually from incremental changes occurring over many years or from an increased frequency or intensity of recurring events. Such events include sea-level rise, increasing temperatures, ocean acidification, glacial retreat and related impacts, salinization, land and forest degradation, loss of biodiversity, and desertification. (Conference of the Parties of the United Nations Framework Convention on Climate Change, 2011)

EXECUTIVE SUMMARY

This study explores the intricate relationship between climate change and human mobility in Jordan, focusing on how climatic stressors influence migration patterns and socioeconomic dynamics. Over the past few decades, Jordan has experienced significant environmental challenges, including rising temperatures, declining rainfall, more frequent heatwaves and prolonged droughts. These shifts have impacted water resources, agricultural productivity and the livelihoods of vulnerable populations. As such, it is critical to identify key drivers of migration, community coping strategies and recommendations for enhancing climate resilience across Jordan's diverse landscapes.

This study employed a multifaceted research approach combining quantitative and qualitative methods to understand the relationship between climate change and human mobility in Jordan. The study area included Irbid, Ajloun, Mafraq and Jerash. The methods used in this study included secondary data analysis, spatial analysis, key informant interviews (KIs) and focus group discussions (FGDs).

Secondary data was used to assess climate change impacts on migration patterns, agricultural productivity, water resources and public health. Data from the Jordan Department of Statistics, meteorological records and agrarian reports provided insights into temperature trends, rainfall variability, and the availability and quality of water resources across different regions. This information indicates a possible causal link between climate-induced changes and economic challenges, migration trends and health issues such as vector-borne and waterborne diseases. Additionally, spatial analyses facilitated an understanding of regional disparities in climate impacts, revealing areas with significant water scarcity, declining agricultural productivity and increased vulnerability to natural hazards. Spatial data also helped map migration flows and the socioeconomic variables driving these movements.

Qualitative methods – KIs and FGDs – were employed to complement the quantitative findings. The KIs involved representatives of non-governmental organizations (NGOs), government officials, academia and community leaders, providing insights into the challenges and strategies related to climate change adaptation and migration. These interviews highlighted the perspectives of policymakers and stakeholders on critical issues such as water management, agricultural resilience and human mobility dynamics.

FGDs were conducted with both urban and rural residents, capturing a wide range of experiences and views of diverse demographic groups. A total of 192 participants, including men, women, persons with disabilities and migrants, were engaged in these discussions. The FGDs were designed to identify the primary reasons for migration decisions, community-level coping strategies and the extent of government support for climate adaptation. Participants were grouped by age and socioeconomic status to ensure comprehensive insights into community perspectives and resilience mechanisms.

KEY FINDINGS

Climate change is recognized as a significant concern across all sectors in Jordan, with water scarcity, droughts, erratic rainfall patterns and floods posing substantial threats to livelihoods and the country's capacity to absorb recent refugee influxes. The impact on agriculture is particularly severe, as the disruption of seasonal farming, water scarcity and land degradation have led to reduced productivity and increased migration from rural to urban areas. Public health is also affected, with a rise in vector-borne and waterborne diseases linked to climate change, as well as a potential relationship between infections such as tuberculosis and typhoid fever and natural hazards like snowstorms and floods.

Migration in Jordan is influenced by a complex interplay of factors, including economic opportunities, service accessibility and family dynamics. Climate change acts as an adverse mobility driver for vulnerable populations. While climate change is not a direct cause of migration, it indirectly influences migration patterns through agricultural productivity disturbances, water scarcity exacerbations and foodborne health risks. Internal migration trends reveal a rural-to-urban movement driven by economic prospects and better services, with refugees, particularly from the Syrian Arab Republic, adding pressure on urban infrastructures and resources.

Various community and government initiatives aim to build resilience against climate change impacts. Community-led projects, such as water harvesting in Ajloun and Mafraq, have improved irrigation techniques, and sustainable agricultural practices in Jerash exemplify local adaptive capacity. Urban areas benefit from organizational support and international funding for climate resilience projects. However, there is a need for more effective government programmes and targeted support to address the specific needs of vulnerable communities, especially in urban centres with water and agricultural challenges.

Enhanced education, health and job creation efforts are necessary to support vulnerable populations and mitigate the effects of climate change and migration. Stronger legislation and integration of climate change adaptation strategies into policies and urban planning are needed. Both government and NGO efforts are vital in implementing sustainable programmes and improving community awareness and readiness levels.

Sustainability and resilience are key components of community-based initiatives that address climate change challenges. These efforts include implementing modern technology in agriculture, water conservation techniques and eco-friendly practices to enhance resilience across sectors. However, challenges remain in integrating climate change adaptation into national strategies and policies. Opportunities lie in fostering green growth and modernizing environmental initiatives to improve resilience and sustainability.

1. INTRODUCTION

This scoping study aims to explore the Jordanian context to understand how climate variables may tacitly impact internal and international migration patterns, and whether there is any direct relationship between climate change and migration patterns that could perhaps exacerbate existing vulnerabilities.

This study will integrate the findings from a desk review and insights from focus group discussion (FGDs) and key informant interviews (KIIs) with stakeholders to provide a cohesive evidence base to inform and support the Government in better response-planning based on facts and figures.

1.1. BACKGROUND

Climate change, environmental degradation and disaster risks are critical challenges with far-reaching implications for human mobility worldwide. These issues are particularly pressing in Jordan due to the country's geographic location, limited natural resources and socioeconomic vulnerabilities. Jordan, situated in the arid region of the Middle East, faces acute water scarcity, frequent droughts and rising temperatures, which collectively exacerbate the living conditions of its population and heighten the risk of internal and international migration.

Jordan's sociopolitical landscape is further complicated by its role as a host to large numbers of refugees, primarily from the Syrian Arab Republic and Iraq, adding stress to already limited resources and infrastructure. These circumstances create a complex interplay of climate variables and migration patterns, necessitating a comprehensive understanding of the context to inform effective policy interventions.

This scoping study aims to delve into this intricate context. It seeks to explore how climate-related factors influence migration trends within Jordan and identify any direct relationships between climate change and shifts in migration that could amplify existing vulnerabilities. By focusing on the specific regions of Irbid, Mafrq, Ajloun and Jerash – areas identified as particularly vulnerable – the study gathered crucial data and insights from key stakeholders, including local policymakers, community leaders and members of vulnerable communities. This evidence-based approach provides a robust foundation for developing climate change adaptation measures that are both effective and sensitive to the needs of different genders and vulnerable groups. Additionally, awareness-raising sessions on climate adaptation will be conducted for vulnerable community members, fostering active civic engagement and empowering these populations to participate in adaptation efforts.

Ultimately, this study seeks to support the Government of Jordan and its partners in crafting informed and responsive strategies to address the challenges posed by climate change, thereby improving the resilience and adaptive capacity of local authorities and vulnerable communities. Integrating stakeholder observations and evidence-based insights will be pivotal in developing data-driven response-planning and policies that mitigate the adverse effects of climate change and support safe and dignified human mobility.

2. METHODOLOGY

The scoping study was carried out in two phases. Phase 1 focused on identifying the questions to be answered by the research. The research questions identified were:

- (a) What are the impacts and implications of climate-induced hazards, including both extreme weather events and slow-onset events, on human mobility in the study areas in Jordan?
- (b) How can climate change adaptation measures avert and minimize displacement and forced migration by improving the resilience of individuals and communities?

The phase began with an inception meeting that was carried out to present the study to the main stakeholders and establish a technical working group. Participants in this meeting included climate and humanitarian specialists, researchers, data analysts and local partners. It was also during this phase that the research scope and methodology were developed. Phase 2 focused on data collection. A literature review was conducted to gather data, studies and reports to identify the data gaps.

Mafraq, Irbid, Ajloun and Jerash Governorates were selected due to their mobility dynamics and vulnerability to environmental degradation. To complement the data gaps, primary data collection methods were used, including focus group discussions (FGDs) with a representative sample of the population in terms of age, sex, nationality and socioeconomic status, and consisting of both urban and rural residents, and key informant interviews (KIs) with government representatives, NGOs, academia, a United Nations agency (UN-Habitat) and community leaders. The following organizations were represented:

- (a) Non-governmental organizations
 - Oxfam
 - UN-Habitat
 - National Association of Regional Councils
- (b) Government representatives
 - Municipal leaders from each governorate: Ajloun, Irbid, Jerash and Mafraq
 - Department of Statistics (DOS)
 - Jordan Meteorological Department
 - Ministry of Agriculture
 - Ministry of Health
 - Ministry of Environment
 - Ministry of Social Development
 - Ministry of Planning and International Cooperation
 - National Centre for Sustainable Coastal Management
- (c) Academia
 - Yarmouk University

The sampling strategy for choosing the representative sample of FGD participants involved selecting urban and rural localities according to environmental status and percentage share of the migrant population. The sample size was determined at a 90-per-cent confidence level (i.e. a 10% margin of error). Table 1 shows the breakdown of FGD participants by gender and locality.

Table 1. Breakdown of focus group participants

	Urban	Rural
Men	19	40
Women	31	60
Migrants (both sexes)	20	22
Total	70	122

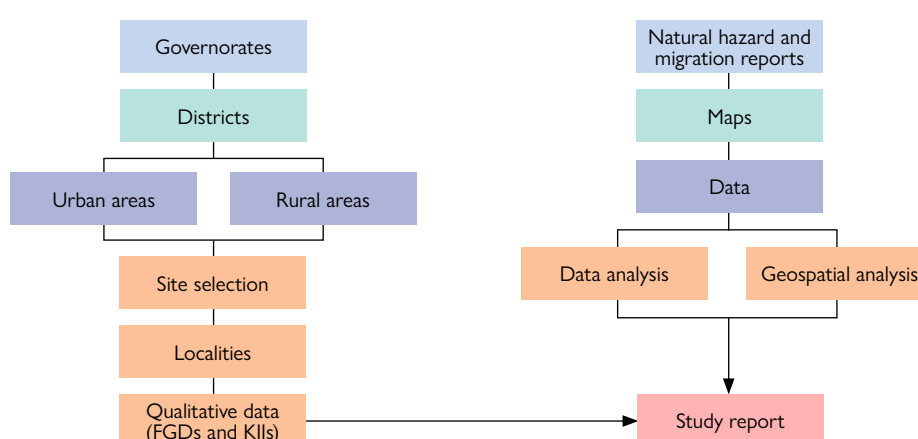
2.1. GEOGRAPHIC SCOPE OF THE STUDY

The national communications on climate change (“national communications”), submitted within the framework of the United Nations Framework Convention on Climate Change (UNFCCC), are important for guiding environmental policies and actions towards sustainable development management. The Ministry of Environment produced the Third and Fourth National Communications on Climate Change, which provided essential information about the current condition of the climate challenge, as well as projections for future changes.

In addition to recent shifts in dynamic demographic and population movements, DOS provides migration data that gives insights into national patterns of human mobility. Migration data served as additional data in these national communications that allow us to discover possible connections between human mobility and climate change.

In the Fourth National Communication, published in 2023 and which used migration data from DOS, areas vulnerable to climate change were identified (Jordan, Ministry of Environment, 2023). Negative migration rates were identified to further examine these hotspots of particular environmental and migration importance.

Figure 1. Data collection and analysis



As stated in the Fourth National Communication, vulnerability assessments considered four main components: (a) the magnitude of exposure to climate change hazards, (b) the degree of sensitivity to the hazard, (c) the extent of resulting impact and (d) its level of adaptive capacity or resilience (ibid.). The following equations identify the relationship between these four dimensions:

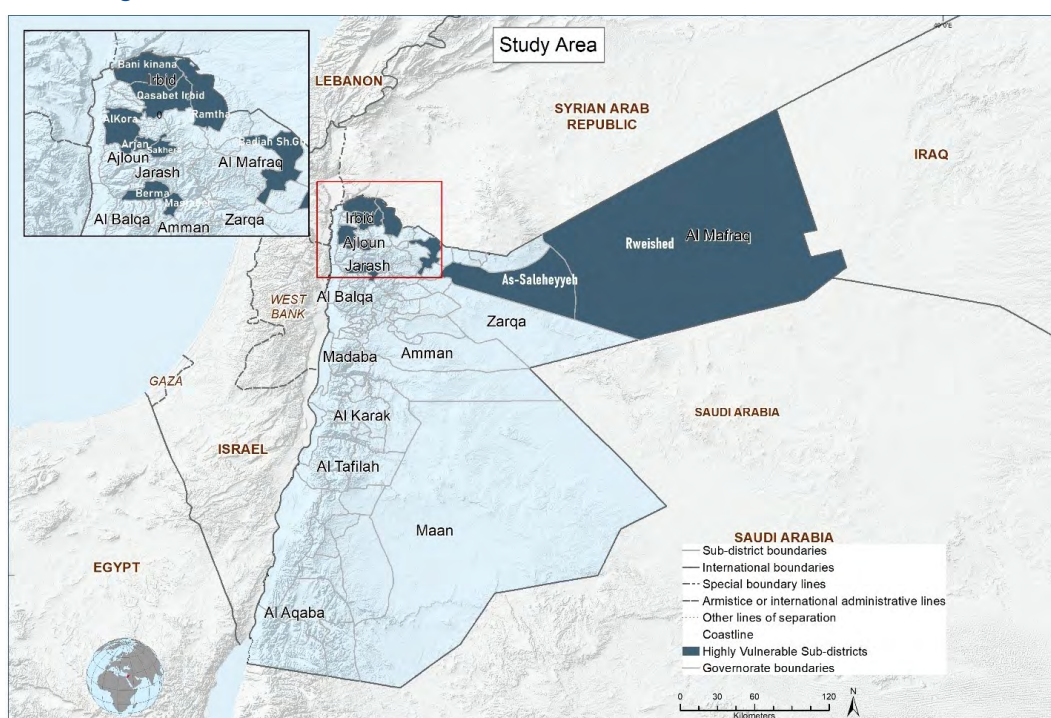
$$\text{Vulnerability (V)} = \frac{\text{Potential Impact}}{\text{Resilience or Adaptive Capacity (I}_a\text{)}} = \frac{\text{Exposure (E)} \times \text{Sensitivity (I}_s\text{)}}{\text{Adaptive Capacity (I}_a\text{)}}$$

The most highly vulnerable subdistricts are shown in Table 2 and the map in Figure 2.

Table 2. Highly vulnerable subdistricts as at the Fourth National Communication

Governorate	District	Subdistrict
Irbid	Irbid Qasabah	Irbid Qasabah
Irbid	Ramtha	Ramtha
Irbid	Koorah	Koorah
Irbid	Bani Kinanah	Bani Kinanah
Ajloun	Ajloun Qasabah	Sakhras
Ajloun	Ajloun Qasabah	Erjan
Jerash	Jerash Qasabah	Borma
Jerash	Jerash Qasabah	Mestabah
Mafrq	Badia Shamaliyah Gharbiyah	Badia Shamaliyah Gharbiyah
Mafrq	Rweished	Rweished
Mafrq	Badia Shamaliyah	Salhiya

Figure 2. Most vulnerable subdistricts as at the Fourth National Communication

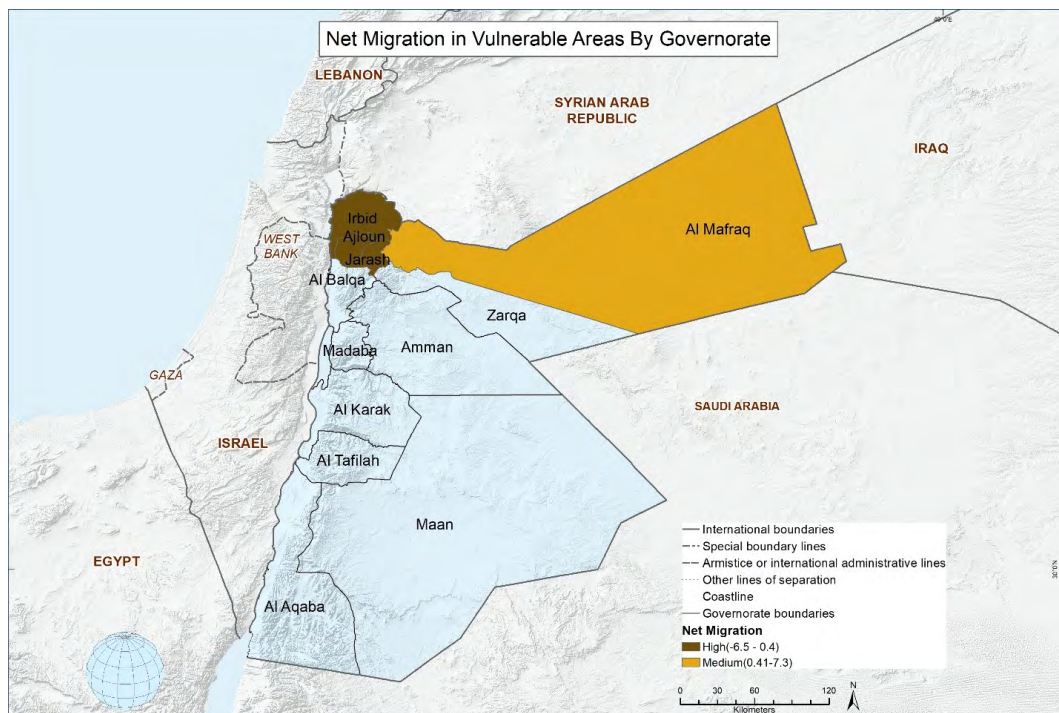


Source: Adapted from European Commission Joint Research Centre (JRC) (2016); population data from DOS (2015).

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

According to the 2015 data on migration obtained from DOS, Ajloun, Jerash and Irbid had net migration of -6.5 , -3.2 and -2.1 per 1,000 population, respectively. This indicates that more individuals have left than moved into these governorates, indicating a decline in population due to migration. The map in Figure 3 shows the net lifetime migration in the governorates of subdistricts highly vulnerable to climate change.

Figure 3. Net lifetime migration rates in the governorates of subdistricts highly vulnerable to climate change



Source: Adapted from JRC (2016); population data from DOS (2015).

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

After intersecting the vulnerability map (Figure 2) with the net lifetime migration map (Figure 3), the governorates of Irbid, Jerash and Ajloun (dark brown) were selected as study areas – that is, accordingly, the subdistricts that are highly vulnerable to climate change lie within the governorates with negative migration rates (Figure 3). Although the Mafrq Governorate has a medium net migration rate, it was included with the subdistricts with high migration rates upon the Ministry of Environment's suggestion. Ajloun, which is rich in vegetation, relies on agriculture and tourism. Irbid, with a high population density, mainly focuses on industrial activity. Jerash is an agro-based centre of great strategic importance, while Mafrq, which also relies on agriculture, is considered to host a large population of refugees relative to its economy. Thus, all these different attributes highlight diverse but interconnected vulnerabilities and adaptive strategies.

2.2. LIMITATIONS OF THE STUDY

The data set used to undertake this research comprises three migration data points: 1994, 2004 and 2015. There is inconsistency in the frequency of temporal data collected – the collection of climatic data is annual, while the migration data does not have that kind of regularity. This made it difficult to establish a direct link between migration trends and climate variables since the timelines are asynchronous.

The population data used in the study are from 2015. Considering this, some of the trends presented might prove to be outdated.

This study report primarily focused on internal migration and the inflow of refugees, while international migration was not covered.

While some of the data on disease case records are informative, they also contain information not supported by exact, verifiable facts to compare health problems and climate directly. Such limitations would preclude the ability to show a direct link between such cases and specific natural hazards, and, hence, further investigation establishing causation is required.

The current stage of report development prevents substantial gender analysis; however, it is recommended that gender sensitivity be integrated in further research.

3. LITERATURE REVIEW

3.1. CLIMATE CHANGE AND ITS IMPACTS IN JORDAN

Jordan, characterized by semi-dry to dry climate conditions and severe aridity, is one of the most water-scarce countries in the world. According to the latest records, more than 90 per cent of Jordan's territory receives rainfall of less than 200 mm per year, and the long-term rainfall rate is about 95 mm per year (Haddad, 2023). While demand continues to rise, projections suggest that by 2040, there will be 30 per cent less water per capita, indicating dire circumstances for agriculture, cities and social systems (World Bank, 2022). In addition, Jordan faces climate-related hazards such as extreme temperatures, droughts, flash floods, storms and landslides, which are increasing in frequency and intensity due to climate change. Flooding has caused serious damage in the last few years, including loss of lives and the destruction of several square kilometres of agricultural land and infrastructure (Jordan, Ministry of Environment, 2022). Climate change is also increasing the frequency and intensity of droughts in Jordan, and multi-year droughts are threatening to become the new normal, whereby municipal water supply nears humanitarian thresholds and food insecurity is further exacerbated by a lack of irrigation water. Landslides and erosion, concentrated on the steep slopes of mountains and *wadis*, affect already vulnerable communities. Climate change affects coastal areas, biodiversity, water, the agricultural sector, urban systems, public health and society at large, and adaptation options are required to mitigate its effects.

Jordan is scarce in natural resources and, therefore, highly import-dependent. This makes the country particularly vulnerable to external shocks. The country imports 98 per cent of its energy, and food imports constituted 20 per cent of total imports in 2019, amounting to over 10 per cent of its GDP (World Bank, 2022). These dependencies underscore the country's need to ensure water, energy and food security in the face of worsening climate change impacts. Such vulnerabilities, underscored by strained fiscal space, place improving water, energy and food security at the core of Jordan's development needs.

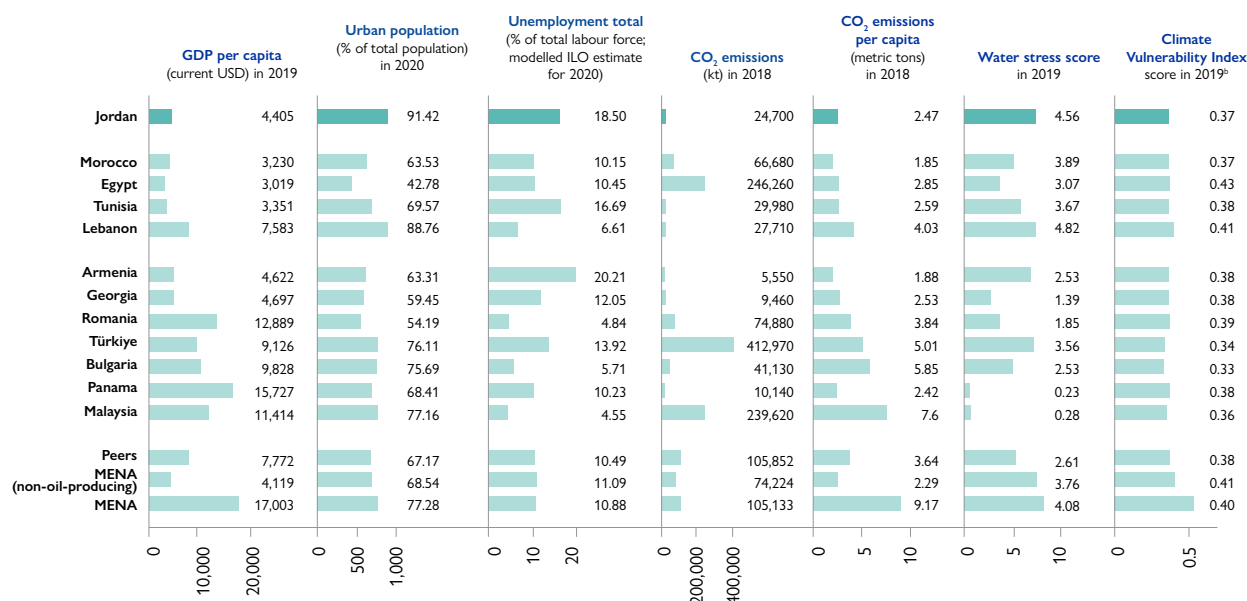
Jordan has recently been in one of the worst droughts in its history. Low precipitation rates, extreme temperatures and overuse resulting from competition with neighbouring countries for limited water resources have resulted in historically low water availability and dry aquifers, wetlands and oases. Once considered the fertile breadbasket of Jordan, the Jordan Valley has become severely threatened and will become unable to sustain agricultural production.

The 2021 report of the United Nations Intergovernmental Panel on Climate Change (IPCC) recognizes Jordan as among the world's most vulnerable country to drought due to climate change. In the Notre Dame Global Adaptation Index (ND-GAIN) for climate vulnerability, Jordan ranked 74 out of 182 countries in 2021, whereas it ranked 63 in 2015, indicating worsening climate vulnerability (ND-GAIN, 2021). The ND-GAIN Country Index summarizes a country's vulnerability to climate change and other global challenges and its

readiness to improve resilience. Jordan's vulnerability score is driven by high sub-scores on freshwater withdrawal, urban concentration and energy import dependency. Figure 4 compares Jordan with peer countries on these indicators, emphasizing how water, urban and energy sector policies can directly impact Jordan's relative regional vulnerability to climate change.

Climate change also affects key economic indicators, such as unemployment, urbanization and GDP. As disasters become more frequent and intense, State resources must be redirected toward rebuilding rather than development and social welfare. Additionally, the sociopolitical landscape of the region poses risks to the security and peace of the country, hence putting additional pressure on the State and its security apparatus. The impacts of climate change are wide-reaching, including water and food insecurity, underdevelopment and direct effects on societal health. The succeeding subsections elaborate on the sectoral impacts of climate change.

Figure 4. Comparison of Jordan with peer countries along key economic and climate indicators



Source: World Bank, 2022.

Note: ^a As measured by the World Resources Institute.

^b A higher score on the index corresponds to higher vulnerability.

3.1.1. Water

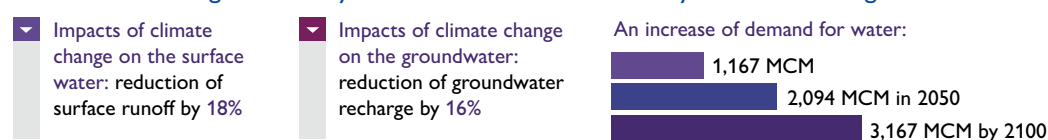
The Jordan River Valley is considered the second most water-stressed area in the world (Mamo, 2022). Jordan's water sector is the most vulnerable to climate change due to rising temperatures, reduced rainfall, prolonged droughts and floods. The shortage is addressed by overpumping underground wells, whose water withdrawal exceeds the annual water storage rate. Climate change is projected to reduce surface runoff by 18 per cent, thus reducing groundwater recharge by 16 per cent (Jordan, Ministry of Environment, 2023). With a per-capita renewable freshwater resource of 61 cubic metres per year, Jordan's available water is well below the "severe water scarcity" threshold of 500 m³/year (ibid.). Water demand continues to rise due to steady population growth and the influx of refugee

populations. Jordan needs about 1.4 billion cubic metres of water annually but maintains a deficit of about 500 million cubic metres annually (Haddad, 2023).

The problem of water scarcity has been exacerbated by the political instability in the region, and the primary transboundary surface water resources have decreased over time. Water scarcity has implications for society, economy and health. Rain-fed and irrigated agriculture face risks, consequently impacting food security for the population. In addition, a significant portion of operational expenses in the water sector is the cost of electricity, a resource that creates high dependency on external agencies.

Even though water scarcity is a significant threat to resource security and economic development, little progress has been made to significantly improve Jordan's position as one of the most water-scarce countries globally.

Figure 5. Analysis of water sector vulnerability to climate change



Source: Jordan, Ministry of Environment, 2023:298.

A summary of water demand, supply (including national desalination) and deficit is shown in the Table 3.

Table 3. Water demand, supply and deficit by sector, present and future projections

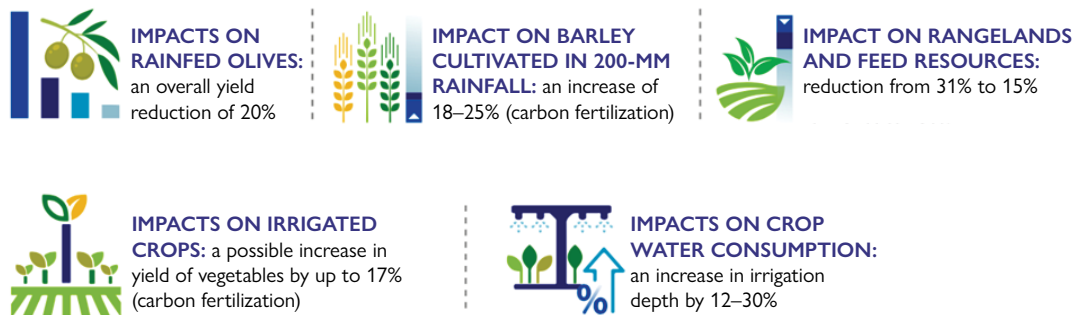
Water demand (MCM)	Present	2050	2070	2100
1. Domestic	470	924	1 261	1 811
2. Irrigated agriculture	658	1 072	1 097	1 201
3. Industrial	32	83	104	125
4. Pastoral	7	15	21	30
Total demand	1 167	2 094	2 483	3 167
Total supply	1 051	1 490	1 558	1 625
Balance	-116	-604	-925	-1 542
Balance (Considering network losses)	-265	-835	-1 240	-1 995

3.1.2. Agriculture and food security

Agriculture is one of the most climate-sensitive economic sectors of Jordan, as production is highly dependent on climate. According to the Central Bank of Jordan's 2022 annual report, the agricultural sector contributes significantly to GDP, accounting for about 5.3 per cent (Jordan, Central Bank of, 2023). Jordan's agricultural sector is particularly fragile and significantly vulnerable to climate change, with most of the rural population depending directly or indirectly on agriculture for their livelihoods. Key climate-related hazards affecting the sector include rising temperatures, decreasing rainfall, shifts in seasonal patterns, heatwaves and extreme events such as heavy rainfall, floods and droughts. These risks can lead to reduced productivity of rain-fed and irrigated crops, livestock and beekeeping, as well as a decline in land fertility and availability for agriculture and cattle-rearing.

The impacts of climate change on agriculture are unevenly distributed, disproportionately affecting the rural poor due to their heavy reliance on agriculture, lower adaptive capacity and higher percentage of income spent on food (Jordan, Ministry of Environment, 2023). As a result, climate change can undermine poverty reduction efforts and negatively impact economic growth in vulnerable rural areas. It can also affect food security by reducing the quality, quantity and accessibility of food resources.

Figure 6. Analysis of agricultural sector vulnerability to climate change



Source: Jordan, Ministry of Environment, 2023:41.

The expected 20-per-cent yield reduction in rain-fed olives, a culturally and economically important crop in Jordan, offers a significant example. Over 80,000 families are involved in olive cultivation and are already experiencing reduced yields due to changing rainfall patterns (Ghazal, 2023). Jordan's Olive Producers and Exporters Association identifies delayed rainy seasons and severe frost as significant climate-related challenges to the olive industry.

Climate change is also projected to reduce rangeland and feed resources by 15 to 31 per cent, adversely affecting cattle and livestock value chains. The Ministry of Agriculture's National Food Security Strategy emphasizes strengthening "climate resilience" as a key objective, acknowledging that climate change impacts all components of food security and food systems in Jordan. The strategy identifies small and subsistence farmers relying on rain-fed agriculture and livestock as particularly vulnerable, with Tafilah highlighted as the most food-insecure governorate. Alarming, 53 per cent of Jordanians (approximately 3.9 million people) are vulnerable to food insecurity due to climate change.

3.1.3. Health

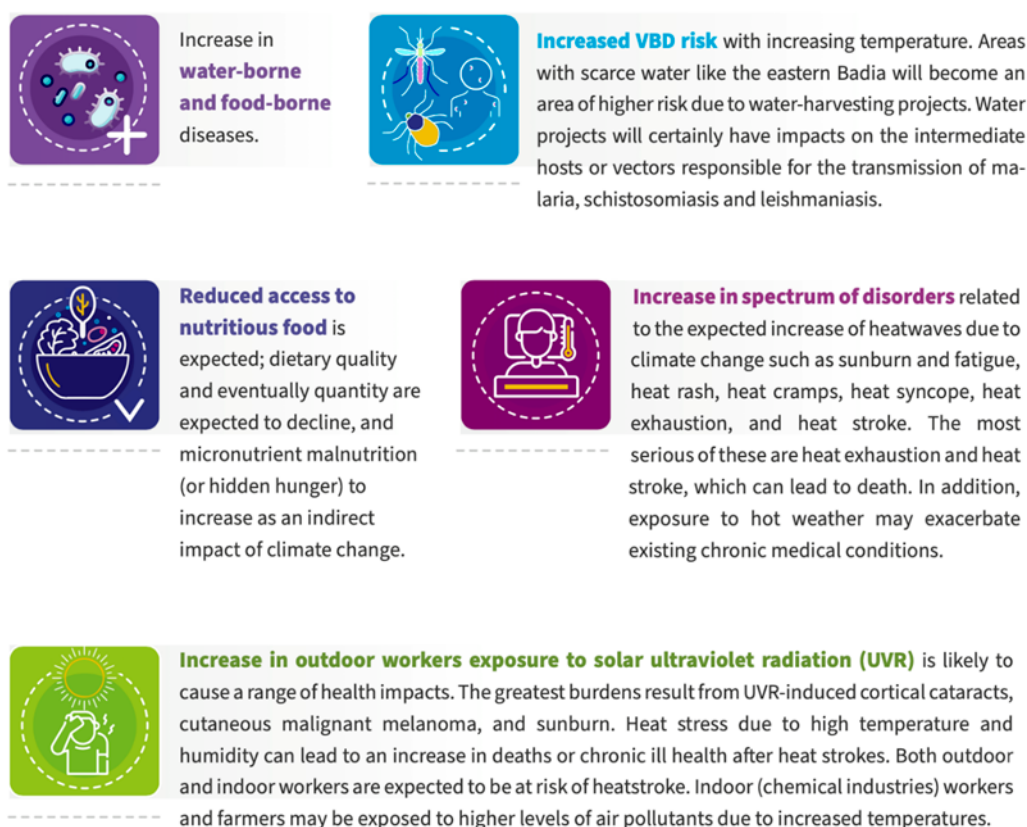
Climate change poses significant health risks in Jordan, impacting various population segments, including farmers, consumers, children and vulnerable groups. The climate change vulnerability assessment in the Fourth National Communication indicates that climate risks such as droughts, dust storms and sandstorms, flooding, shifts in the rainy season, increasing humidity, decreasing precipitation, and rising temperatures have direct and indirect linkages with health risks across the country (Jordan, Ministry of Environment, 2023). The impacts identified in the water and agricultural sectors are also expected to interact with potential impacts on health.

Increasing temperatures lead to a rise in water-, food- and vector-borne diseases, especially in areas with water scarcity, such as the arid and semi-arid Eastern Badia region. These conditions are expected to worsen in regions where water harvesting projects will be established.

Water scarcity also reduces access to nutritious food, contributing to malnutrition and related health problems. These challenges are further amplified due to direct vulnerabilities from increased incidence of heat stroke, fatigue and exposure to harmful solar ultraviolet radiation.

Refugees living in camps face heightened risks: rising temperatures inside caravans made of zinc boards lead to asthma and lung diseases, and power outages result in food poisoning due to non-functional refrigerators (El-Sharif and Muasher, 2024). Those with pre-existing health conditions, such as diabetic patients whose medications require refrigeration, find it harder to cope. Climate change exacerbates these health challenges and necessitates investments in climate-resilient water, energy, food and health systems.

Figure 7. The most visible impacts of climate change on health



Source: Jordan, Ministry of Environment, 2023:49.

The presence of refugees compounds the strain on Jordan's infrastructure. In his address to the United Nations General Assembly, King Abdullah II emphasized that Jordan's capacity to deliver necessary services to refugees has exceeded its limits (Abdullah II, 2023). This concern led to the announcement of the Climate-Refugee Nexus initiative at the Twenty-seventh Conference of the Parties (COP27). This initiative focuses on the vulnerability of natural resources and national infrastructure in countries facing the dual pressures of climate change and hosting significant refugee populations. It aims to attract attention and financing to Jordan to mitigate the impacts of climate change and refugee influx.

3.1.4. Water–energy–food security nexus

The interconnection of water, energy and food security is a critical issue in Jordan, a nation grappling with high energy consumption, water scarcity and limited food resources (Jordan, Government of, 2023). Climate change further exacerbates Jordan's economic and environmental vulnerabilities. The country's reliance on imported energy, rising energy demand, volatile oil prices and challenges with securing energy supplies highlight its security concerns. Addressing these challenges is necessary for enhancing energy security and minimizing exposure to external supply shocks while ensuring fiscal and macroeconomic stability.

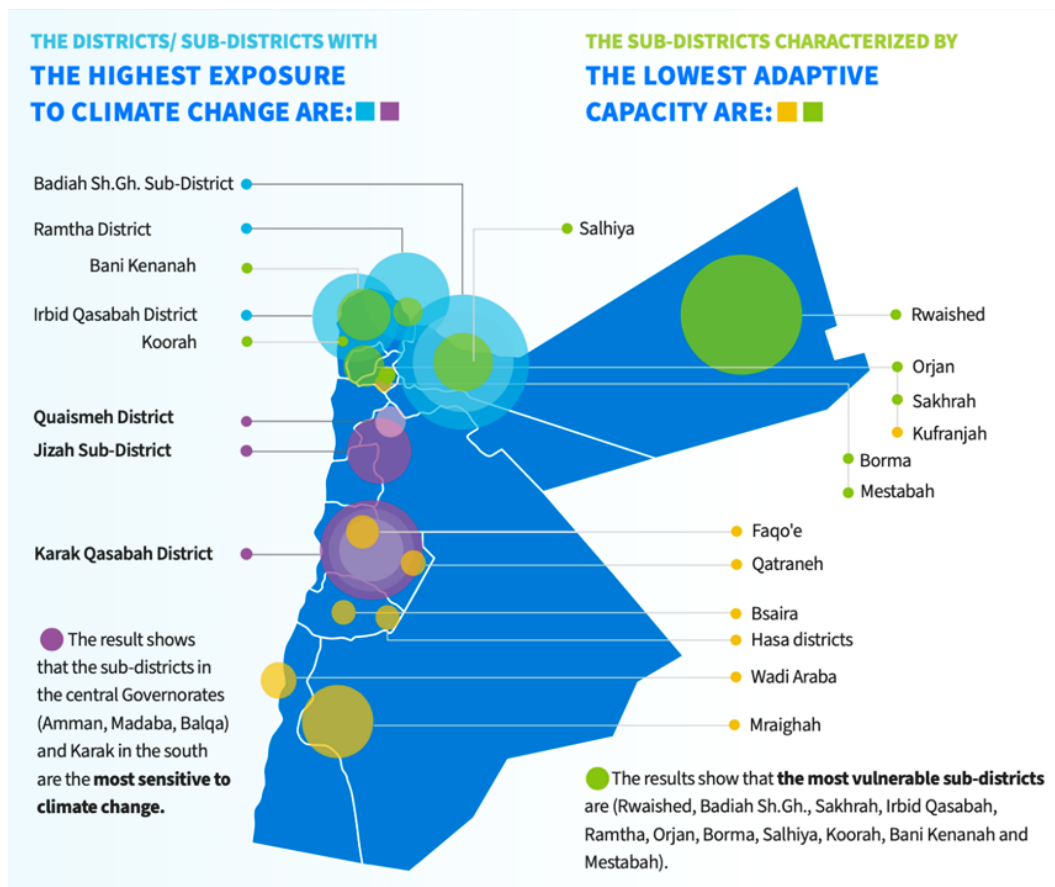
To tackle energy security challenges, Jordan is engaging in discussions with neighbouring countries to secure reliable energy supplies. The Government also focuses on optimizing national energy resources, such as oil shale and natural gas from the Risha field, promoting renewable energy programmes, expanding oil storage capacity, rehabilitating infrastructure and liberalizing the domestic oil market.

Water security has been established as a pressing issue in the previous sections. This is highly intertwined with energy, as water forms a most significant portion of Jordan's energy costs. Food security in Jordan goes beyond domestic agricultural production, encompassing material and economic access to safe and nutritious food for all people. This multidimensional sector requires collaboration among various institutions and stakeholders to address related issues, such as food access, governance, stability and sustainability.

3.1.5. Economic development

Jordan's development trajectory has been significantly influenced by external shocks over the past 15 years, shaping its path to economic recovery. The 2008 global financial crisis and regional conflicts since 2011 have disrupted trade routes (World Bank, 2022). Jordan also faces a debt ratio of 114 per cent of its GDP (El-Sharif and Muasher, 2024). The complex social structure includes half a million registered Iraqi refugees and 1.6 million Syrian refugees who have settled in cities and border camps (Jordan, Ministry of Environment, 2023). This, combined with domestic population growth, has contributed to a doubling of the population from 5 million to 11 million in two decades, placing immense pressure on service delivery and Jordan's scarce natural resources, particularly water and land. As of 2022, the national poverty rate was 24.1 per cent, according to DOS, up from 15.7 per cent in 2018 (World Bank, 2022; Bertelsmann Stiftung, 2024). The COVID-19 pandemic, the war in Ukraine, the war in Gaza and Jordan's geopolitical location further contribute to its economic uncertainty.

Figure 8. Subdistricts in Jordan with the lowest adaptive capacities



Source: Jordan, Ministry of Environment, 2023:47.

Urbanization in Jordan has increased significantly, with the urban population rising from 59.9 per cent in 1980 to 78.5 per cent in 2010. With 4 million inhabitants, Amman accounts for 42 per cent of the country's total population, followed by Irbid (1.77 million) and Zarqa (1.36 million) (Jordan, Ministry of Environment, 2023). Jordan's unprecedented population growth, driven by the influx of refugees and migrants due to regional conflicts and migrant labour influxes, has increased the demand for housing. Between 2000 and 2021, the number of housing units grew by 102,676 annually, exceeding the increase in households (91,975 annually). This growth is concentrated in Amman, Irbid and Zarqa, where, collectively, 61 per cent of Jordan's buildings were located as of 2015. As of 2021, the unemployment rate reached 24.8 per cent: 22.7 per cent for males and 33.1 per cent for females. By October 2021, Jordan's population reached 11.03 million, with most living in urban areas and only 9.7 per cent in rural areas.

Climate change compounds an already dire economic situation, impacting key sectors of the economy, particularly water, agriculture, food and health. It also influences low-carbon policies in energy and transport and affects economic considerations related to trade, water and energy tariffs, unemployment, and the financial services sector.

In response to these challenges, Jordan developed its **Economic Modernisation Vision** in 2022. This ambitious plan aims to create 1 million jobs and attract USD 41 billion in investments by 2033 (Jordan, Government of, 2024). Jordan was one of the first countries in the region to develop a national adaptation plan and has updated its Nationally Determined Contributions to address climate change and promote economic resilience. Additionally, the **National Resilience Plan** was drafted in March 2014 by the Government of Jordan, in cooperation with the United Nations Country Team, other donors and NGOs to address the fiscal burden resulting from the Syrian crisis. The plan includes a request for USD 4.3 billion to support priority projects in the education, health, energy, municipalities, water, housing and security sectors.

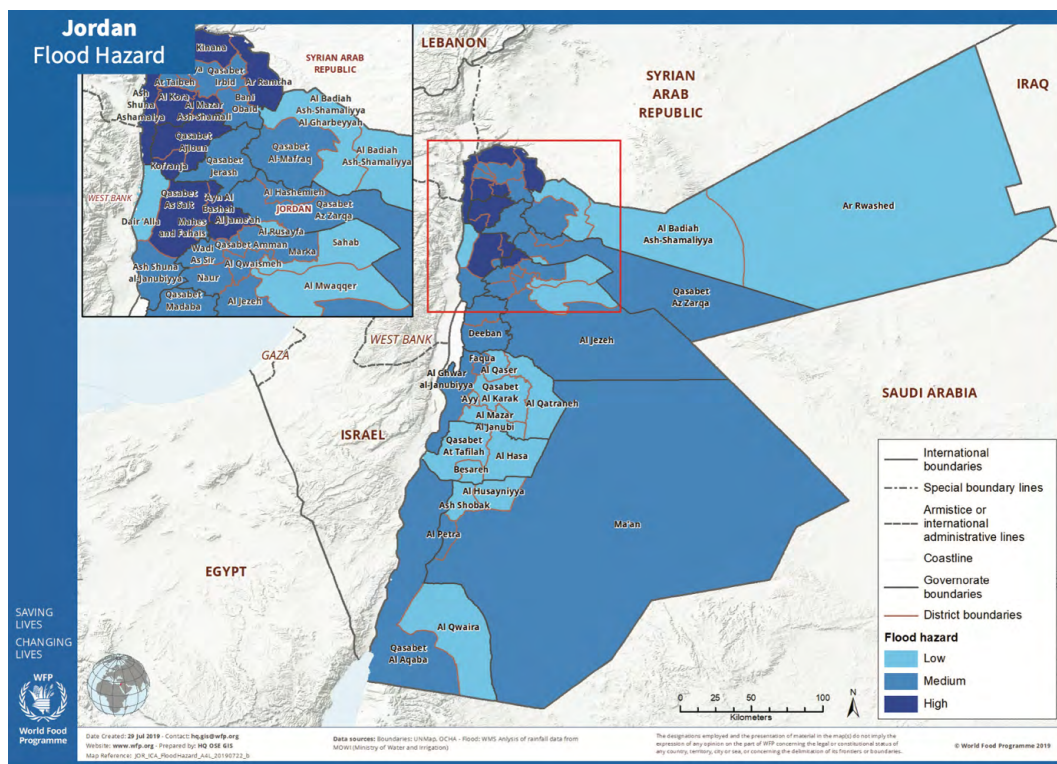
3.2. HAZARDS AND DISASTER RISKS

Droughts, extreme temperatures and floods are some natural hazards facing Jordan and its more than 11 million citizens. Climate change has raised the spectre that such hazards will become even more commonplace in the decades to come. Jordan is affected by various risks, particularly climate change-induced hazards, such as flash floods, landslides and droughts, which are becoming more frequent. These cause loss of life and property and cost millions of economic damages each year in different regions.

3.2.1. Flash floods

Flash floods are one of Jordan's most frequent natural hazards, causing significant human and economic losses. The Ma'an flood of 1966 is considered one of the most severe disasters in Jordan's recent history, resulting in 266 deaths and substantial material damage. Recent studies indicate that flash floods are among Jordan's most prevalent hazards, affecting large areas of its populated regions. Over the past few years, flash floods have been recorded nationwide, leading to multiple casualties and extensive property damage in Zarqa, Ma'in, Petra, Central Amman and Mafraq Governorates (Jordan, Government of, 2023). The map in Figure 9 illustrates that flash flood risk ranges from moderate to high in most populated areas of the country.

Figure 9. Flood hazard map of Jordan



Source: Adapted from World Food Programme (2019:7), with map borders and relief based on JRC (2016); flood hazard classification based on Watershed Modelling System analysis of rainfall data from the Ministry of Water and Irrigation of Jordan.

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

3.2.2. Drought

Over the past two decades, Jordan has experienced reduced and variable rainfall, exacerbating the pressure on available water resources, affecting their distribution and increasing the cost to the Government and citizens. Two significant drought events occurred in 2001 and 2009, which increased drought extent and intensity throughout the year, amplifying their national impact. Also, late-onset spring droughts occurred in 2008, 2011 and 2021, with severe localized impacts, particularly on farming systems, which integrate cropping and livestock. In 2002 and 2012, drought conditions were mostly confined to the Badia region, while the 2014 “flash” drought had a rapid onset and subsidence and mainly affected the western highlands (Fragaszy et al., 2022).

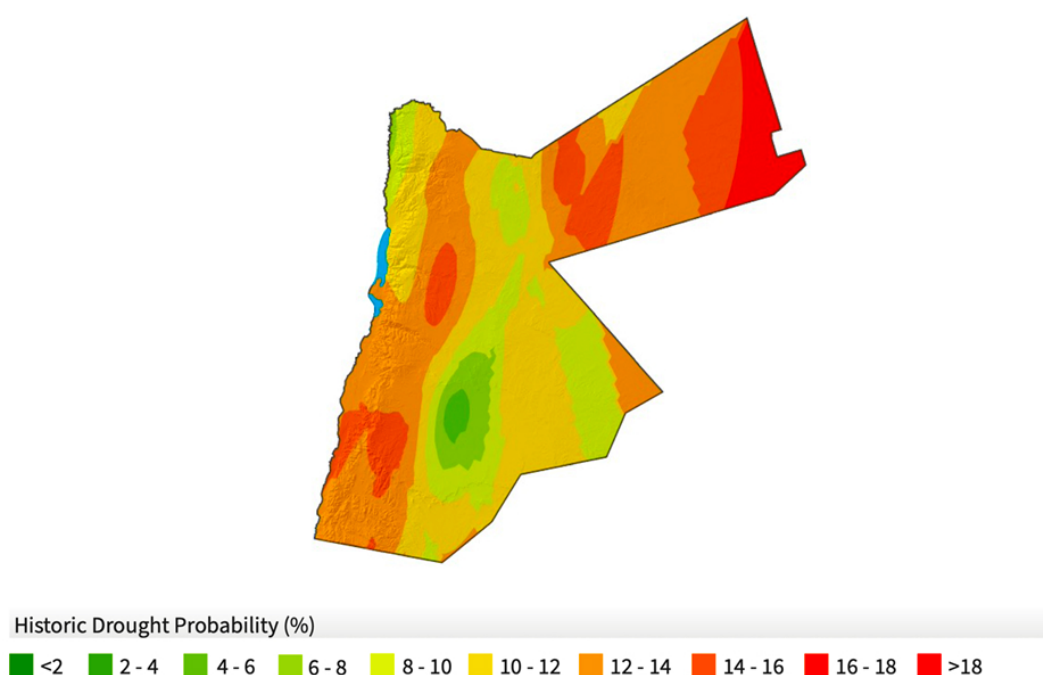
The Rift Valley mountain chain, extending from south to north along Jordan’s western border, faces a high drought hazard. Similarly, Karak and Balqa Governorates and parts of Zarqa, Jerash and Ma’an are highly susceptible to drought. In contrast, the eastern area of the northern highlands in Irbid, Ajloun and Jerash and parts of Amman, Zarqa, Mafraq and Tafileh Governorates have a lower drought hazard risk. Jordan’s primary surface water basins – the Jordan Valley, Yarmouk and Amman-Zarqa – are heavily modified and intensively farmed, weakening the relationship between drought and surface water flows (ibid.). Drought impacts on groundwater are severe; multi-year droughts can cause spring discharge to take

years to recover, if at all. Droughts have also reduced surface water drainage and flow in valleys near the Jordan Valley and decreased water storage in dams to less than half the normal rate over the past 20 years.

Data from the Meteorological Department and global and local studies indicate negative changes in temperature and rainfall in Jordan, with a potential increase in drought frequency and severity. Over the past 40 years, successive drought waves have occurred at least three times, with expectations of increasing frequency every 20–25 years. Moderate drought waves are expected every 3–4 years, while severe or extreme drought waves occur once every 6–7 years. Drought severity and frequency are anticipated to increase, with moderate droughts transforming into severe droughts. Past droughts have negatively impacted Jordan's water sector, causing springs to dry up, reduced surface water drainage and declining groundwater levels at a rate of approximately 1 metre per year over the last three decades. With more frequent droughts and negative climate change impacts, water availability in Jordan is projected to decline by 15–20 per cent (Jordan, Government of, 2023).

The agricultural impacts are most pronounced on rain-fed systems, including cereal-based systems and staple crops critical for food security, such as chickpeas, lentils and olives, as well as crop-livestock integrators and rangelands pastoralism. Historically, drought has severely impacted livestock, though introducing feed subsidies has significantly improved the sector's coping capacity. However, the benefits are unevenly distributed, with smallholders still facing severe impacts during droughts. Additionally, water shortages and the use of low-quality water can adversely affect public health services. This underscores the importance of assessing distributional impacts within each sector and subsector rather than relying solely on macro-level indicators.

Figure 10. Historical Standardized Precipitation Index (SPI), estimated by number of drought events



Source: Jordan, Ministry of Environment, 2023:277.

3.2.3. Seismic hazards

The Jordanian Transform Fault, stretching from the Gulf of Aqaba in the south to northern Syrian Arab Republic, on the Turkish border, and comprising key areas like the Gulf of Aqaba, Wadi Araba and the Jordan Valley, is the primary source of seismic risk in Jordan. Based on the tectonic nature of the fault and historical data, seismic activity in Jordan is considered moderate compared to other regions globally. Most of Jordan's cities and populated areas, where over 90 per cent of the population resides, are located within close proximity to this main source of seismic activity. Considering these, seismic hazards can cause catastrophic impacts if an earthquake's exceeds magnitude 6 on the Richter scale. The Nablus earthquake of 1927 was the most recent devastating seismic event in Jordan.

3.2.4. Locusts

The locust threat is one of the most significant dangers to the agricultural and related sectors due to its direct impact on the environment and food security and its potential to increase poverty and unemployment. Managing the locust hazard in Jordan requires close cooperation and a high level of coordination with neighbouring countries that serve as pathways for locust swarms, which can pose significant threats to crops, trees and vegetation. The Ministry of Agriculture actively monitors this hazard, especially when environmental and climatic conditions favourable for the locust reproduction exist in source countries.

3.3. HUMAN MOBILITY IN JORDAN AND ITS INTERACTION WITH CLIMATE CHANGE

Jordan's population nearly doubled from 6.3 million in 2008 to 11.5 million in 2023 due to a significant influx of refugees, leading to a growing demand for its limited resources (DOS, 2008 and 2023a). Officially, approximately 3 million refugees are registered with the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) and the Office of the United Nations High Commissioner for Refugees (UNHCR), along with an additional 600,000 unregistered Syrians residing in Jordan (Jordan, Government of, 2023). According to the Thomson Reuters News Foundation, the number of Syrian refugees in Jordan now exceeds 1.5 million, accounting for over 10 per cent of the population (Bankova, 2024). These large numbers have increased pressure on Jordan's limited water resources, led to increased food imports, impacted the livelihoods of host communities and severely strained infrastructure and related sectors. Jordan's geographical location shapes its political, economic and social dynamics. Due to its proximity to the Occupied Palestinian Territory, the Syrian Arab Republic and Iraq, which are significantly affected by crises and insecurity, and other unstable regions, Jordan is consistently affected by the situations in these areas (ibid.). As a relatively small country with limited resources, Jordan's economy, trade and social ties are closely linked to those of its neighbouring nations.

Meanwhile, refugee camps are ill equipped to withstand the impacts of climate change, as water supply is intermittent, and many must walk to get their water. There is a lack of awareness of water conservation, and the camps are unprepared for heavy rains or flooding. Rising temperatures also cause frequent power outages and impact necessary electrification

for food, medical supplies and online learning, further exacerbating the vulnerabilities of those living in the camps, as they cannot access essential services for health and education (El-Sharif and Muasher, 2024).

Jordan incurs high direct and indirect costs to provide services to refugees, the maintenance of which has become challenging with declining assistance and grants through United Nations organizations and international donors. Direct costs include humanitarian aid and relief in refugee camps, field hospitals, medical treatment and food aid. Indirect costs encompass development plans to enhance service facilities to manage the crisis, such as water and electricity projects, sewage networks and other necessary infrastructure and services. In response, Jordan launched the global Climate–Refugee Nexus Initiative at the UNFCCC COP27 to garner international support, assistance and funding for countries like Jordan that are dealing with climate change and significant refugee populations (Abdullah II, 2023).

3.4. INSTITUTIONAL, POLICY AND GOVERNANCE LANDSCAPE

Jordan has developed a comprehensive governance system to address climate change, disasters and migration by linking multiple government organizations and implementing environmental policies through the **Ministry of Environment**, established in 2003. The ministry aims to enhance Jordan's environment, conserve natural resources and promote sustainable development through effective policies and strategies. Its **Directorate of Climate Change**, established in 2014, coordinates all climate-related activities in Jordan and supports the nation's commitments to the UNFCCC (Jordan, Ministry of Environment, 2023).

Jordan has made substantial progress in documenting national greenhouse gas emissions and preparing National Communications on Climate Change to the UNFCCC. With the support of the Global Environment Facility (GEF), Jordan submitted four National Communications in 1998, 2009, 2014 and 2022 and biennial update reports in 2017 and 2021. Jordan is proactive in updating its climate commitments, issuing its Fourth National Communication and updating its NDCs. In addition, Jordan developed its National Disaster Risk Reduction Strategy, first for the period 2019–2022, with an update for 2023–2030; a National Food Security Strategy (2021–2030); the Jordan Climate-Smart Agriculture Action Plan; the National Adaptation Plan, the Jordan Long-Term, Low-carbon and Climate-Resilient Strategy; and the Jordan Response Plan, and launched the Climate–Refugee Nexus Initiative at the UNFCCC COP27. These reflect the significant progress made at the regulatory, policy and project levels.

The first **National Climate Change Policy** (i.e. for 2013–2020) outlined Jordan's priorities for adaptation and mitigation, while the updated Climate Change Policy (2022–2050) provides strategic orientations for developing a low-carbon, climate-resilient society. In 2021, the Ministry of Environment launched the National Climate Change Adaptation Plan, outlining a clear vision for climate adaptation to guide government institutions, academia, community-based organizations, and private sector entities in implementing adaptation initiatives.

In 2019, **Climate Change By-law No. 79** established a regulatory framework for climate-related actions, creating the National Climate Change Committee (NCCC), chaired by the Ministry of Environment. The NCCC includes 16 secretaries-general from various ministries, oversees climate change coordination and reports to the UNFCCC. Jordan's Ministry of Environment is responsible for establishing a Measurement, Reporting and Verification Registry System and coordinating the development of a National Climate Finance Plan.

Jordan enhanced its greenhouse gas emission reduction target from 14 to 31 per cent by 2030, with 5 per cent being unconditional and 26 per cent conditional on international support. Despite contributing only 0.06 per cent of global emissions, Jordan seeks to attract climate financing and investments to support its mitigation and adaptation efforts. The country achieved 27-per-cent renewable energy in its electricity mix by 2022 and is on track to meeting its 31-per-cent target by 2030 (Jordan, Ministry of Energy and Mineral Resources, 2024). The country is also a regional leader in adopting hybrid and electric vehicles, which comprise 18.5 per cent of the total fleet (*The Jordan Times*, 2024).

The Economic Modernization Vision (EMV) for Jordan targets creating 1 million jobs and generating USD 41 billion in investments by 2033. This plan aligns with the country's climate goals and seeks to address the challenges of climate change, disasters and migration. The EMV, NDCs, Climate Investment Mobilization Plan and Green Growth National Action Plans (GG-NAPs) emphasize public-private partnerships and investment opportunities. However, adaptation remains a priority, as climate change poses significant threats to Jordan's water, agriculture, food and health sectors.

Despite these efforts, Jordan's governance framework for climate change still requires strengthening. The Ministry of Environment should lead climate policy and action while building capacities at the municipal level, particularly in the Aqaba Special Economic Zone Authority and the Petra Development and Tourism Regional Authority. There is a need to streamline existing laws, policies and strategies and develop a regulatory framework that supports sustainable governance. Jordan must prioritize local and municipal development plans to address climate and migration risks. This includes empowering municipalities to develop local climate action plans, such as the Sustainable Energy and Climate Action Plans (SECAPs) implemented by Irbid and Karak municipalities. Jordan can strengthen its governance framework and achieve long-term sustainable development by aligning executive and legislative priorities and enhancing national capabilities to attract climate financing.

4. DATA ANALYSIS

4.1. SECONDARY DATA COLLECTION

Climate variables are essential for conducting a thorough analysis of the environmental context. Table 4 summarizes the essential climate variables and their data sources and types (including in terms of format).

Table 4. Data sources for the study

Climate variable	Source of data	Type and format of data	Year
Monthly mean air temperature (°C)	Previous studies	Table	1993–2020
Total monthly rainfall (mm)	Previous Studies	Table	1993–2020
Population data (Jordanian and non-Jordanian)	DOS	Census (table)	2015
Employment data	DOS	Census (table)	2017–2022
Crop yield (by governorate)	DOS	Census (table)	1995–2022
Livestock mortality for sheep, goats and cattle	DOS	Census (table)	1995–2022
Number of employees engaged in livestock activity aged 16 years and above, by type of livestock holdings, specific activity, type/term of employment, nationality and sex	DOS	Census (table)	2010–2022
Quantity and usage of groundwater for distant regions and livestock farming, by water basin (for industry, agriculture, municipal and tourism)	DOS Ministry of Water and Irrigation	Table	1995–2022
Water supply, by governorate	DOS Ministry of Water and Irrigation	Table	1997–2022
Water supply per capita, by governorate	DOS Ministry of Water and Irrigation	Table	1997–2022
Environmental diseases	DOS	Table	1990–2022

4.1.1. Natural hazards

Natural hazards must be understood to determine risk and vulnerability. Table 5 lists natural hazard data sources and types.

Table 5. Sources and types of data on natural hazards

Natural hazard	Source of data	Type of data	Year
Floods	National Centre for Sustainable Coastal Management (NCSCM) International sources	Frequency (table)	1993–2023
Droughts	International sources	Frequency (table)	1993–2021
Heatwaves	International sources	Frequency (table)	1993–2021
Earthquakes	International sources	Frequency (table)	1993–2021
Frost, rain and landslides	International sources	Frequency (table)	1993–2021

4.1.2. Migration data

Migration patterns are critical for understanding population movement dynamics. Table 6 lists the migration data sources and types.

Table 6. Sources and types of data on migration

Migration data	Source of data	Type of data	Year(s)
Migration data disaggregated by urban and rural residence, by governorate	DOS	Census	2015
Migration data by governorate	DOS	Census	1994 and 2004

4.2. STATISTICAL DATA ANALYSIS

4.2.1. Temperature and rainfall data

The data analysis is based on the review of the main climate variables. There are five meteorological stations in the study areas: Irbid, Ramtha, Ras Muneef, Rweished and Safawi. The findings are based on the temporal trends in temperature and precipitation patterns using data from meteorological stations and other statistical sources. Such trends will be depicted in graphical form using charts and graphs. In this sense, the present descriptive analysis offers the first hint towards understanding the dominant climatic conditions over the chosen period, which, in turn, would allow insights into possible environmental stresses affecting human mobility.

Temperature trends are essential for farmers to make appropriate and informed choices in crop selection, irrigation timing and pest control. Both hot and cold conditions can be harmful to crop productivity. Generally, the temperature rises in the summer (June to August), leading to increased use of water resources. Water resource management authorities could use these data to forecast evaporation rates and employ water conservation strategies for sustainable water use.

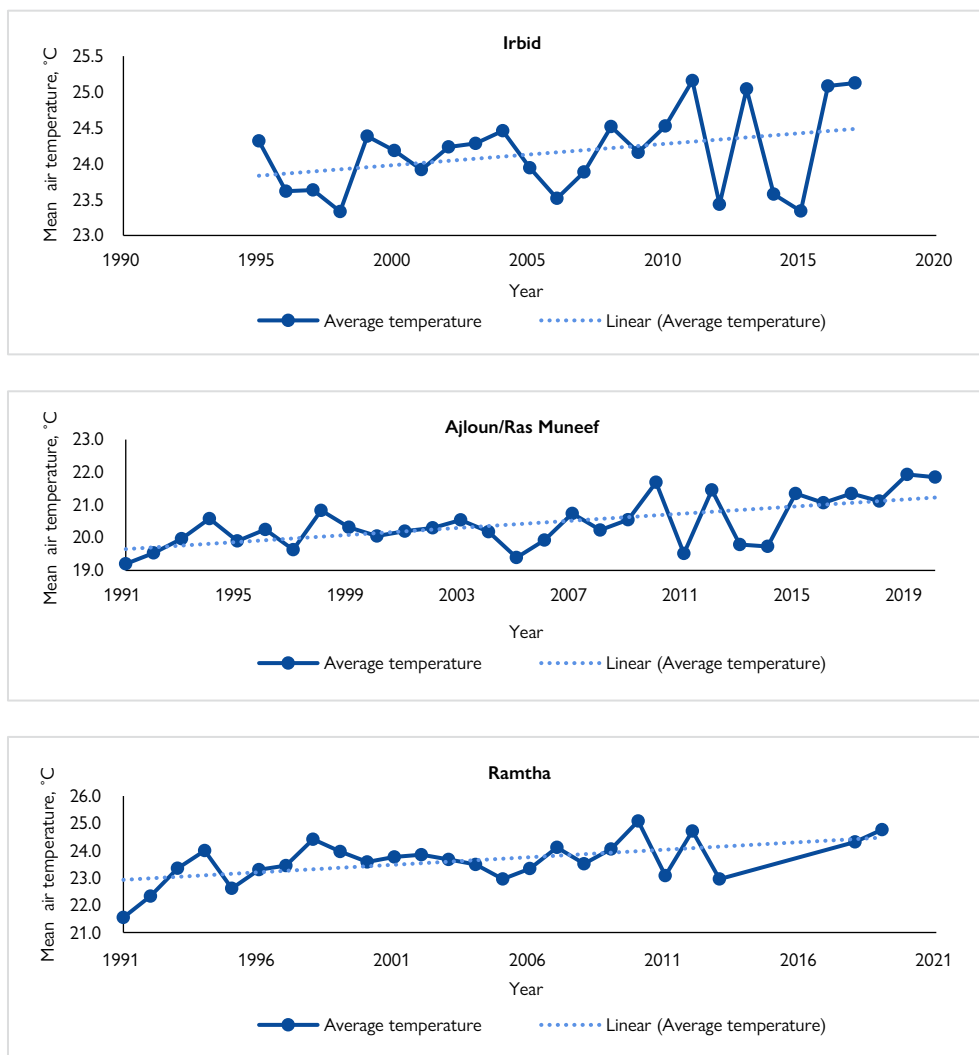
The emphasis for this analysis was on the months from May to October, as they provide a vivid picture of temperature patterns for these months in making various necessary climate adaptations for people, communities and businesses, such as choosing correct cooling systems and regulated work hours, as well as preparations for high temperatures. The period from May to October also represents an important part of the agricultural growing season.

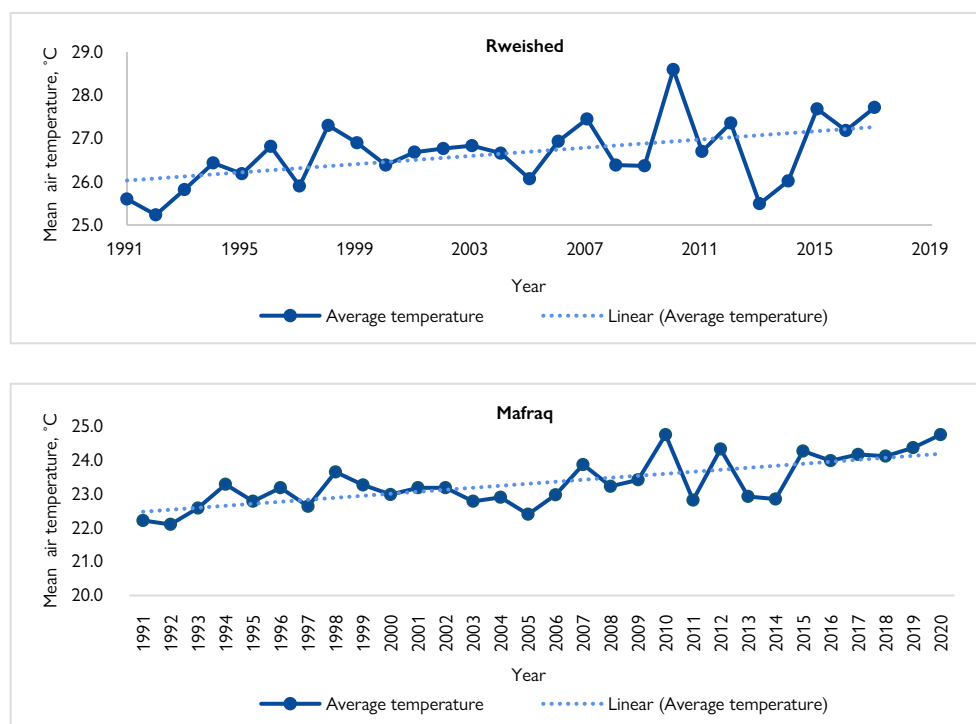
Temperature patterns. During the past few decades, Jordan has experienced a significant shift in temperature patterns. In addition, heatwaves are becoming increasingly prevalent, and the observed warm conditions are resulting in prolonged summers, which forms a more extended period of dry seasons, affecting the availability of water resources and ecosystems as a whole. This trend is very marked and is a sign of the driving forces behind global climate change, among which are emissions of greenhouse gases and urbanization.

Rainfall patterns. Data on rainfall is essential in determining the effects of climate change on agriculture or its impact on water supply and ecosystems. The data shows a tendency to reduce rainfall in some areas, which provokes long-term droughts and water scarcity. This decline in precipitation poses enormous challenges and exacerbates fragility in these regions.

The inputs required to depict the context of climate change in Jordan include maximum and minimum interaction temperature and rainfall data. Further increases in temperature lead to higher evaporation rates and add to a more complex scenario for water scarcity. Any change in rainfall, such as a reduction in its amount, with a shift in distribution, will lead to water availability changes and affect agricultural yield. These two issues potentially undermined the financial stability of Jordan, as they also increased risks to society of desertification, fragile ecosystems and many more due to an increase in the frequency of extreme weather events. Figure 11 shows historical rainfall data from 1991 to 2020 from the weather stations that cover the study areas.

Figure 11. Average May–October mean temperatures in the areas under study, selected years



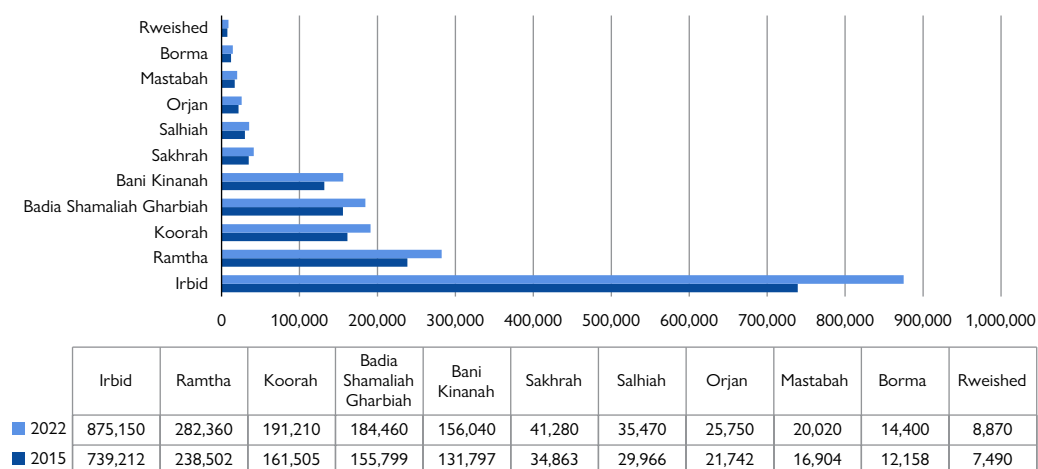


Source: Previously unpublished data from the Jordan Meteorological Department.

4.2.2. Population and demographics

Figure 12 shows the 2015 census population and migration data for designated subdistricts in Irbid, Ajloun, Jerash and Mafrq Governorates. They provide valuable insights into the country's demography, showing an increase in population size from 2015 to 2022 (comparing 2015 census figures with 2022 projections based on those census figures). Table 7 shows the percentages of non-Jordanians in the designated subdistricts.

Figure 12. Population by subdistrict, 2015 (enumerated) and 2022 (estimated)



Source: DOS, 2015 and 2023a.

Table 7. Percentages of Jordanians and non-Jordanians in the designated subdistricts, 2015

Subdistricts	Non-Jordanian	Jordanian	Percentage of non-Jordanian (%)
Irbid	234 481	504 731	31.7
Badia Shamaliyah Gharbiyah	127 589	28 210	81.9
Ramtha	77 903	160 599	32.7
Koorah	21 576	139 929	13.4
Bani Kinanah	19 062	112 735	14.5
Sakhray	6 671	28 192	19.1
Salhiya	4 910	25 056	16.4
Rweished	1 981	5 509	26.4
Orjan	1 438	20 304	6.6
Mestabah	794	16 110	4.7
Borma	490	11 668	4.0

Source: DOS, 2015.

4.2.3. Employment in the four governorates

The interaction between climate change, socioeconomic challenges and their impact on human mobility is an important and complex subject. This study assessed the potential impact of these socioeconomic factors on human mobility, where climate change is considered a detrimental factor disrupting livelihoods.

The set of graphs in Figure 13 shows the trends of unemployed Jordanian men and women in the four governorates covering the study areas (Irbid, Ajloun, Mafraq and Jerash) from 2017 to 2022.

Figure 13. Unemployment trends in the four governorates covering the study areas, 2017–2022



Source: DOS, 2023a.

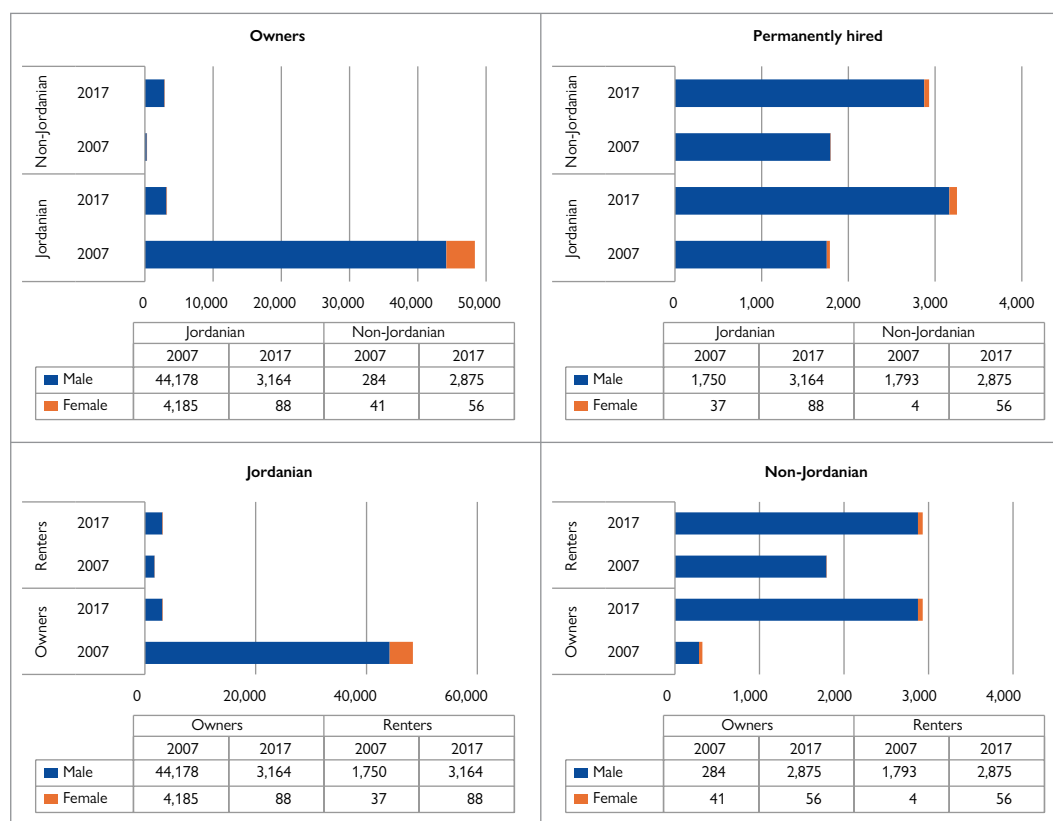
Comparing 2017 and 2022, the governorates have generally seen higher rates of unemployment across both genders and marital status. Taking the gender and marital status lenses into consideration, Irbid has the highest unemployment rate of the four governorates. In 2022, Irbid had 18,144 unemployed never-married women, compared to 3,438 in Mafrq, 2,169 in Jerash and 2,036 in Ajloun. Unemployed ever-married women were most concentrated also in Irbid (8,902), followed by Ajloun (2,085), Jerash (1,646), and Mafrq (2,471). These figures demonstrate that Irbid has more female unemployment than the other three governorates.

4.2.4. Employment in livestock and agriculture, by district

As indicated previously, human mobility and socioeconomic dynamics are interconnected, and climate change adds further complexity to their interlinkages, as it could be one of the main factors affecting migration and displacement. Agriculture is the main sector affected by climate change, which is considered a key contributor to GDP (accounting for 5.3%) and supports national economic stability and food security. Figure 14 show the gender distribution of family owners and permanent hired labour in agriculture and livestock farms.

Figure 14 compares the total number of labourers from landholders' own families and the total number of hired permanent labourers in agriculture, including livestock farming, disaggregated by nationality (Jordanian and non-Jordanian) and sex, in the study area between 2007 and 2017.

Figure 14. Jordanians and non-Jordanians working on their own farms and as permanently hired employees, 2007 and 2017



Source: DOS, 2008 and 2018.

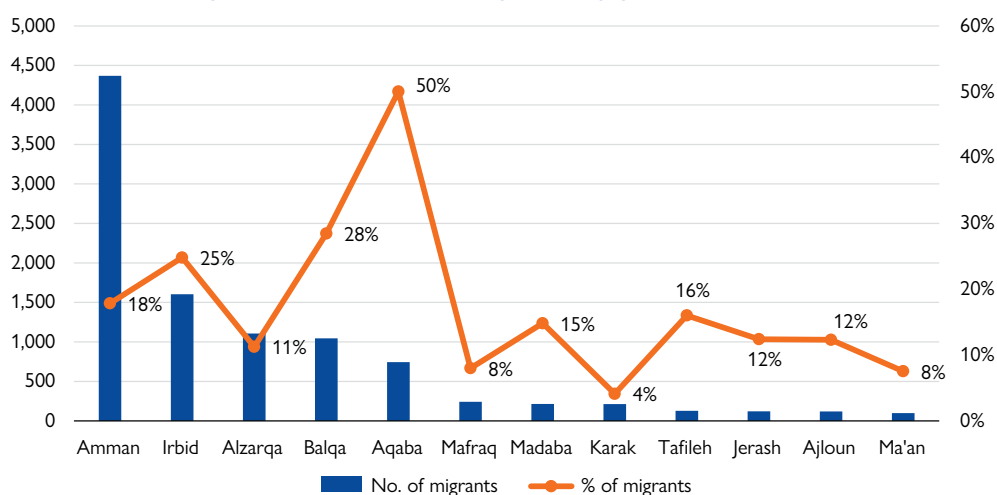
Between 2007 and 2017, both crop and livestock farming in Jordan's agricultural sector experienced remarkable changes. Previously dominated by Jordanian families, this sector has shifted to a model where non-Jordanian families own more farms and contribute more labour. For example, the number of Jordanian males working on their farms dropped from 44,178 to only 3,164. At the same time, many Jordanians transitioned to being permanently hired workers on farms they did not own. There was also an increase in farms operated by non-Jordanian families, which affected local employment.

The migration trends of both lifetime and current migrants underscore this shift; people consistently left regions like Irbid, Ajloun and Jerash, searching for better job opportunities. This transformation in the agricultural workforce highlights the urgent need for policies to promote sustainable rural economies and address the economic factors causing migration, while also considering the different effects on men and women.

4.2.5. Displacement and forced migration in rural Jordan

Prolonged droughts and land degradation may force households in rural areas to migrate to better locations within and outside the country to find new jobs and income stability. The findings show that Amman and Irbid have seen 4,369 and 1,604 new arrivals, respectively, from rural areas. This rural-to-urban migration trend could be induced by droughts, land degradation and inadequate adaptation strategies, demonstrating the desire to establish more sustainable and resilient lifestyles.

Figure 15. Rural-to-urban migration, by governorate, 2023



Source: DOS, 2023a.

4.2.6. Crop and livestock production

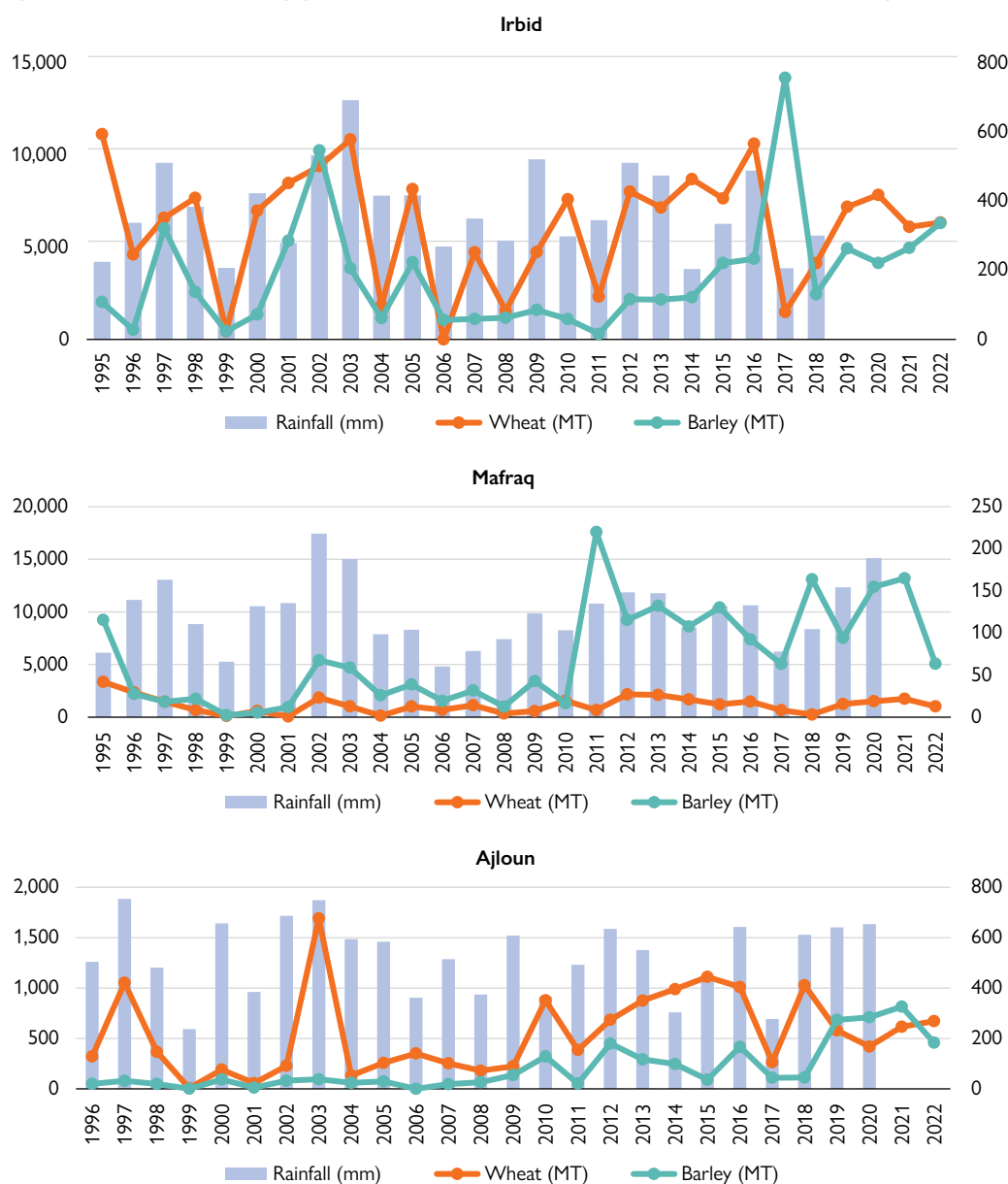
Crop yield by governorate

This section compares crop yields in the four governorates with rainfall data for the rainy months (November to March). An attempt is made to find a relationship with observed migration patterns. Figure 16 shows wheat and barley production (key crops in the region) (Perosino, 2023) in Irbid, Ajloun and Mafraq vis-à-vis rainfall using available weather station data in the study areas.

Irbid demonstrates a direct relationship between crop productivity (specifically, wheat and barley) and rainfall patterns, which could influence population movements. Ajloun implies a less direct relationship, but the relationship could still be considered influential on local migration trends, as the governorate suffers a comparable crop production concern. Despite some differences, the findings from the two governorates suggest that in years of reduced crop production, both areas may experience increased rural-to-urban migration or movement to more agriculturally stable regions.

Rainfall significantly impacts agricultural productivity, especially in Irbid. Changes in rainfall patterns could also impact human mobility and economic stability, emphasizing how urgently adaptable agricultural practices are needed to address climate change.

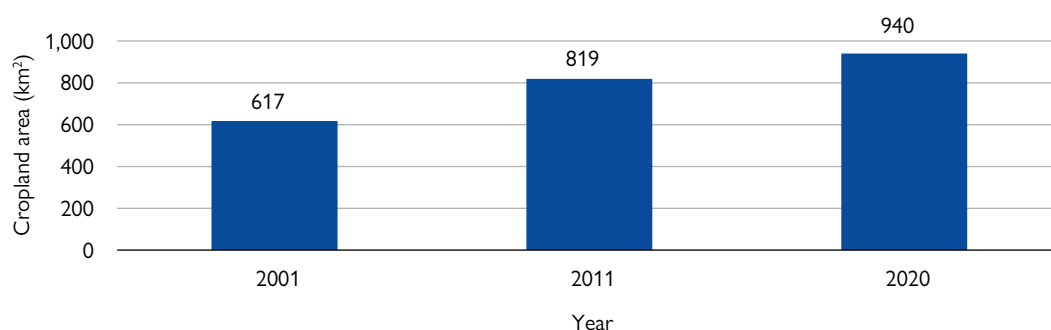
Figure 16. Wheat and barley production and rainfall levels in Irbid, Ajloun and Mafraq, 1995–2022



Source: DOS, 2023b.

To gain additional understanding of the crop yield in these governorates, satellite images from 2001, 2011 and 2020¹ were examined. Despite the temperature increase and rainfall decrease over 20 years, the images demonstrate that cropland areas expanded across the study areas. This expansion of agricultural areas could be due to improvements in farming practices, the instalment of advanced irrigation systems, digging of wells, and government subsidies. On the other hand, sustainable land management must also address environmental trade-offs such as biodiversity loss, soil quality changes and water resource depletion from development and adaptation. Cropland areas have expanded by 32.74 per cent and 14.77 per cent from 2001 to 2011 and from 2011 to 2020, respectively (Figure 17).

Figure 17. Change in cropland area size, 2001, 2011 and 2020



Source: DOS, 2023b.

Over the last few decades, the intensification of agricultural activities has been related to the expansion of cropland areas and the transformation of rain-fed lands into irrigated lands in Irbid, Ajloun and Jerash Governorates. While these changes would bring economic opportunities in terms of increasing output and efficiency in agriculture, the consistently negative migration trends in those governorates have shown that the financial benefits of such an expansion in agriculture are probably not enough to keep the locals in their region. Outmigration might have occurred for several reasons, such as anticipated negative environmental impacts like depletion of water, loss of biodiversity and disruption of traditional farming practices, among others. In addition, these expansions of agricultural might not have effectively relieved the broader economic pressures or improved the overall livelihoods of the residents, leading to continuous migration. All these issues must be borne in mind so that appropriate policies for agricultural development will allow communities to sustain their livelihoods and not damage the environment.

4.2.7. Livestock trend in study areas, by governorate

Livestock patterns, a significant indicator of ecological and economic stability, might affect rural areas, thus prompting migration into other environments. The areas covered by the study are dominated by pastoralism and farming to some extent. These activities have resulted in the presence of animals that are the centre of life and culture for the local people. Rainfall and temperature patterns are likely to change; the increased frequency of rainfall and temperature extremes threatens pasture quality, water availability and animal health as crucial determinants for increased animal productivity and resilience. Figure 19 shows

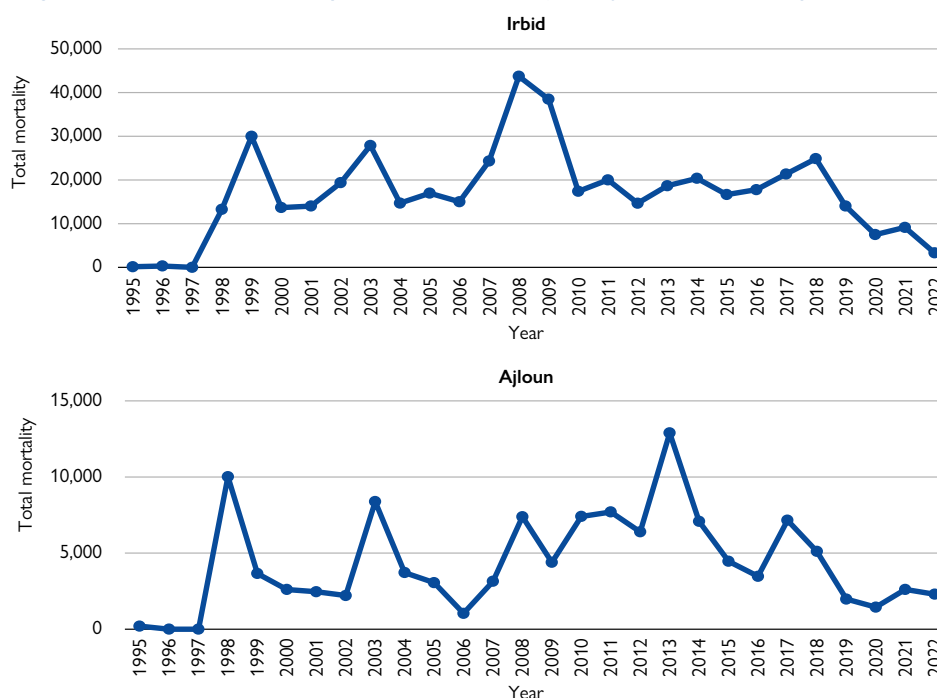
¹ The satellite images are available from the set entitled "MODIS/Terra+Aqua Land Cover Type Yearly L3 Global 500m SIN Grid V061", available from the NASA website: <https://search.earthdata.nasa.gov/search?q=C2484079608-LPCLOUD>.

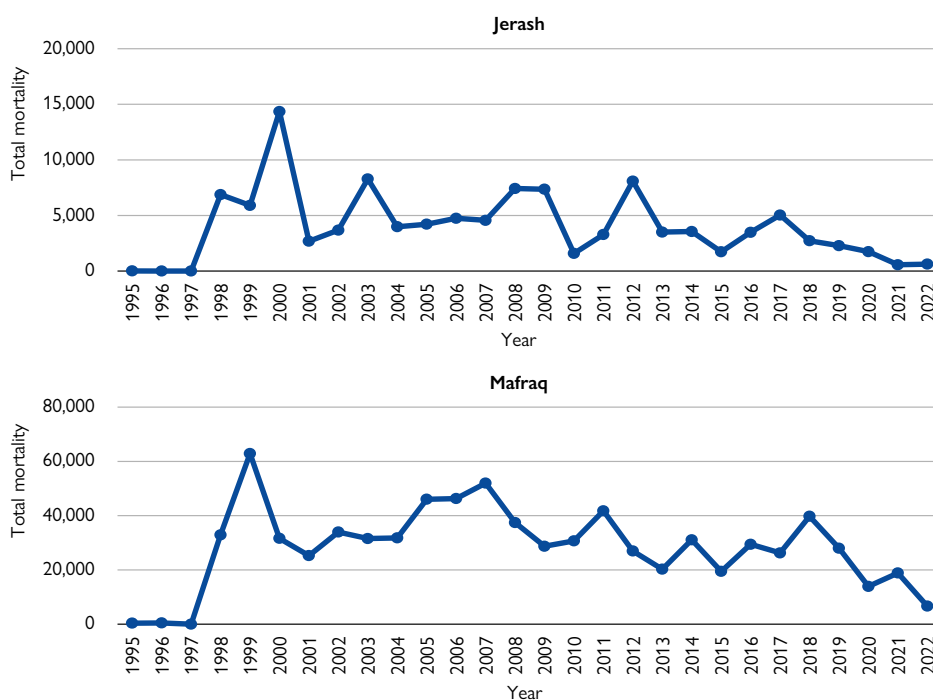
that there were many livestock mortalities in Irbid in 1999 but that they decreased in 2008. As for Mafrq, there was a significant increase in livestock mortality in 1999, and then the figures fluctuated, but they lessened overall until 2010. The year 2000 saw an enormous rise in livestock mortality in Jerash, apart from other increases in that period. The increase in the number of deaths was a drastic change in 1998, with a minor one around 2003 in Ajloun.

It should be noted that other variables at play may also affect livestock mortality rates. Flash floods, characterized by extremely heavy rain, can cause pasture flooding, resulting in animal death and/or injury. On the other hand, drought leaves little or no water for the animals, reducing forage availability to much lower quantities and starving the livestock to death, increasing mortality. All these natural hazards will cause severe potential damage to the livestock breeders' livelihoods, ultimately leading to disturbances in the agricultural economy and financial stress. As a result, the population in the affected regions would be food- and cash-insecure, inducing people to migrate and be displaced due to poor living conditions and limited opportunities.

Correlating livestock mortality incidence with natural hazards (Figure 20) usually requires extensive data analysis. However, based on the available data, some preliminary correlations can be made between the observed livestock mortality peaks and natural hazard events in the designated governorates. Such correlations are theoretical and would require a more comprehensive statistical investigation. The study tried to find a correlation between the different natural hazards and the livestock mortality rates in the four governorates.

Figure 18. Livestock mortality trends for Irbid, Ajloun, Jerash and Mafrq, 1995–2022

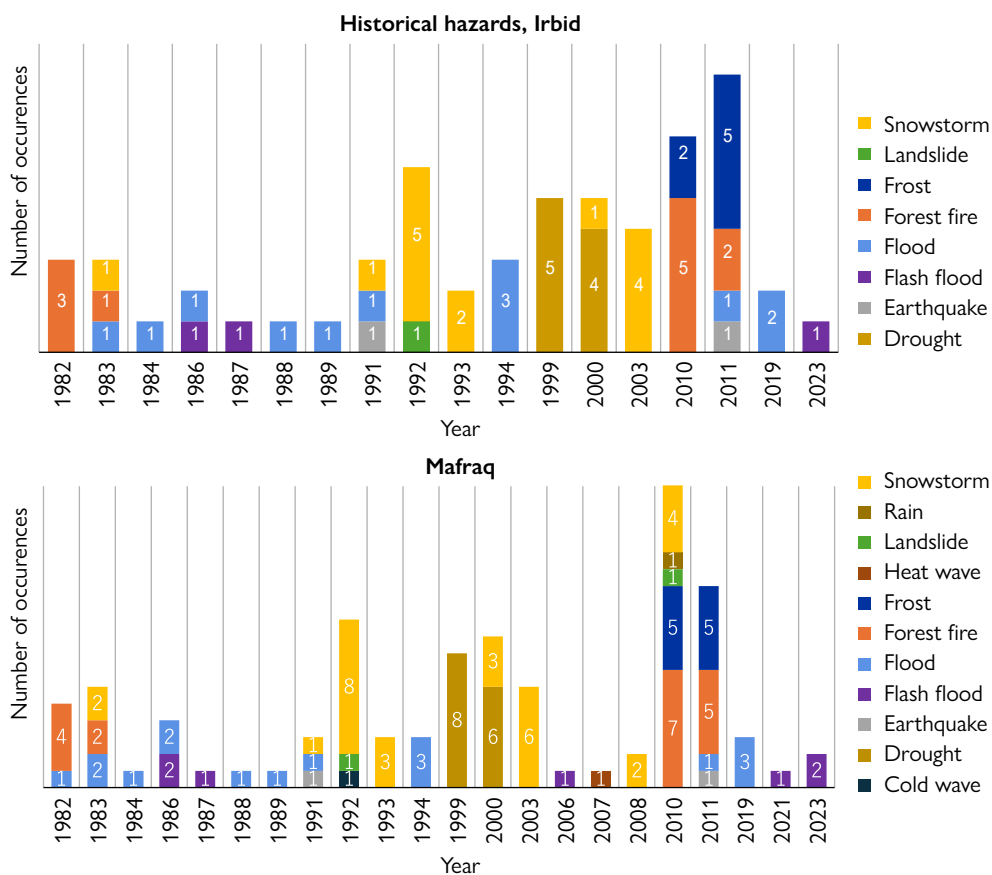


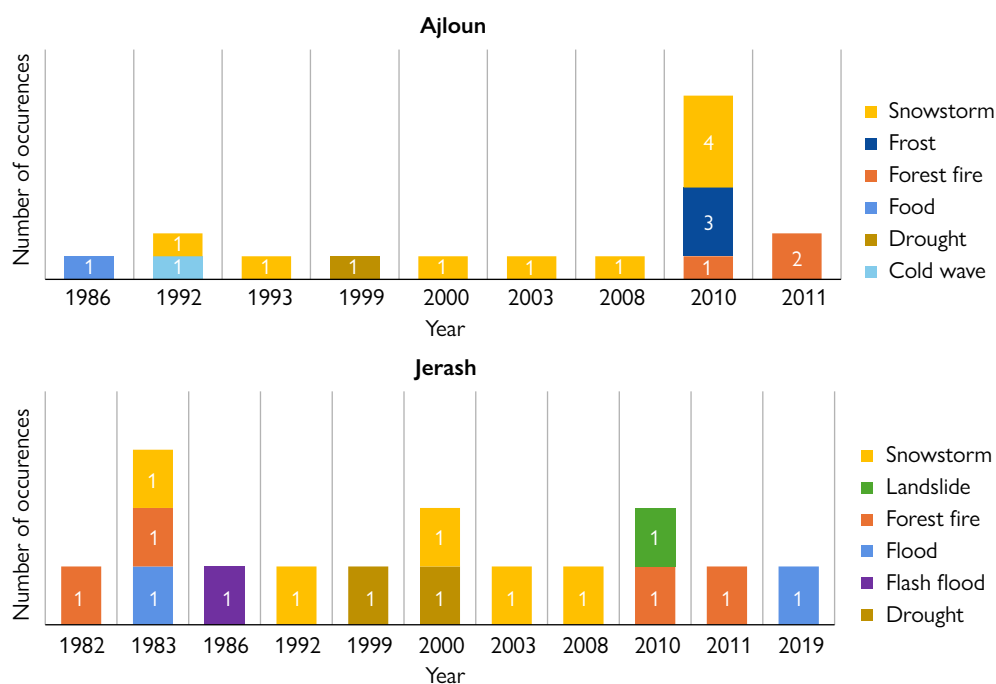


Source: DOS, 2023c.

4.2.8. Historical hazards in study areas, by governorate

Figure 19. Types of natural hazards and their frequencies in Irbid, Ajloun, Jerash and Mafrqa, selected years



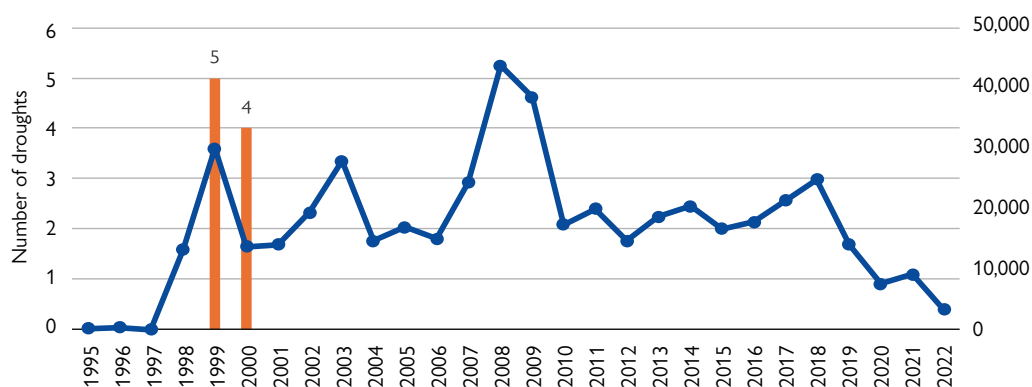


Source: UNISDR, 2024.

Irbid

In 1999, five drought events were recorded; at the same time, there was a report of an increase in livestock mortality. The drought's effects may not only be immediate and have been constant in such a manner that they continue to affect the health of livestock and raise the mortality level from starvation and thirst. While snowstorms can cause immediate death from cold stress, especially among the very young, very old and very sick animals, they represent a small fraction of total mortality for this year. This could imply that farmers were well prepared or that snowstorms had little impact on animal mortality.

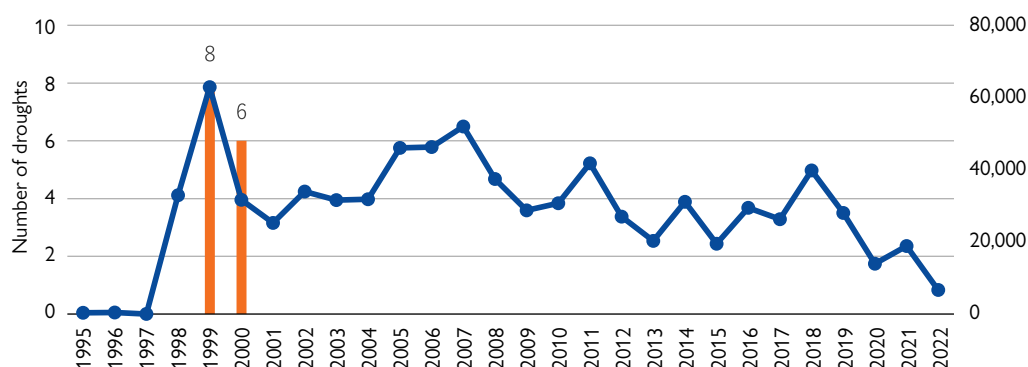
Figure 20. Livestock mortality and drought incidence in Irbid, 1995–2022



Source: DOS, 2022a and 2022b.

Mafrag

Figure 21. Livestock mortality and drought incidence in Mafrag, 1995–2022



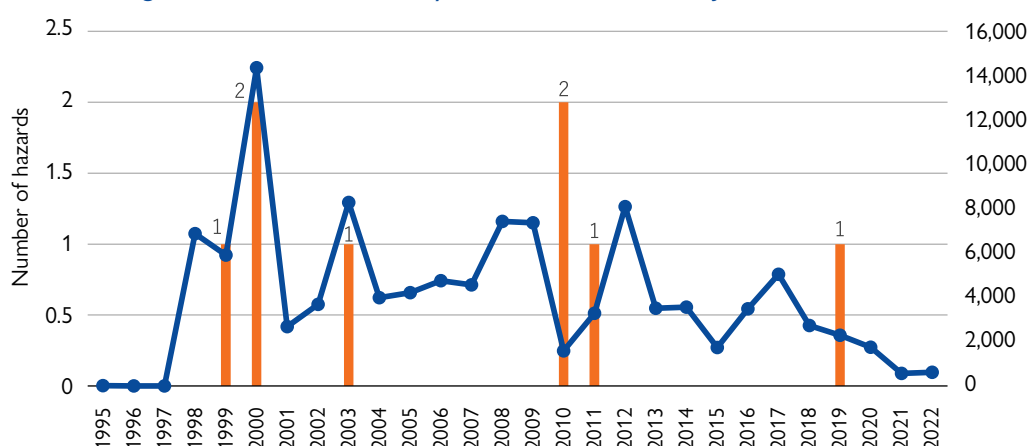
Source: DOS, 2022a and 2022b.

There is no direct relationship between flash floods and livestock mortality because flash floods can have acute consequences, but they rarely impact mortality in the long term. The peak of livestock mortalities coincides with that of natural hazards in 1999, and thus this year witnessed the highest rate of livestock mortality in the 1995–2022 period. Mafrag was exposed to eight drought events preceded by three snowstorm events in 1993 and three flood events in 1994 that affected livestock health and made them more vulnerable.

Jerash

The drought and snowstorm events in 2000 resulted in more livestock life loss. Drought may result in a food shortage, and a snowstorm can lead to sudden death or an injury that ultimately causes death. Forest fires and landslides in 2010 and forest fires in 2011 may have contributed to habitat loss and fodder scarcity and, thereby, increased mortality; however, data on livestock mortality show a fall rather than a peak around this time.

Figure 22. Livestock mortality and hazard incidence in Jerash, 1995–2022

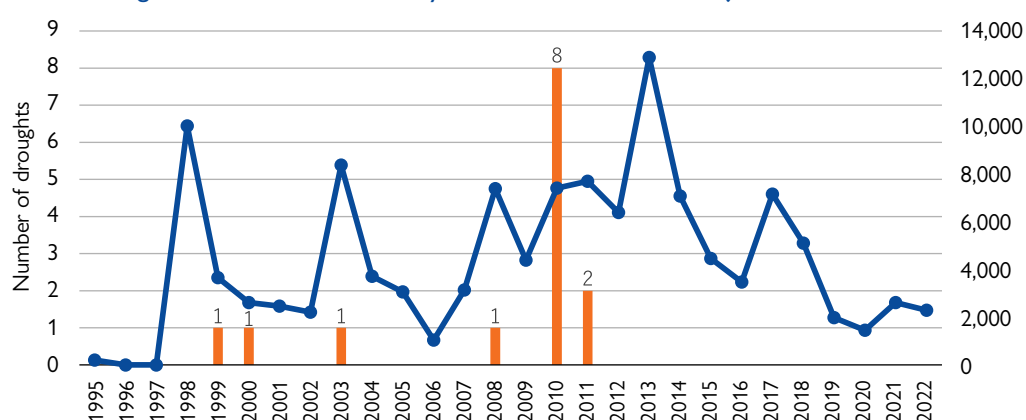


Source: UNISDR, 2024.

Ajloun

There is no clear relationship between the recorded natural hazard events and livestock mortality in 1998. However, theoretically, one can establish a relationship that the snowstorm event might have contributed to increased mortality in livestock in 2003. Other factors should be considered, such as local farming methods, the timing of hazards and cumulative impacts of natural hazard events on livestock mortality over the years. Factors affecting the response to livestock mortality induced by natural hazard events include improved infrastructure and availability of veterinary services.

Figure 23. Livestock mortality and hazard incidence in Ajloun, 1995–2022



Source: UNISDR, 2024.

A direct correlation cannot be affirmed between livestock mortality in Irbid, Ajloun and Jerash and migration patterns in 1994, 2004 and 2015 (Figure 19). Since there are spikes in mortality figures that can be objectively identified and verified, peaks have presented themselves in the past. They may have contributed to economic stresses that might have influenced migration decisions. Broader socioeconomic factors influence migration drivers, such as employment opportunities in other sectors and agricultural policies. A more consistent data set would have to be available for those same intervals for a definitive analysis, underlining the general complexity of correlating single economic factors to migration trends.

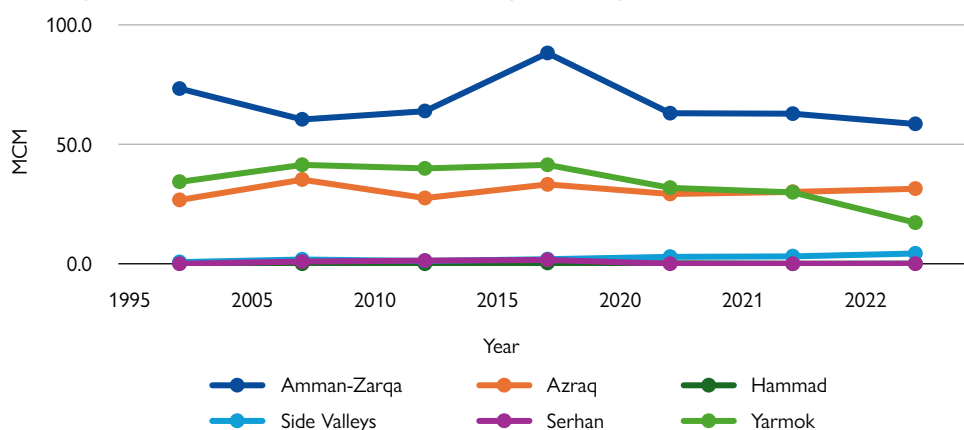
4.3. WATER AVAILABILITY AND SUPPLY

Groundwater is the primary water source for farmers in arid and semi-arid areas, providing a crucial buffer during droughts or when surface water is scarce. It plays a vital role in stabilizing agricultural activities, which are essential for food security and the livelihoods of rural communities. The relationship between groundwater and climate change is complex. On the one hand, climate fluctuations can affect groundwater recharge, impacting both the quantity and quality of available groundwater. Water table levels are sensitive to rainfall patterns, increased evaporation rates and seasonal weather changes. However, as climate change makes surface water less reliable, communities may increasingly depend on groundwater, leading to overextraction.

Figures 24 and 25 graphs illustrate the quantity of water and the number of wells used in agriculture, per water basin. Figure 24 shows agricultural water availability trends across

several water basins. The Amman-Zarqa basin has experienced a decline in water availability since 2015. Although other basins, such as the Azraq and Yarmouk, have also been experiencing declines, they are less severe. The water supply in the Side Valleys and Serhan basins has remained relatively steady.

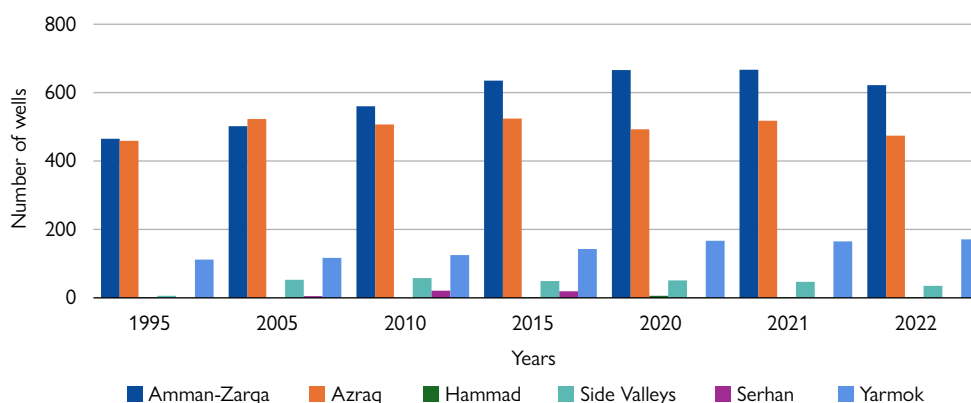
Figure 24. Amount of water utilized for agriculture per water basin, 1995–2022



Source: DOS, 2023d.

Note: MCM – million cubic metres.

Figure 25. Number of wells per water basin, 1995–2022



Source: DOS, 2023d.

Figure 25 presents the count of wells in each basin from 1995 to 2022. There has been an increase in the number of wells and water used for agriculture in the Amman-Zarqa and Side Valleys basins, indicating a reliance on groundwater extraction in these areas. Conversely, the Azraq basin shows a decline in water availability and a reduction in the number of wells, which could indicate stricter regulations on drilling or depletion of groundwater resources. In the Hammad basin, the number of wells remains low, corresponding to the steady water levels observed in Figure 24.

These trends suggest increased groundwater extraction in certain years, which may be unsustainable in some basins. This is likely due to unpredictable surface water supplies caused by climate variability and change. The findings highlight the potential for overextraction, particularly in the Amman-Zarqa basin, which could have long-term impacts on the region's water security and agricultural sustainability.

While the water availability and groundwater trends data suggest a potential link to migration patterns, water scarcity cannot be considered the sole factor driving migration. Other socioeconomic influences, such as employment opportunities, quality of life and regional conflicts or economic conditions, also significantly shape migration trends.

From 1994 to 2014, Irbid experienced a steady net loss in migration, with only a slight improvement over time. The number of wells in the area increased significantly during this period, indicating that while groundwater resources were being tapped extensively, they might not have been sufficient to meet the population's demands or boost agricultural production to a level that prevents outmigration.

Ajloun, similarly, exhibits chronic negative net migration, which has remained relatively stable over time. The significant increase in wells in Ajloun suggests that the groundwater supply is inadequate to retain residents. Other factors, such as job opportunities elsewhere or different environmental challenges, also contribute to migration.

In Jerash, net migration consistently shows negative trends without significant fluctuations despite the development of wells. This indicates that the water available for agricultural use is insufficient for local communities and has not prevented residents from leaving the region. This underscores the ongoing search for a better quality of life and services as reasons for outmigration.

Mafrq presents an interesting case, with increased net migration in 1994 and 2004, but a decrease in 2015. The significant increase in the number of wells in 2004 might reflect efforts to boost agricultural production or address water scarcity, potentially attracting or supporting the population initially. However, by 2015, other factors likely contributed to a reversal of this trend, leading to outmigration.

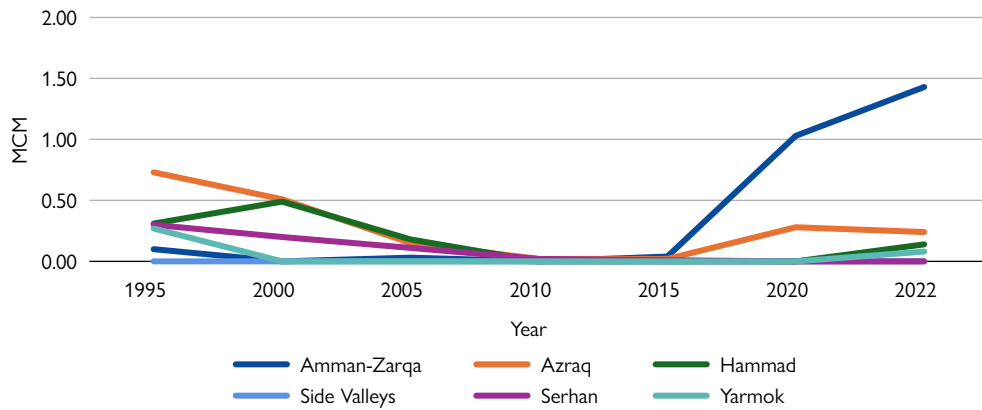
Recent migration trends show a persistently negative pattern in Jerash with little variance, while Irbid and Ajloun see slight improvements in their negative trends. This suggests that better water resource management, sustainable farming techniques and improved economic conditions could positively influence reducing outmigration from these areas.

Quantity and usage of groundwater for distant regions and livestock use per water basin

From 2015 to 2022, there has been a significant and rapid increase in groundwater consumption in the Amman-Zarqa basin, indicating a growth in the livestock industry and an increased demand for water. The rising number of wells and water usage in this basin confirm the year-on-year expansion of livestock activities. This growth in the agricultural industry could also attract new settlers, potentially influencing migration trends.

The Yarmouk basin has experienced a slow but noticeable increase in groundwater consumption from 2015 to 2022. This suggests that the livestock business is expanding gradually, necessitating additional water extraction infrastructure. Conversely, the Azraq basin has seen a decrease in groundwater utilization since 2005, with a brief increase between 2015 and 2020. This trend could potentially reflect improvements in water efficiency, either through water-saving livestock-rearing techniques or local water conservation efforts.

Figure 26. Groundwater usage for distant regions and livestock farming, by water basin, 1995–2022



Source: DOS, 2023e.

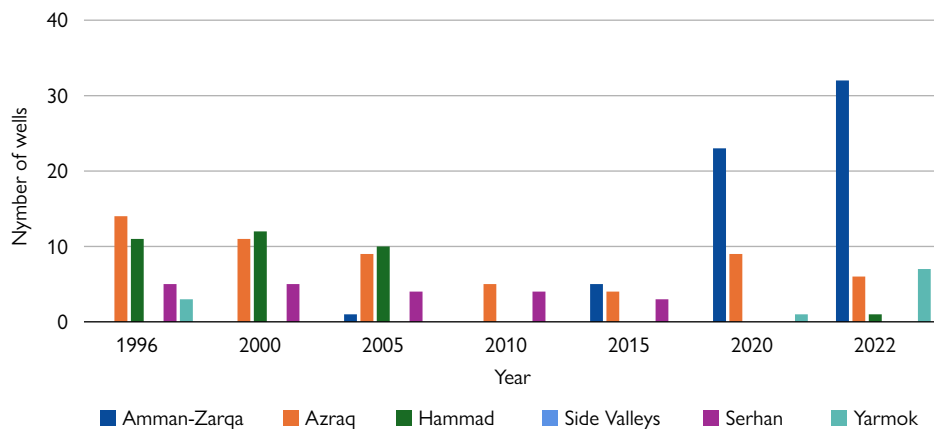
Note: MCM – million cubic metres.

In the Hammad basin, the number of wells increased slightly from 1996 to 2020, while groundwater consumption decreased until around 2005 and has since stabilized. This stability might be attributed to more sustainable water use practices on livestock farms.

The Side Valleys and Serhan basins have maintained constant groundwater consumption and well numbers, suggesting a stable demand for water in the livestock industry. This balance indicates harmony between available water resources and farming practices.

Overall, the trends in groundwater abstraction and usage highlight the development of the livestock industry and its impact on water resources. The growth in the Amman-Zarqa basin could boost the local economy and encourage in-migration. In contrast, basins with constant or decreasing groundwater demand may see less economic activity, potentially influencing migration patterns. Figures 26 and 27 illustrate the quantity and usage of groundwater for distant regions, livestock use by water basin and the number of wells, respectively.

Figure 27. Number of wells for livestock farming, by water basin, 1996–2022



Source: DOS, 2023e.

4.4. HEALTH SECTOR

4.4.1. Correlation between pulmonary TB incidence and environmental hazards

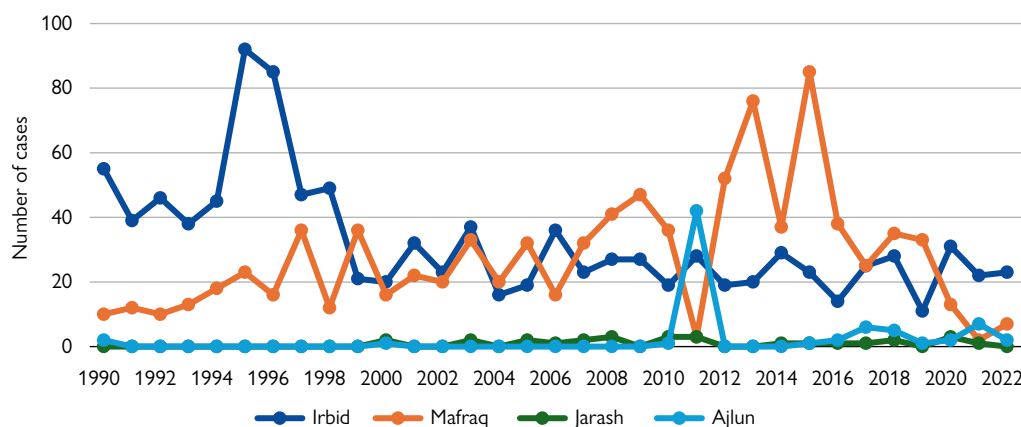
Research on the relationship between climate change and diseases like tuberculosis (TB) requires a multidisciplinary approach that includes climatology, epidemiology, public health and the social sciences. Factors contributing to the spread of TB include crowding, extreme climatic events and severe weather conditions. Air quality issues, such as pollution caused by climate change, also impact lung health, while extreme temperatures can weaken the immune system by causing stress and damage.

When comparing the graph of pulmonary TB patients in the governorates of Irbid, Mafrq, Jerash and Ajloun to the incidence of natural hazards such as floods and droughts (Figure 28), Irbid presents a complex picture with a higher occurrence of natural hazards. Years characterized by significant snowstorms and floods coincide with higher TB case numbers. This suggests that environmental stresses within a year correlate with TB incidence, possibly due to migration, overcrowding and health-care disruption.

However, the correlation between TB incidence and natural hazards is not consistently strong across all regions. For example, for Jerash, where TB incidence and environmental hazards are low, it is challenging to draw definitive conclusions without statistical analysis. Jerash's environmental data lacks the diversity of hazards found in other areas.

In Ajloun, variations in the number of TB cases across time could be influenced by environmental factors, with cold winter months and floods potentially increasing TB incidence. Evidence shows extreme weather events can overwhelm local health-care systems, impacting TB control and treatment. Preliminary analysis indicates a potential link between environmental hazards and TB in these governorates, but this assumption requires validation through comprehensive epidemiological studies.

Figure 28. Number of pulmonary TB cases by governorate, 1990–2022



Source: DOS, 2023f.

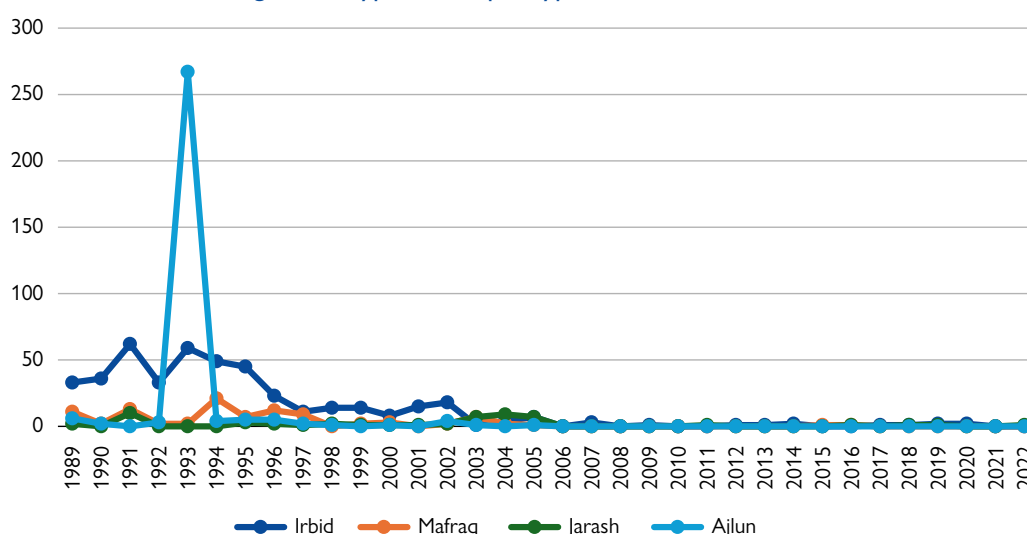
Conducting research in this area would allow for the collection of more data, adjustment for biases and application of appropriate statistical tools to investigate these relationships. It is important to note that correlation does not imply causation; environmental influences are just one component of the complex TB epidemiology problem. A thorough examination must also consider socioeconomic factors, health-care access, public health policies and population density.

4.4.2. Link between typhoid and paratyphoid fevers and flood events

Typhoid and paratyphoid fevers are bacterial infections typically transmitted through contaminated food and water. Floods can exacerbate this issue by increasing the likelihood of contamination. Data on natural hazards suggest that floods significantly contribute to typhoid and paratyphoid incidence in Irbid, Mafrq, Jerash and Ajloun.

The incidences of typhoid and paratyphoid fever were examined alongside environmental hazard incidence over the same period and locations to identify any temporal links between floods and disease outbreaks. The graph of typhoid and paratyphoid cases (combined) shows spikes that align with flood and snowstorm events (Figure 29). Floodwaters can contaminate drinking water and disrupt sanitation systems, increasing disease transmission risk.

Figure 29. Typhoid and paratyphoid cases, 1989–2022



Source: DOS, 2023g.

While this comparison between graphs may suggest a causal relationship, it does not provide conclusive evidence, as multiple factors contribute to the spread of these diseases. These observations highlight the importance of a robust public health infrastructure in areas prone to flooding to mitigate the risk of waterborne diseases following such events.

Epidemiological research should focus on assessing water source pollution, population density and public health activities. This could help develop strategies to prevent the spread of flood-related typhoid and paratyphoid, ensuring effective measures are in place to protect public health.

4.4.3. Relationship between infectious disease incidence and internal migration patterns

Demographic changes, particularly internal migration, significantly impact the dynamics of infectious diseases like TB and paratyphoid. In Irbid and Ajloun, periods of outmigration appear to coincide with a reduction in TB and paratyphoid transmission, suggesting a potential link between declining population density and decreased disease incidence. Conversely, peaks of net in-migration in Mafraq Governorate may coincide with increased disease incidence, possibly due to higher population density and stress on public health systems.

It is important to note that the time lag in disease reporting and the potential for underreporting may affect these observations. Additionally, migration can influence health-care access and quality, impacting disease detection and management.

While a relationship between internal migration patterns and the prevalence of TB and paratyphoid in the analysed governorates is apparent, the data do not establish causation. More detailed research is needed to clarify these dynamics, incorporating migration statistics with health-care and societal data. For example, further investigation into the context and drivers of migration, whether financial, conflict-related, or environmental, could provide valuable insights into how population changes affect public health outcomes.

4.5. SPATIAL ANALYSIS

4.5.1. Population change detection

Spatial analysis helps in further examining the relationships spatially between the different climate variables, demographic characteristics and migration patterns. In this study, we first generated the change detection in population locally from 2004 to 2015 for each of the study areas. This analysis will help us identify areas with significant population increases or decreases to indicate potential migration patterns. The change detection was conducted for urban and rural localities in the designated subdistricts of Irbid, Ajloun, Jerash and Mafraq. Table 8 shows 20 localities with significant increases (>100% change) in their rural population between 2004 and 2015, while Table 9 presents the localities with decreases.

Table 8. Localities with significant rural population increases, 2004–2015

Governorate	District	Subdistrict	Localities	Population change
Ajloun	Qasabet Ajloun	Erjan	Asiem	142
Irbid	Qasabet Irbid	Irbid	Ham	107
Irbid	Bani Kenanah	Bani Kenanah	Zaweh	113
Irbid	Kora	Kora	Abu El-Qain	114
Irbid	Bani Kenanah	Bani Kenanah	Azriet	126
Irbid	Bani Kenanah	Bani Kenanah	Mzaireeb	140
Irbid	Kora	Kora	Sowwan	146
Irbid	Qasabet Irbid	Irbid	Teqbel	156

Governorate	District	Subdistrict	Localities	Population change
Irbid	Qasabet Irbid	Irbid	Um El-Jadayel	170
Irbid	Bani Kenanah	Bani Kenanah	Bareshta	347
Irbid	Kora	Kora	Rahwah	420
Jarash	Qasabet Jarash	Jarash	Hasainiyyat	250
Jarash	Qasabet Jarash	Jarash	Shak Mfarrej	384
Mafrq	Badiah Shamaliyyeh Gharbiyyeh	Badiah Shamaliyyeh Gharbiyyeh	Sorrah	113
Mafrq	Badia Shamaliyah	Salhia	Salhiya	119
Mafrq	Badia Shamaliyah	Salhia	Bostaneh	124
Mafrq	Badia Shamaliyah	Salhia	Ashrafiyyeh	126
Mafrq	Badia Shamaliyah	Salhia	Hashimiyyeh Sharqiyyeh	132
Mafrq	Badia Shamaliyah	Salhia	Zamlet Al-Amir Ghazi	248
Mafrq	Qasabet El- Mafrq	Bal'ama	Manshiyyet Alaian (Alkhan)	2 238

Source: Previously unpublished data from DOS.

Table 9. Localities with significant rural population decreases, 2004–2015

Governorate	District	Subdistrict	Locality	Population change
Mafrq	Badiah Shamaliyyeh	Salhia	Kaidat Al-Amir Hassan Al-Jauiah	–98
Mafrq	Al Ruwaished	Rweished	Jeser Rweished	–63
Irbid	Kora	Kora	Iskayeen	–44
Ajloun	Qasabet Ajloun	Ajloun	Keshiebeh El-Foqa	–37
Jarash	Qasabet Jarash	Borma	Majdal	–30
Mafrq	Al Ruwaished	Rweished	Fhaidhah	–16
Jarash	Qasabet Jarash	Borma	Fawara	–15
Irbid	Kora	Kora	Kherbet El-Hawi	–14
Jarash	Qasabet Jarash	Mastabah	Raieh	–4
Irbid	Bani Kenanah	Bani Kenanah	Yarmook	–2

Source: Previously unpublished data from DOS.

Further, Table 10 shows the 13 urban localities with significant population increases (over 100%) for the same period.

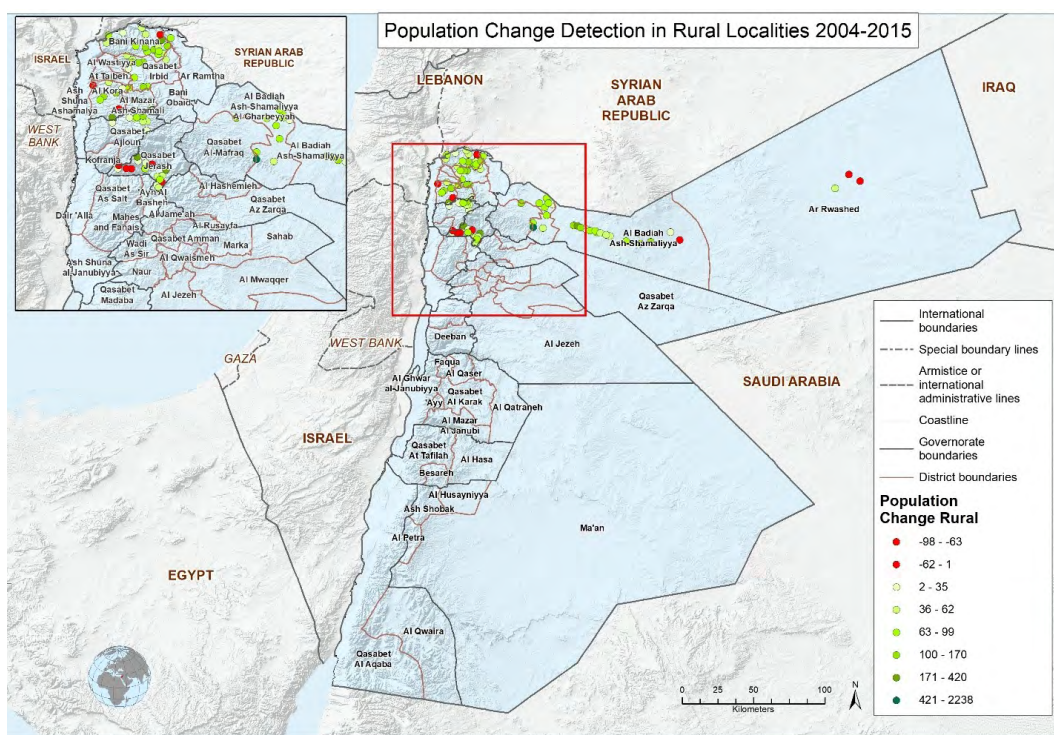
Table 10. Localities with significant urban population increases, 2004–2015

Governorate	District	Subdistrict	Locality	Population change
Irbid	Qasabet Irbid	Irbid	Irbid	101
Irbid	Qasabet Irbid	Irbid	Kofor Yooba	104
Irbid	Bani Kenanah	Bani Kenanah	Kharja	106
Irbid	Qasabet Irbid	Irbid	Soom	107
Irbid	Qasabet Irbid	Irbid	Hakama	109
Irbid	Qasabet Irbid	Irbid	Jijien	113
Irbid	Ramtha	Ramtha	Ramtha	118
Irbid	Ramtha	Ramtha	Torrah	123
Irbid	Qasabet Irbid	Irbid	Bait Ras	127
Irbid	Ramtha	Ramtha	Shajarah	143
Irbid	Kora	Kora	Dair Abi Sa'id	181
Mafrq	Badia Shamaliyah	Dair El-Kahf	Mansoorah	118
Mafrq	Badia Shamaliyah Gharbiyah	Badia Shamaliyah Gharbiyah	Za'tary	164

Source: Previously unpublished data from DOS.

The maps in Figures 30 and 31 show the rural and urban population change detection maps; the red localities in the map represent a decrease in population, while the dark green ones represent a significant increase in population, which are listed in Tables 8–10.

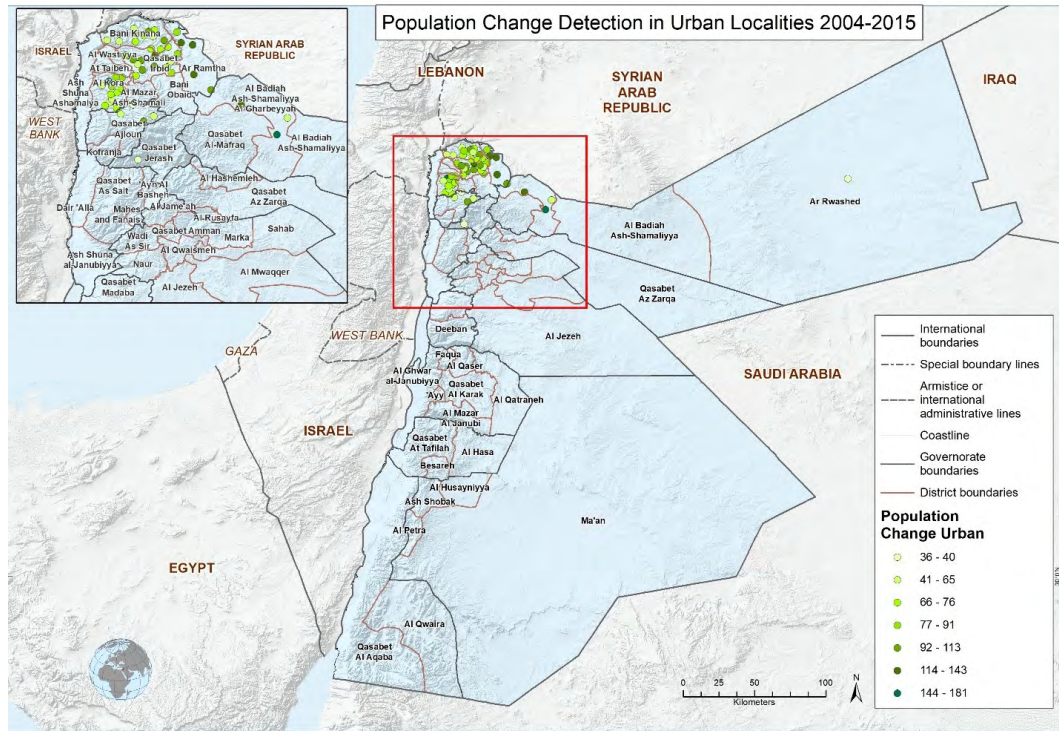
Figure 30. Population change map of rural localities, 2004–2015



Source: Adapted from JRC (2016); population data from DOS (2015).

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

Figure 31. Population change map of urban localities, 2004–2015



Source: Adapted from JRC (2016); population Data from DOS (2015).

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

At first glance, we notice the change in demographics that has taken place in these localities between 2004 and 2015. Rural localities are red on the map, indicating an intensive outmigration. However, whether the people have migrated to urban sites within the country or abroad is unclear. On the other hand, urban localities are shown in varying shades of green, which would imply different growth rates. These differences suggest that, while some urban areas retained more residents, they may have attracted people from other localities. This, then, is perhaps an indicator of a general trend of urbanization, although the exact dynamic regarding internal and international migration must be teased out to define best the origins and impacts of both types of population change.

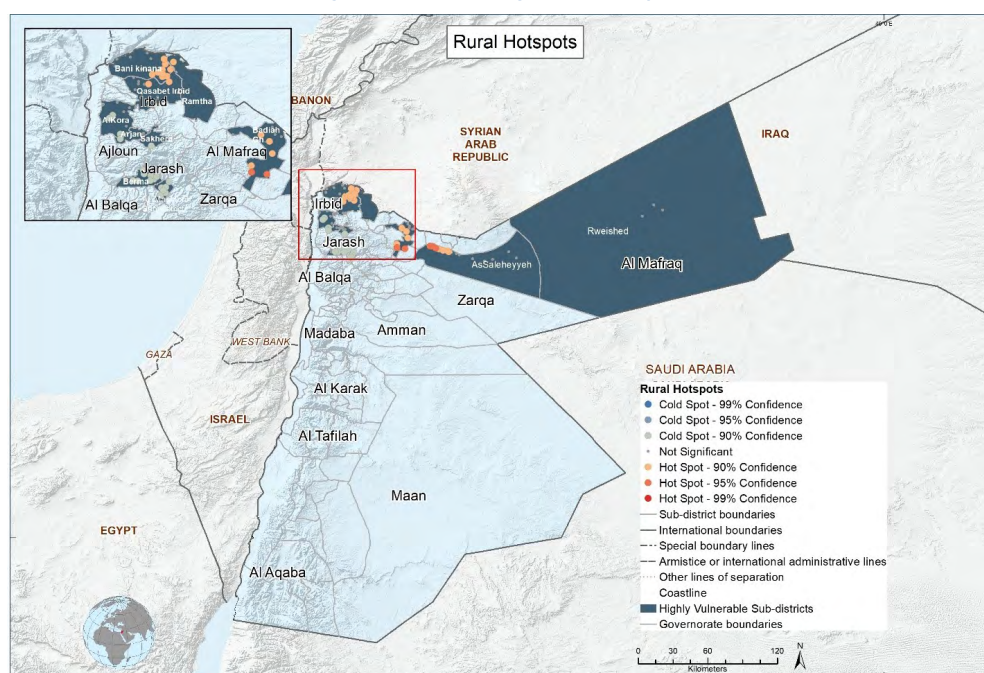
4.5.2. Identifying hotspots

This analysis aims to identify specific clusters of migrants within different localities. Two hotspot analysis methods for each locality type were employed: the Optimized Hotspot Analysis for rural localities and the Getis-Ord Gi statistic for urban areas. The choice of two different methods was due to the limited number of urban localities (fewer than 60), which made the optimized hotspot analysis less suitable.

The rural hotspot analysis revealed five localities representing the most statistically significant clusters of high values (indicated by red and orange dots). All five rural localities are in the Mafrq Governorate: Alsahieh, Zamlet Al-Amir Ghazi, Bostaneh, Meferdat and Manshiyyet Alaian (Alkhan).

In urban localities, the analysis identified only one locality with a light orange cluster (Ramtha) and one with a dark red cluster (Irbid) as the most statistically significant clusters of high values. Figures 32 and 33 display maps of both rural and urban hotspots.

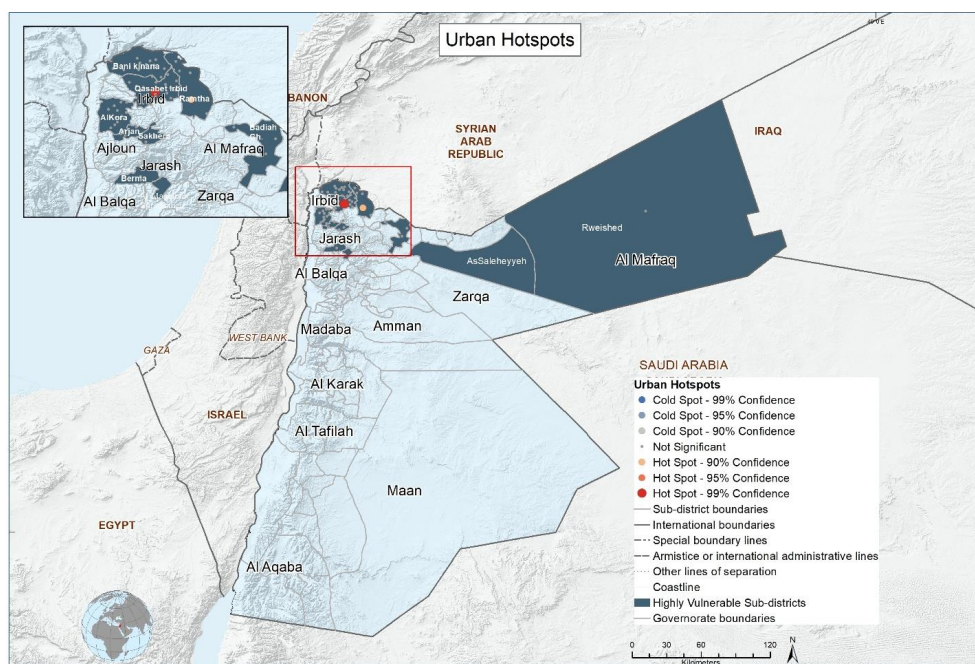
Figure 32. Rural migration hotspots



Source: Adapted from JRC (2016); population data from DOS (2015).

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

Figure 33. Urban migration hotspots



Source: Adapted from JRC (2016); population data from DOS (2015).

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

5. QUALITATIVE DATA ANALYSIS

5.1. KEY INFORMANT INTERVIEWS

The KIs were conducted with nine key government stakeholders (seven men and two women), four representatives from NGOs and academia, and four community leaders. The interviews revealed crucial insights into the challenges and opportunities related to climate change, migration, and resilience in Jordan. The findings are organized thematically in this section.

5.1.1. Climate change and environmental impacts

Climate change is recognized as a significant concern in qualitative interviews conducted with representatives from NGOs, government and community leaders across all sectors in Jordan. The primary climate-related issues include water scarcity, droughts, erratic rainfall patterns and floods, which impact livelihoods and the country's capacity to absorb recent refugee influxes.

Water scarcity was identified as a critical concern in 15 out of 17 KIs (88%), and food insecurity was recognized as a key concern in 6 out of 17 (35%). All interviewees underscored the severe effects of climate change on agriculture, citing challenges such as seasonal farming disruptions, frost, water scarcity and land degradation. These challenges are particularly acute in rural areas, leading to increased outmigration as residents seek better opportunities elsewhere.

"In Mafraq, people plead for tyres to use on frost days to warm their crops."

Key informant, Oxfam

The depletion of water resources leads to land degradation and diminished agricultural productivity, forcing rural inhabitants to seek alternative sources of income or migrate to urban areas. For instance, UN-Habitat cited that water wells supplying rural areas are of declining quality, with increased salinity affecting land productivity and crop yields. This degradation has increased unemployment, especially among youth in places like Tafleh and Jerash, where few agricultural projects engage them (DOS, 2018).

The influx of refugees contributes to the demand for water and food, complicating Jordan's ability to manage climate-induced stresses. Interviewees indicated that the Badia and Bedouin communities, traditionally reliant on rangeland, now find it difficult to settle due to less rainfall and deteriorating rangelands, further amplifying migration trends within the country.

Respondents noted that the frequency and intensity of natural hazards, such as floods and droughts, have increased, posing significant risks to agriculture and infrastructure. The impacts of such hazards have led to soil erosion and reduced agricultural land, affecting both traditional farming and livestock management. The National Agriculture Research

Centre (NARC) and UN-Habitat also indicated that soil degradation due to flash floods has diminished the natural reserves of junipers in Jordan, making the soil unproductive and forcing farmers to move away from agriculture.

“Efforts for adaptation cannot handle all the rapid climate change.

There are losses and damages even if we try to adapt.

Despite all the efforts we make, we are still not keeping up.”

Key informant, UN-Habitat

Climate change is also impacting public health in Jordan. The Ministry of Health noted that new illnesses, particularly vector-borne diseases like leishmania and dengue, are linked to climate change and increased waterborne disease. Climate-induced stress compounds these health issues. Jordan’s health sector is now focusing on these issues, trying to establish connections between climate change and various health outcomes, including mental health.

In response to these challenges, Jordan is attempting to implement adaptation strategies. However, these efforts are insufficient to match the rapid pace of climate change. Despite initiatives like water harvesting in rural areas, the current adaptation measures are not enough to counterbalance the impact of climate change, which continues to exceed the capacity of existing strategies. There is a clear need for more comprehensive and coordinated efforts that integrate climate change considerations into national policies and development plans. Addressing these issues is essential for mitigating the impacts of climate change and ensuring sustainable development for Jordan’s future.

5.1.2. Climate change–human mobility dynamics

Jordan faces a multifaceted challenge as it grapples with climate change impacts and human mobility dynamics, significantly influenced by population growth, refugee influxes and rural-to-urban migration. Water scarcity, exacerbated by climate change-induced droughts, erratic rainfall patterns and floods, severely impacts agriculture, a cornerstone of Jordan’s rural economy. These environmental stresses compel many rural inhabitants to abandon their lands, leading to their increased migration to urban centres in search of better opportunities and living conditions.

The Ministry of Social Development noted a link between multidimensional poverty, climate change and vulnerability. Similarly, the Ministry of Agriculture observed that vulnerability is more visible in rural areas due to their reliance on agricultural production, which is directly tied to climate. Women, who tend to be responsible for agriculture and households, may suffer due to this migration. Property fragmentation was another concern, as farmers were forced to sell their land, and smaller farms became less productive. When farmers lose revenue due to climate change, they will look for new sources of income, prompting migration from rural to urban regions. Some respondents also pointed to a trend of Jordanian workers being replaced by non-Jordanians in agriculture, echoing observations from the secondary data analysis.

“People are increasingly leaving their native location due to economic difficulties and prefer living in better economic and climatic conditions. Individuals migrate seasonally, and the summer has become inconvenient for farmers in Ghor, particularly the youth who started finding jobs in the service sectors and army rather than agriculture, where non-Jordanian labourers are replacing these people and working on their land.”

Key informant, Yarmouk University

Several respondents cited economic factors as a primary driver of migration within Jordan. Many rural inhabitants migrate to urban areas seeking employment opportunities, higher incomes and better services, including health care and education, with some villages now abandoned due to high migration rates. The disparities between urban and rural infrastructure further incentivize migration; urban areas are generally better equipped to handle climate challenges with superior technology, infrastructure and financial resources. In contrast, rural areas lack the facilities and services to effectively manage climate change impacts, leading to increased vulnerability. For example, flooding incidents are more devastating in rural areas due to inadequate infrastructure and awareness, often resulting in property damage and loss of life.

Populations migrating to urban centres experience a cultural shift as new residents adapt to city life, facing higher living costs and a different cultural landscape. Migrants often experience a cultural shock, adjusting to new norms and political views while dealing with the financial burdens of urban living. Furthermore, the economic burden of migration is significant, as many migrants struggle to find jobs that meet their expectations or provide sufficient income to support their families.

Rural and urban communities are trying to adapt through water conservation, diversified income sources and community support networks. However, these efforts are often insufficient to keep pace with the accelerating impacts of climate change. The lack of comprehensive infrastructure planning, particularly in urban areas, hinders the effective management of natural resources and disaster risks, such as floods. This highlights the urgent need for coordinated efforts between government and community stakeholders to improve infrastructure, provide targeted support and enhance public awareness about climate change impacts.

“There is migration; climate change is one reason, but there are others. Droughts impacted individuals who relied on livestock and crops; fodder prices climbed globally, and herders sought alternate income. Rain-fed agriculture depends on rainfall; however, there is no proper distribution of rainfall; the rainfall pattern fluctuates, causing harm, and recent high-intensity floods were disastrous. Rural migration appears to be economic, but a closer examination reveals that it is the result of climate change.”

Key informant, Ministry of Environment

Jordan hosts a large refugee population, particularly from the Syrian Arab Republic, adding another layer of complexity to its climate change and migration issues. Refugees primarily settle in urban areas, such as Amman, Irbid and Mafraq, attracted by existing family ties and better economic opportunities. However, this influx strains urban resources and infrastructure, particularly in refugee camps like Za'atari, where inadequate sanitation and water management further exacerbate water pollution issues. The continued influx of refugees compounds the challenges of urbanization, leading to increased population density and competition for already scarce resources. Additionally, while Syrian refugees often migrate as families, other nationalities, like Egyptians, tend to migrate as individuals, highlighting diverse migration patterns.

5.1.3. Ongoing initiatives and coping strategies

5.1.3.1. United Nations and non-governmental organizations

Several NGOs are actively implementing adaptation projects to mitigate the adverse effects of climate change on vulnerable populations, including refugees. **UN-Habitat, for instance, is involved in permaculture projects in northern areas, water harvesting in schools for Syrian refugees, greywater systems for mosques and schools, and coping strategies for agricultural risks like frost.** These projects aim to improve the livelihoods of refugees and host communities by promoting sustainable farming practices and efficient water use. They also fund the Urban Planning and Infrastructure in Migration Contexts Project (UPIMC), an adaptation project in Mafraq and Irbid because of refugee populations. **NARC** focuses on enhancing the resilience of farmers through projects that address seasonal production challenges and extreme weather conditions and has established ten projects involving Syrian refugees in agricultural activities like hydroponics, aquaponics, composting and food waste recycling, and other agricultural practices. NARC also provides training in climate change adaptation, soil conservation and food processing, helping communities become more resilient. **Oxfam** supports initiatives in the Mafraq governorate, including cash-for-work opportunities, waste management awareness, water conservation and best practices in recycling and the circular economy to bolster the climate resilience of both Jordanian and Syrian refugee communities. Oxfam also implemented 180 greywater systems in the Za'atari camp, which saved refugees 35 per cent of their water use.

Yarmouk University is pivotal in education and research on climate, environment and migration. The university offers various courses across departments such as geography, geology and other sciences, focusing on environmental and climate science, human geography and natural resources. These educational programmes equip students with the knowledge and skills to address climate-related issues. Yarmouk University is also involved in research projects, such as those exploring eco-agriculture and its impact on climate change, aiming to introduce new technologies that help communities adapt to changing environmental conditions. In collaboration with ministries and local communities, advocacy and policy papers produced by the university support efforts to reduce migration driven by climate impacts.

5.1.3.2. Government Initiatives

The Government of Jordan has launched several initiatives to support climate adaptation and improve the resilience of its citizens. The **Ministry of Agriculture (MOA)** has established risk and solidarity funds to compensate farmers for crop losses due to climate events such as frost, drought and flooding. Additionally, the MOA supports rural development initiatives that help individuals in rural areas increase their income through various income-generating activities. The MOA Risk Fund and loans for farmers also provide relief to farmers facing losses. The **Ministry of Social Development** is preparing a national social development strategy, which includes creating job opportunities, empowering education and health sectors and establishing an emergency fund to protect vulnerable populations before and after crises. The Government is also facilitating the construction of wells for water harvesting and supporting refugees in skill development projects. The **Ministry of Local Administration** is strengthening vulnerable people's resilience through nature-based solutions and initiatives such as healthy landfills, waste-sorting and incorporating climate change concepts into strategies and policies. Their projects are participatory and carried out in close collaboration with the communities.

Although early warning systems exist in areas like Petra and Aqaba, there is a pressing need for improved community awareness and engagement. Despite initiatives, there remains a substantial gap in support systems for migrants, especially in urban areas. While some programmes aim to assist Syrian refugees, full support and integration into sustainable programmes are needed.

5.1.3.3. Community initiatives

Community-level adaptation strategies are prevalent across Jordan, particularly in rural areas where traditional practices are integrated with modern techniques to mitigate climate impacts. Communities engage in water harvesting, supplementary irrigation and well-digging to ensure water availability for agriculture and livestock. Traditional knowledge, such as using specific materials to protect crops from frost, is combined with livestock breeding to diversify income sources. Families often rely on financial support from stable jobs or loans to sustain themselves when agriculture and livestock production falter. Despite the challenges posed by climate change, rural communities demonstrate resilience through their adaptive practices and resourcefulness. Facing increasing uncertainties due to climate change, rural populations seek supplementary income sources such as employment in the army or Government.

5.2. FINDINGS FROM THE STUDIED AREAS

5.2.1. Ajloun

Ajloun, located in northern Jordan, is a crucial link between Jerash, Irbid and Ghor in the west and Mafraq in the east. It boasts a mountainous terrain and holds 2 per cent of Jordan's vegetation cover, with an area of 248,000 km² and a population of 210,000 (DOS, 2023a). Ajloun Greater Municipality comprises 48 per cent of this region. Ajloun's demographic profile includes a higher percentage of youth than the elderly, with a sex distribution of 49

per cent female and 51 per cent male (ibid.). The region experienced a Syrian population influx, peaking at 80,000 but later reducing to 10,000, alongside Egyptian workers in construction (ibid.). Ajloun is a notable example of Muslim–Christian coexistence spanning over 300 years.

5.2.1.1. Climate change and its impacts

Ajloun faces diverse climatic challenges, including early winters starting in October, variable rainfall leading to floods, frost in mountainous areas and droughts impacting vegetation such as oak trees. These conditions pose risks to agriculture and infrastructure, impacting local livelihoods, particularly those relying on agriculture and livestock. Climate change affects all societal groups, notably women in food manufacturing and agroforestry, who face income disruptions due to droughts. Livestock-dependent individuals struggle with high fodder prices, while retirees with small agricultural projects experience income instability.

Recent government initiatives have established the Kufranjeh Dam for agricultural and domestic uses, complementing the region's natural springs and *wadis*. Agriculture is a primary economic activity but remains traditional and largely rain-fed due to the basin's nature and limited water resources. Despite the region's agricultural potential, many residents rely on government and military jobs, with tourism projects like the Ajloun Telpher offering alternative employment.

5.2.1.2. Mobility

Economic factors drive migration, with families moving to Amman and Irbid for educational and employment opportunities, seeking to reduce living costs. The significant distance to Amman presents a major transportation challenge, wasting time and effort and putting an economic strain on residents. This situation underscores the need for improved infrastructure and transportation solutions to alleviate financial burdens.

5.2.1.3. Coping strategies and ongoing initiatives

Ajloun communities have developed water harvesting solutions to combat water scarcity, such as wells and drip irrigation systems. The municipality collaborates with Arabia Weather and the Ministry of Municipalities to provide timely weather forecasts via various platforms, including Facebook, enhancing community preparedness. Collaborations with USAID and the Food and Agriculture Organization (FAO) have yielded food security projects focusing on women, although further efforts are needed to benefit all societal groups. Despite the available capacity among youth, project opportunities remain limited. Civil societies and municipal development units support youth and women, highlighting successful participation stories, particularly among women.

5.2.2. Irbid

Irbid, a major governorate in northern Jordan, comprises 18 municipalities, with Irbid Municipality being the largest in Jordan in terms of employees, financial earnings and population size. The total population is approximately 3,000,000, including 400,000 Syrian

refugees (DOS, 2023a). The region has five public and private universities and a diverse labour market, including Jordanians, Bangladeshis and Chinese in the industrial sector, working in sites like Hassan Industrial City. However, agriculture is declining, particularly in the eastern and western parts, where Pakistani, Egyptian and Syrian workers are engaged. Irbid has a higher proportion of youth, with over 51 per cent male and 48 per cent female (ibid.). The 20–40 age group forms the majority, including many young Syrians. Employment in the army and public sector is more common in rural areas, while urban areas like Irbid City offer jobs in malls, shops and the expanding services sector (ibid.).

5.2.2.1. Climate change and environmental impact

Irbid faces significant climate challenges, including fluctuating rainfall and rainstorms, which in November accounted for 20 to 25 per cent of the wet season, overwhelming drainage systems and causing flooding. The region also struggles with pollution from crowded roads, leading to high CO₂ emissions, while decreasing water availability and loss have reached 40 per cent. Soil erosion from rainstorms affects agriculture and roads, and the local sewage systems are inadequate to handle unexpected high-intensity rainfall.

5.2.2.2. Mobility

Economic factors drive migration, with many people moving to Amman, Aqaba and Zarqa for job opportunities. Rural-to-urban migration within Irbid is common as most jobs are in the cities. However, an insufficient transport network discourages people from staying in their locations. External migration is also challenging due to visa difficulties, especially for those without university degrees. Internally, high rent, housing prices and poor transportation pose obstacles.

“People are moving from rural areas to Irbid city because most of the jobs are in urban centres, like malls and shops. The services sector is expanding at the expense of industry and agriculture.”

Key informant, Irbid Municipality

5.2.2.3. Coping strategies and ongoing initiatives

Despite high unemployment among youth, Irbid has various initiatives, including early childhood programmes and civil societies that initially focused on agriculture but now prioritize trade and other sectors. The municipality actively seeks grants and funds, collaborating with universities and international organizations like USAID, the European Union and UN-Habitat for urbanization and disaster risk monitoring. An early warning system for emergencies during rainfall events is in place, and communication channels via Facebook and radio are well established. Yet, climate change is not considered an urgent issue compared to others that the municipality faces.

Irbid values community participation and has established committees for cooperatives, NGOs and social societies. The municipality has created a high council for investment and units for youth, women’s empowerment and early childhood. Collaboration with the Ministry of Agriculture supports reforestation initiatives, while supporting committees in all 18 municipalities provide valuable information.

5.2.3. Jerash

Jerash is located in northern Jordan, surrounded by Irbid to the south, Ajloun to the east and Mafraq to the west. The region covers an area of 460,000 km², with a municipality spanning 162,000 km² (DOS, 2023a). Jerash's economy primarily relies on government jobs, agriculture, trade and a small tourism sector. The population is predominantly Jordanian, with a significant presence of about 45,000 Palestinians in the nearby Gaza camp.² Syrian refugees also reside and work in Jerash, although their numbers are fluid due to registration in other regions (such as Irbid) and in Za'atari camp. Jerash has a young society, and job opportunities in restaurants and shops attract Syrians and Jordanians. However, the unemployment rate for women remains high. Agriculture and government jobs are key income sources, with limited tourism activities. The competition for jobs between Syrians and Jordanians is notable, especially in the service sector.

5.2.3.1. Climate change and its impacts

Jerash experiences fluctuating rainfall seasons, with droughts and low rainfall affecting agriculture. Many residents are forced to sell lands that no longer provide sufficient revenue. The rise in temperature and drying springs significantly impact agriculture and livestock, prompting people to seek alternative income sources. Jerash is among the scarcest municipalities regarding water availability, with water scarcity being a significant concern. The region's heritage sites and monuments complicate the establishment of sewage networks, posing health risks.

5.2.3.2. Mobility

The primary motivation for migration is job opportunities, with people moving to Amman for trade and Zarqa for industrial jobs. The high cost of living and lack of public transportation hinder relocation. The absence of water services further exacerbates the challenge of moving to new areas.

5.2.3.3. Coping strategies and ongoing initiatives

People in Jerash implement water harvesting, rainwater collection and modern irrigation techniques to address water scarcity. The municipality prioritizes community safety and communication during adverse weather conditions. Initiatives like greywater reuse for irrigation are in place, with projects supported by organizations like USAID and the World Bank. Despite shifting donor priorities due to regional political situations, local communities actively participate in decision-making. In 2023, 23 meetings with local communities were held, ensuring that decisions are made collaboratively.

5.2.4. Mafraq

Mafraq is located in the northern part of the Kingdom of Jordan, bordering the Syrian Arab Republic and Iraq. Agriculture is the primary sector, with about 75 per cent of the population engaged in agricultural activities. Military jobs form the second main sector. Mafraq is one of the municipalities most affected by the Syrian crisis, hosting 120,000 refugees in addition to

² As per the latest count.

those in the Za'atari camp (DOS, 2023a). The population is predominantly young, followed by middle-aged individuals. Syrians have purchased land and started businesses, contributing to the economic landscape alongside other nationalities, such as Pakistanis and Egyptians.

5.2.4.1. Climate change and its impacts

Drought and water scarcity are the main hazards impacting Mafraq, primarily affecting livestock breeders and agricultural workers. Some groups depend on assistance from relatives and families to adapt to climate change. The Farmers' Union and the Ministry of Agriculture collaborate with the local community to compensate for crop and livestock damages. The high cost of living and economic expenses remain significant obstacles.

5.2.4.2. Mobility

A small portion of the population has relocated to the western part of Mafraq, which has more trees and forests. The search for jobs in cities is a reason for relocation, but the percentage of people moving remains low in Mafraq.

5.2.4.3. Coping strategies and ongoing initiatives

Water harvesting, well construction and pool development are being implemented with the Ministry of Agriculture to combat drought. The Ministry of Agriculture raises awareness about drought through television and social media, informing farmers and the municipality about weather conditions via digital television. There is a collaboration with international non-governmental organizations through the Ministry of Agriculture for funded projects. The German Federal Aid Agency (GIZ), the World Bank and USAID have supported initiatives to improve infrastructure.

Local communities actively participate in decision-making by organizing meetings, discussing projects and priorities, and voting on initiatives. Even refugees are involved in this participatory approach, ensuring that diverse voices are heard and considered in development plans.

5.3. FOCUS GROUP DISCUSSIONS

Considering the escalating impacts of climate change, understanding the complex patterns of human mobility has become crucial for developing resilient and adaptive strategies. The study aimed to comprehensively explore how climatic stressors influence human mobility across diverse landscapes. To achieve this, FGDs were conducted in urban and rural residents, which was essential for capturing the experiences and perspectives of communities affected by climate change.

The FGDs included a diverse group of 192 participants from different age brackets (18–25, 26–35, 36–50, and 51 and above), ensuring representation across broad demographics. FGD participants also included persons with disabilities and migrants to incorporate a variety of voices and insights. Female respondents comprised 60 per cent of the participants, while male respondents accounted for 40 per cent.

The primary objective of these FGDs was to identify and understand the main reasons behind migration decisions in the context of climate change. The research team sought to determine the most significant drivers of migration and to uncover community-level coping strategies, local initiatives and the role of government interventions in mitigating climate-related challenges. The discussions also aimed to assess the awareness levels and information flow regarding climate change among different demographic groups.

To ensure a representative sample, statistical sampling techniques were employed, considering factors such as population density, demographic composition and the anticipated impacts of climate change on different communities. This approach allowed for accurately identifying vulnerabilities and resilience mechanisms, thereby enhancing understanding of mobility dynamics within the context of climate change.

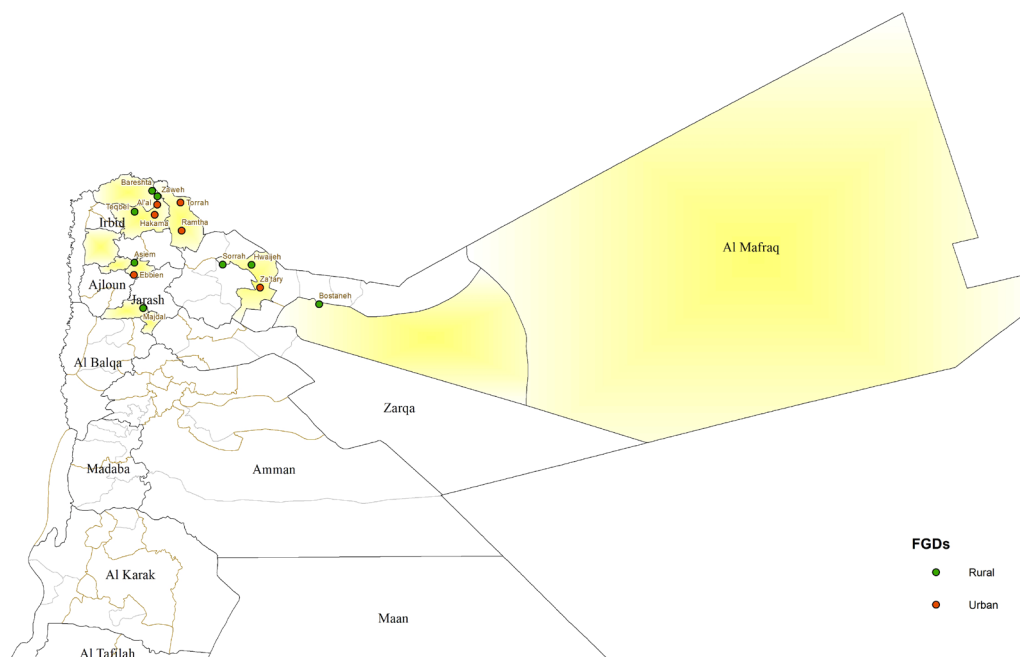
At a 90-per-cent confidence level, the selection of FGD areas also considered the percentage of migrants (proportionate stratified sampling) based on data from the latest census (2015). This methodology ensured that the distribution of 14 FGDs across urban and rural localities in the four governorates was informed by comprehensive demographic insights. The inclusion of migrant data underscores the study's aim to obtain a representative and comprehensive sample, reflecting the population dynamics within the studied regions. Table 11 shows the names of localities where the FGDs were conducted.

Table 11. Governorates and localities of the FGDs

Setting	Locality	Governorate
Rural	Bareshta	Irbid
	Teqbel	Irbid
	Zaweh	Irbid
	Asiem	Ajloun
	Majdal	Jerash
	Bostaneh	Mafraq
	Hwaijeh	Mafraq
	Sorrah	Mafraq
Urban	Ramtha	Irbid
	Hakama	Irbid
	Torrah	Irbid
	Al'al	Irbid
	Ebbien	Ajloun
	Za'tary	Mafraq

The map in Figure 34 shows the distribution of the localities.

Figure 34. Distribution of FGDs in rural and urban areas



Source: Adapted from a map of Jordan available at <https://maps.un.org>.

Note: This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the International Organization for Migration.

5.3.1. Water scarcity and agriculture

Urban communities were increasingly concerned about water scarcity and its impact on agriculture, leading to a push for community-based adaptation strategies to address these issues. Despite these concerns, urban respondents did not typically cite climate change as a dominant factor for relocation, indicating that other socioeconomic factors take precedence in their migration decisions.

In rural areas, water conservation techniques were prominent, with 37.2 per cent of responses highlighting their importance. Sustainable agricultural practices follow closely at 32.6 per cent, underscoring the reliance on agriculture and the need for sustainability. Rural respondents, like those from Brishta, expressed satisfaction with their moderate climate and were generally unwilling to relocate due to climatic changes alone. Many rural residents view their environment as suitable for their lifestyle, indicating that climate change is not the sole factor influencing migration decisions.

All respondents highlighted the severe consequences of climate change on agriculture, including water scarcity, land degradation and seasonal farming disruptions, especially in rural areas.

5.3.2. Human mobility dynamics in urban and rural areas

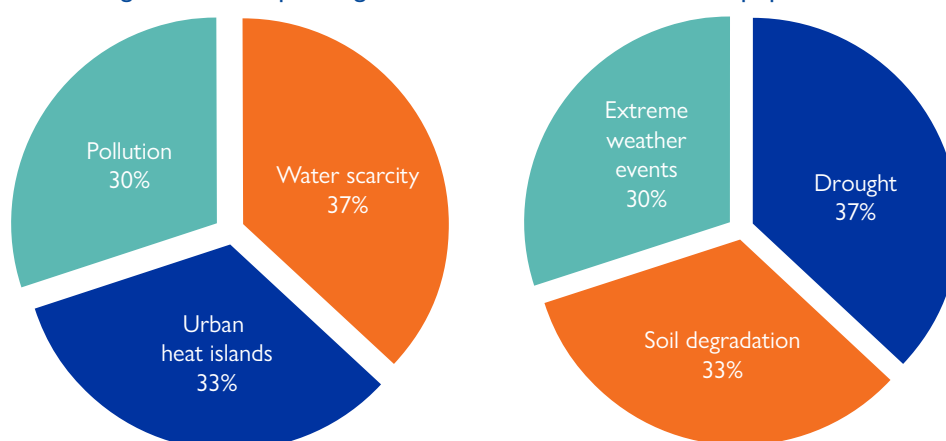
Individuals prioritize job opportunities and education in urban areas, while rural residents prioritize family connections. Urban areas focus on economic diversity and community support networks. Migration decisions are influenced more by economic opportunities than by direct climate impacts.

Migration to urban areas is a significant response to rural challenges, with 30.2 per cent of respondents indicating this trend. For many rural residents, the decision to move is more about accessing better services rather than escaping climate impacts. This highlights the importance of service availability in rural areas as a critical factor in migration decisions. The rural environment is considered suitable, and migration decisions are not solely based on climate change concerns. Economic opportunities and service accessibility are more critical.

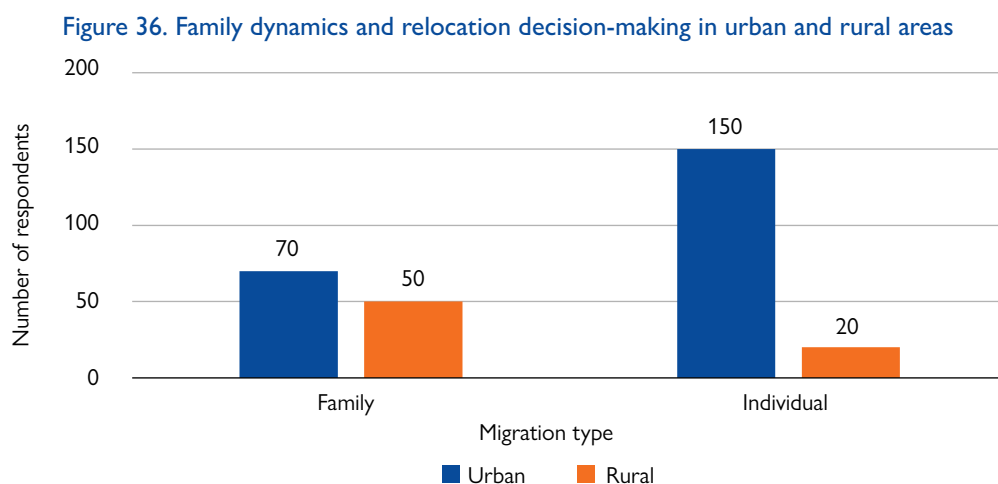
In the urban setup, 41.7 per cent reported that community support networks were dominant and depended mainly on community connections. Coming second at 33.3 per cent was diversifying income sources, as economic resilience was made possible by having different income sources. Investing in education came in at 25 per cent, indicating they realized long-term returns for human capital. Management of water resources in the rural context was represented by water conservation techniques, at 37.2 per cent. Sustainable agricultural practices followed, at 32.6 per cent, pointing out that dependency on agriculture necessitates its sustainability.

Migration is driven by a complex interplay of factors, with economic considerations, service accessibility and family dynamics being significant influencers. Climate change is acknowledged but not the primary driver of migration decisions. It is quite evident that the primary focus of urban strategies is community and economic diversity, while rural strategies are focused on resource management and sustainability.

Figure 35. Most pressing climate issues for urban and rural populations



Source: Primary data from the current study.



Source: Primary data from the current study.

Families prioritize education and health services in migration decisions, while individuals, especially youth, migrate for jobs or education.

5.3.3. Organizational initiatives and coping strategies

Rural populations employ sustainable agricultural practices and water conservation techniques for resilience. Traditional practices and savings strategies are used to cope with climate impacts. In urban areas, community support networks and diversifying income sources are key strategies, with a significant focus on investing in education for long-term human capital development.

The younger population of urban areas demonstrates a high awareness of the impacts of climate change, which they attribute to information widely disseminated through social media. Rural communities were aware of the weather elements and possible results of climate change due to social media and phone alerts such as SMS. Social media, television, the Internet and SMS have been used to spread climate change information and awareness in urban and rural communities. However, there remains a need for more dedicated awareness campaigns and educational initiatives to further inform rural populations about climate adaptation strategies.

What is perceived as effective government programmes in urban areas carries mixed reviews. While there is some support, it is often perceived as inadequate, leading to calls for more targeted assistance for vulnerable communities. This suggests a need for government initiatives to be more responsive and tailored to the specific needs of urban populations.

There is a call for more targeted government support to address the needs of vulnerable urban communities, particularly with water and agricultural challenges. Effective government programmes are essential in tackling these issues, especially in urban centres with prevalent water scarcity and agricultural problems. Enhancing education, health services and job creation efforts is vital to support vulnerable populations and mitigate the effects of climate change and migration. Financial support is a critical component, closely followed by providing infrastructure services and implementing climate resilience projects. Additionally,

organizational support from international projects and initiatives plays a significant role in strengthening community resilience. To effectively support rural and urban communities in adapting to climate change impacts, there must be a focus on improving service delivery, financial assistance and awareness initiatives. Stronger legislation and integrating adaptation strategies into policies are necessary to address climate issues effectively.

5.3.4. Findings from focus group discussions with migrants

To make sure that all the migrants' voices are heard, and additional FGD was conducted in the Al Bustaneh rural area in Mafraq Governorate. The FGD included both Egyptians and Pakistanis, who were daily workers and farmers, and 13 females and 15 males participated. The discussions showed that despite the impact of extreme weather events on agricultural job opportunities and the acknowledgment of climate change effect, those farmers migrants would decide to migrate mainly because of the economic constraints, looking for better services, job opportunities and education. They refer to the cost of moving to other places as the most significant barrier to relocation.

Rural Egyptian women referred to the lack of support from the Government and NGOs, while some assistance comes from other community members, like Syrian refugees. As regards adaptability and resilience initiatives to climate change, they apply traditional practices and saving strategies.

Egyptian men in rural areas were aware of climate change impacts and were informed about weather conditions through the Internet, social media and SMS. However, there is a lack of dedicated awareness campaigns about climate change, and the community relies on basic protective measures and alerts. Moreover, the Pakistani participants shared the same concerns as the Egyptians, expressing the pressing need for better public services and financial support to enhance economic stability in rural areas. Improving service delivery, financial support, and awareness and adaptation strategies are critical to supporting rural Pakistani men and women in coping with climate change impacts.

6. RECOMMENDATIONS

A complex interplay of environmental, economic and social factors drives Jordan's climate change–human mobility dynamics. Addressing these challenges requires a multifaceted approach that considers different populations' diverse needs and circumstances. The following are overarching recommendations based on the analyses presented in this study, to inform policy development and support effective adaptation to and mitigation of climate change impacts.

- 1. Invest in widespread awareness and education regarding climate change and its impacts, particularly in rural areas.** KII indicate that many communities are unaware of existing early warning systems, such as those in Petra and Aqaba, and there is a lack of contingency plans to act on these warnings. To bridge these gaps, comprehensive awareness programmes must be developed, targeting students, women, youth and refugees to raise awareness about climate change adaptation and resilience. Raising public awareness and understanding of climate change's impacts is critical, yet current efforts are inconsistent across different initiatives. Education institutions like Yarmouk University have taken steps to incorporate climate-related courses, but there is a need for more widespread educational efforts and practical implementation on the ground.
- 2. Invest in data collection to deepen understanding of linkages between climate change, environmental degradation and human mobility patterns.** KIIs suggest a significant gap exists in understanding the direct links between climate change and migration. More research and data – including on migration trends, the impact of climate stressors on human mobility, socioeconomic factors influencing migration decisions and their intersectionality with gender and the life cycle – are needed to inform policies and actions.

The abovementioned information will be crucial for developing, in particular, effective migration policies and strategies and supporting affected communities. Leveraging technology, such as remote-sensing and data analytics, can improve early warning systems and disaster response capabilities. Data accessibility is essential to encouraging evidence-based decision-making and policymaking.

Effective coordination among sectors and data-driven decision-making are essential for addressing the challenges posed by climate change. The Department of Statistics should be engaged in these efforts, with a portion of its budget allocated to data collection and analysis. Furthermore, fostering multisectoral partnerships between government agencies, NGOs, academic institutions and the private sector will facilitate knowledge exchange, resource sharing and the implementation of innovative solutions to climate challenges.

3. Safeguard agriculture, as the backbone of rural Jordan, through strengthened local response mechanisms and by fostering resilience at the community level.

Jordan needs to bolster its economic resilience by supporting alternative sources of income and promoting climate-smart projects. Many rural areas suffer from a lack of economic opportunities, driving migration to urban centres. To address this, initiatives should focus on creating jobs, promoting entrepreneurship and supporting small projects, particularly for youth and women, as they play a critical role in agriculture. There is a crucial need for targeted research to enhance understanding of climate-specific challenges, improved access to seasonal weather information to guide agricultural activities, and better water resource management. Investment in early warning systems is crucial for providing useful and potentially life-saving information regarding droughts, floods, frost, contaminated drinking waters and other issues related to climate impacts. This necessitates the implementation of community-based climate adaptation measures.

The Government should facilitate more comprehensive access to financial resources, such as loans and grants, so that farmers can adopt new technologies and improve agricultural productivity. Additionally, there is a need for better communication and awareness about available support systems, such as the Ministry of Agriculture's risk fund and other financial aid. Enhanced education, health and job creation efforts are needed to support vulnerable populations and mitigate the effects of climate change and migration.

Leveraging international partnerships and projects can encourage community-led projects that focus on sustainable practices, such as water harvesting, agroforestry and permaculture, and enhance community resilience. Collaboration with NGOs and international organizations can bring expertise, funding and innovative solutions to local climate challenges and provide technical support and resources to empower local communities to implement these initiatives effectively.

Encouraging efficient use of water resources through water management plans and large-scale irrigation projects aligned with the sector's needs and vulnerabilities will support agricultural productivity and food security and contribute to the restoration of critical regenerative ecological and physical functions of water bodies in the near to the long term. This requires targeted research to address water challenges at both the community and regional levels, informed by existing vulnerability assessments. Enhancing collaboration between water management institutions and deploying educational programmes in rural areas will encourage sustainable water availability for development and domestic use.

4. **Integrate climate change considerations into national strategies and policies, prioritizing resilience-building and ensuring sustainable development.** Interlinkages between climate, agriculture and migration dynamics necessitate comprehensive strategies that address short- and long-term impacts on communities and sectors. The Ministry of Environment and other government bodies must prioritize climate change in their planning and implementation efforts, focusing on sustainable urbanization, agricultural innovation and community engagement. This includes providing technical support, training and capacity-building initiatives for staff and communities. Additionally, national strategies should emphasize the role of women and youth in climate adaptation efforts, offering support and resources to empower these groups in their communities.
5. **Strengthen government support systems and infrastructure, ensuring these trickle down to the lowest level.** There is a clear need for improved infrastructure to manage water scarcity and other natural resources effectively. Many rural areas lack the facilities and services necessary to cope with climate impacts, such as water-harvesting systems, irrigation technology and reliable power supply. Urban areas, while better equipped, still face challenges due to inadequate infrastructure planning and the pressures of increased population density. To decelerate migration from rural to urban areas and ensure sustainable development, investments in infrastructure improvements, such as smart urban planning, water management systems, transportation networks and sustainable agricultural practices, are critical. These improvements should also involve integrating early warning systems and disaster preparedness measures to mitigate the impacts of climate-related events like floods and droughts.

Funding remains critical to implementing effective climate change adaptation and resilience strategies. The Government and its various ministries have recognized the importance of addressing climate change in their strategy and policies, but financial constraints hinder progress. There is a need for increased investment in climate adaptation projects and infrastructure development. International collaboration and external funding are essential to support Jordan's efforts, especially in light of its limited national resources. Programmes such as the Jordan Response Plan (JRP) have shown success. However, a significant funding gap still needs to be addressed to ensure comprehensive support for refugees and local communities.

To effectively address the challenges posed by climate change in vulnerable communities around Jordan's drought-affected areas, there is a pressing need for institutional strengthening and access to financial assistance. Financial support is crucial for designing targeted interventions for vulnerable groups, including women, youth, persons with disabilities, migrants and refugees.

6. **Identify opportunities to strengthen, support and extend robust multi-institutional responses in climate change, migration and disaster risk management.** Mainstreaming activities outlined in the Fourth National Communication, the Global Environmental Facility (GEF) and the National Action Plan, including gender and youth mainstreaming, public awareness, education and capacity-building, knowledge management, technology needs assessments, and scientific research and innovation, will enable a holistic approach to managing the climate change–disaster–human mobility nexus in an inclusive and participatory manner. Formulating policies that address the socioeconomic and environmental drivers of migration should focus on supporting communities affected by climate-induced migration and enhancing the resilience of rural areas to prevent forced migration.

Capacity-building efforts through training programmes for government officials, community leaders, and local stakeholders are necessary to enhance skills for implementing effective adaptation measures. Additionally, designing targeted interventions for vulnerable groups, including women, youth, persons with disabilities, migrants and refugees, ensures that these groups have access to resources and opportunities to participate in climate adaptation initiatives. Recognizing the role of women and youth in climate adaptation and supporting their involvement in agricultural activities, while ensuring access to education and training programmes, is essential for promoting gender-inclusive approaches.

REFERENCES*

Abdullah II (2023). [Remarks by His Majesty King Abdullah II at the plenary session of the seventy-eighth General Assembly of the United Nations](#). New York, 19 September.

Advisory Group on Climate Change and Human Mobility (2015). [Human mobility in the context of climate change UNFCCC – Paris COP21](#). Recommendations. Office of the United Nations High Commissioner for Refugees, Geneva.

Anatol, M., R.M. Kirton and H.G. Katwaroo (2023). [Cross-border Evacuation Protocol for Countries of the Eastern Caribbean in the Context of Disasters](#). International Organization for Migration, Roseau.

Bankova, D. (2024). [Syrians abroad weigh returning to the country they fled](#). Reuters, 11 December.

Bertelsmann Stiftung (BTI) (2024). [Country report – Jordan](#). Bertelsmann Stiftung, Gütersloh, Germany.

Carloni, A.S. (2005). [Rapid Guide for Missions: Analysing Local Institutions and Livelihoods](#). Food and Agriculture Organization, Rome.

Chambers, R. and G.R. Conway (1991). [Sustainable rural livelihoods: practical concepts for the 21st century](#). Discussion paper. Institute of Development Studies, Brighton, United Kingdom.

Conference of the Parties of the United Nations Framework Convention on Climate Change (2011). [Report of the Conference of the Parties on its sixteenth session, Cancun, Mexico, 29 November to 10 December 2010. Addendum part two: Action taken by the Conference of the Parties \(FCCC/CP/2010/7/Add.1\)](#).

El-Sharif, S. and M. Muasher (2024). [Vulnerability and governance in the context of climate change in Jordan](#). Article. Carnegie Endowment for International Peace – Middle East Program, 15 May.

European Commission – Joint Research Centre (2016). [European Civil Protection and Humanitarian Aid Operations \(ECHO\) daily map](#). European Union, 21 January.

Fragaszy, S., M. Belhaj Fraj, M. McKee, G. Jobbins, E. Al-Karablieh, K. Bergaoui, A. Ghanim, L. Lawrenson and R. McDonnell (2022). [MENA drought synthesis of drought vulnerability in Jordan](#). Final report. International Water Management Institute, Colombo.

Ghazal, M. (2023). [Changing times for olive groves: The impact of climate change on olive cultivation in Jordan](#). *The Jordan Times*, 13 June.

* All hyperlinks were working at the time of writing this report.

Haddad, R. (2023). [The threat of climate change in Jordan](#). Blog post. Sada, Carnegie Endowment for International Peace – Middle East Program, 27 April.

Intergovernmental Panel on Climate Change (IPCC) (2018). Annex II: Glossary. In: [Climate Change 2022: Impacts, Adaptation and Vulnerability](#). Sixth assessment report contribution of Working Group II. Cambridge University Press, Cambridge, United Kingdom.

International Organization for Migration (IOM) (2019). [Glossary on Migration](#). International Migration Law, No. 34. IOM, Geneva.

Jordan, Central Bank of (2023). [Annual Report 2022](#). Central Bank of Jordan, Amman.

Jordan, Department of Statistics (DOS) (2008). [Jordan Population and Family Health Survey 2007](#). Report. DOS, Amman.

DOS (2015). Table 3.1: Distribution of population by population category, sex, nationality, administrative divisions and urban/rural. In: [Statistical Tables of the Population and Housing Census 2015](#). Data set.

DOS (2018). [Agricultural Census 2017](#). Report. DOS, Amman.

DOS (2022a). [Livestock](#). Data set.

DOS (2022b). [Table 3: Summary of compensation for frost and drought \(2022\)](#). Data set.

DOS (2023a). [Demographic statistics – population](#). Data set.

DOS (2023b). [Distribution of area according to land use in Jordan, 2004–2023](#). Data set.

DOS (2023c). [Number of newborn and mortality of livestock, 1995–2002](#). Data set.

DOS (2023d). [Table 6: Quantity and usage of ground water for agriculture use by water basin \(1995–2023\)](#). Data set.

DOS (2023e). [Table 8: Quantity and usage of ground water for distant regions & livestock use by water basin \(1995–2023\)](#). Data set.

DOS (2023f). [Table 1: Number of pulmonary TB cases by governorate \(1990–2023\)](#). Data set.

DOS (2023g). [Table 3: Number of typhoid and para typhoid cases by governorate \(1989–2023\)](#). Data set.

Jordan, Government of (2023). [National Disaster Risk Reduction Strategy 2023–2030](#). Government of Jordan, Amman.

Jordan, Government of (2024). [Economic Modernisation Vision](#). Government of Jordan, Amman.

Jordan, Ministry of Energy and Mineral Resources (MEMR) (2024). [Energy and its partners are studying the most suitable infrastructure options for green hydrogen in Jordan](#). News article. MEMR, 19 February.

Jordan, Ministry of Environment (2022). [The National Climate Change Adaptation Plan of Jordan – 2022](#). Ministry of Environment, Amman.

Jordan, Ministry of Environment (2023). [Fourth National Communication on Climate Change](#). Ministry of Environment, Amman.

Mamo, D. [The Indigenous World 2020](#). International Work Group for Indigenous Affairs, 2020.

McAdam, J. (2009). [From economic refugees to climate refugees? Review of International Refugee Law and Socio-Economic Rights: Refuge from Deprivation by Michelle Foster](#). *Melbourne Journal of International Law*, 10(2):579–585.

Notre Dame Global Adaptation Initiative (ND-GAIN) (2021). [ND-GAIN Country Index – Country Rankings](#) section.

Perosino, L. (2023). [Comprehensive overview of the agricultural sector in Jordan](#). Technical Reports, No. 72. Agence Française de Développement, Paris.

The Jordan Times (2024). [Electric, hybrid vehicles constitute 18.5% of Jordan's total vehicle fleet – environment minister](#). *The Jordan Times*, 4 January.

United Nations (1951). General Assembly resolution 429(V) on the [Convention relating to the Status of Refugees](#), adopted on 14 December (A/RES/429(V)).

United Nations (1992). [United Nations Framework Convention on Climate Change](#), adopted on 9 May (FCCC/INFORMAL/84).

United Nations (2010). General Assembly resolution 64/291 on the [Follow-up to paragraph 143 on human security of the 2005 World Summit Outcome](#), adopted on 16 July (A/RES/64/291).

United Nations (2012). General Assembly resolution 66/290 on the [Follow-up to paragraph 143 on human security of the 2005 World Summit Outcome](#), adopted on 10 September (A/RES/66/290).

United Nations (2016). General Assembly, [Report of the Open-Ended Intergovernmental Expert Working Group on Indicators and Terminology Relating to Disaster Risk Reduction](#), 1 December (A/71/644).

United Nations Convention to Combat Desertification (UNCCD) (2022). Desertification – definition. [UNCCD Terminology](#) section.

United Nations High Commissioner for Human Rights (Office of the) (1998). [Guiding principles on internal displacement](#). Report of the Representative of the Secretary-General, Mr Francis M. Deng, submitted pursuant to Commission resolution 1997/39, addendum (E/CN.4/1998/53/Add.2).

United Nations High Commissioner for Refugees (Office of the) (2024). "Asylum-seeker", definition in [Master Glossary of Terms](#) section.

United Nations Office for Disaster Risk Reduction (UNISDR) (2009). [2009 UNISDR Terminology on Disaster Risk Reduction](#). UNISDR, Geneva.

UNISDR (2024). [Jordan](#). DesInventar Sendai data set.

World Bank (2022). [Jordan Country Climate and Development Report](#). World Bank, Washington, D.C.

World Food Programme (2019). [Flood hazard map – Jordan](#). Map, 22 July.



International Organization for Migration
17 route des Morillons, P.O. Box 17, 1211 Geneva 19, Switzerland
Tel.: +41 22 717 9111 • Fax: +41 22 798 6150
Email: hq@iom.int • Website: www.iom.int