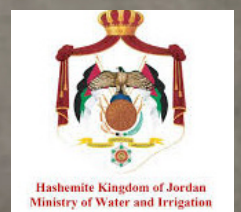


# PLANNING FOR SECURE WATER FUTURES IN CONTEXTS OF DROUGHT AND DISPLACEMENT:

Evidence from Mafraq, Jordan





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**Planning for Secure Water Futures in  
Contexts of Drought and Displacement:  
Evidence from Mafrq, Jordan**



## Abbreviations

BA	British Academy
CRUMP	Climate-Resilient Urban Master Plan
GIS	Geographic Information System
GMM	Greater Mafraq Municipality
ibid	ibidem (same source as previously cited)
IPCC	Intergovernmental Panel on Climate Change
IIED	International Institute of Environment and Development
JVA	Jordan Valley Authority
MCM	Million Cubic Meters
MoA	Ministry of Agriculture
MoE	Ministry of Education
MoENV	Ministry of Environment
MoH	Ministry of Health
MoI	Ministry of Interior
MoLA	Ministry of Local Administration
MOWI	Ministry of Water and Irrigation
NDC	Nationally Determined Contribution
NGOs	Non-Governmental Organizations
NRW	Non-revenue water
RCP	Representative Concentration Pathway
UN-HABITAT	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
WASH	Water, Sanitation, and Hygiene
WAJ	Water Authority of Jordan
YMC	Yarmouk Water Company

# FOREWORD

## FROM HEAD OF UN-HABITAT JORDAN OFFICE

Climate change, rapid urbanization, and forced displacement are placing unprecedented pressure on Jordan's urban systems, particularly in water-scarce cities hosting large refugee populations. Increasing drought, groundwater depletion, and infrastructure stress are deepening existing inequalities in access to essential services and challenging the capacity of cities to respond in an inclusive and sustainable manner.

UN-Habitat Jordan is committed to supporting cities in addressing these intersecting challenges through evidence-based planning, inclusive governance, and climate-resilient urban development. Within this framework, the project "Drought in Displacement: Generating Evidence to Inform Responses to Urban Drought that are Inclusive of Refugees", implemented with the International Institute for Environment and Development (IIED) and supported by the British Academy, provides critical insights into the lived realities of water insecurity at the neighbourhood scale.

Focusing on Dahiyat Al-Malik Abdullah in Mafraq City, the study combines GIS analysis, household surveys, and participatory validation to examine how drought, displacement, and governance systems interact to shape unequal access to water. The findings highlight how climate stress and institutional constraints disproportionately affect low-income households, tenants, and refugee communities, resulting in chronic and uneven water insecurity.

At the same time, the report underscores the resilience and adaptive strategies of local communities, while also revealing the limits of household-level coping in the absence of systemic solutions. It calls for integrated responses that link water governance, urban planning, and climate adaptation across national, regional, city, and neighbourhood levels.

The lessons from this study extend beyond Mafraq, offering important implications for cities across Jordan and other displacement-affected contexts. They reinforce the need to treat water not only as an infrastructure challenge, but as a matter of equity, governance, and climate justice. UN-Habitat Jordan extends its gratitude to all partners and stakeholders who contributed to this work. It is our

hope that this report will inform more inclusive, resilient, and sustainable urban water governance in Jordan and beyond.



*Eng. Deema Abu-Thiab  
Head of UN-Habitat Jordan Office*



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## Executive Summary

This report presents findings from the research project “Drought in Displacement: Generating evidence to inform responses to urban drought that are inclusive of displaced people,” funded by the British Academy and led internationally by the International Institute for Environment and Development (IIED) and in Jordan by UN-Habitat. The study examines Dahiyyat Al-Malik Abdullah in Mafraq City, an urban center where climate stress, rapid urbanization, and protracted displacement converge to intensify water insecurity and infrastructure strain.

The study adopts a mixed-methods approach combining GIS analysis, household surveys, field observation, and stakeholder validation workshops. It develops an integrated evidence base across four interlinked dimensions: drought dynamics, displacement and urban transformation, water governance, and urban planning and service provision.

The findings demonstrate that water insecurity in Dahiyyat Al-Malik Abdullah is not solely a function of physical scarcity, but is produced through the interaction of environmental stress, displacement driven urban expansion, and fragmented governance systems. These overlapping pressures generate structurally unequal access to water and deepen vulnerability across both refugee and host communities.

**Drought** is intensifying both at the regional and local level. Meteorological drought probability in northern Jordan is projected to rise from 10-14% historically to between 60-70% under high-emission scenarios. Hydrological drought is already chronic: the Amman-Zarqa aquifer (one of two primary water sources for Mafraq) is being extracted at nearly double its safe yield. At the neighbourhood level, green cover in Dahiyyat Al-Malik Abdullah has declined by approximately 67% over the past decade, agricultural productivity is collapsing, and no public recreational green space exists.

**Displacement** has fundamentally reshaped the neighbourhood. Dahiyyat Al-Malik Abdullah has experienced rapid population growth driven by both refugee settlement and internal Jordanian migration. The majority of residents are economically vulnerable, with 74% of households earning below the national minimum wage. Syrian households are disproportionately affected, with near-universal tenancy and lower levels of income and educational attainment, reinforcing structural inequality within the urban system.

**Water governance** emerges as a critical driver of uneven access. Although 73% of households are formally connected to the piped network, service delivery is highly unreliable. Water is typically supplied once per week, with seasonal deterioration in summer months and a significant


proportion of households experiencing interruptions exceeding one day. Only a minority of households can consistently fill their storage tanks without supplementary coping measures. These constraints are compounded for refugee households, who face higher effective costs due to shared metering arrangements, lower storage capacity, limited formal engagement with utilities, and dependence on landlord-mediated access. As a result, 74% of residents report recurrent episodes of water deprivation, with Syrian households disproportionately experiencing high-severity water insecurity and its associated impacts on health, livelihoods, hygiene, and wellbeing.

**Urban planning** and regulatory systems have not kept pace with rapid and largely informal urban expansion. Approximately 62% of the neighbourhood lies outside formally regulated planning zones, despite being densely populated and functionally integrated into the city. This regulatory mismatch constrains infrastructure provision and limits equitable service delivery. The study estimates that immediate regularization could bring approximately 22,000 additional residents into formal planning and enable improved access to basic services, particularly water. Persistent gaps in education, health, and commercial infrastructure further reinforce spatial and social inequality within the neighbourhood.

The analysis highlights that vulnerability in Dahiyyat Al-Malik Abdullah is structurally produced through the interaction of climate stress, governance fragmentation, and unequal urban development processes. In this context, households are increasingly required to absorb system failures through costly and informal coping strategies, reinforcing socio-economic disparities and reducing long-term resilience.

**The report concludes that addressing water insecurity in Mafraq requires a shift away from fragmented and reactive approaches toward integrated, multi-scalar urban governance.** This includes aligning water management, climate adaptation, and urban planning systems; strengthening institutional coordination; and ensuring that displacement-affected communities are explicitly included in planning and service delivery frameworks. Rather than being treated solely as a humanitarian concern, refugee-hosting urban areas should be recognized as critical sites for advancing long-term climate resilience and equitable urban development.

The recommendations set out in this report, validated through stakeholder and community engagement, provide a pathway toward more inclusive and climate-resilient urban water governance in Mafraq and offer transferable lessons for secondary cities facing similar intersecting pressures across the region.



**67%**  
Decline in green cover



**73%**  
Households experience recurrent water deprivation



**62%**  
Of the neighbourhood lies outside formally regulated planning zones



**22,000**  
Residents excluded from formal planning systems



01

INTRODUCTION



## Project Overview

### Project Overview

Across the world, displacement and climate risks are increasingly converging in cities (UNHCR 2024). Today, most forcibly displaced people live in urban areas rather than camps (ibid.), often settling in low-income neighbourhoods and informal settlements where housing is more affordable and livelihoods are accessible through the informal economy (Cocina et al 2025). These same neighbourhoods are frequently the most exposed to climate risks (ibid.), placing both displaced populations and host communities under compounded pressure. Yet, research on how climate risks impact displaced people and low-income host communities in neighbourhoods where they settle remains limited.

The research project “Drought in Displacement: Generating evidence to inform responses to urban drought that are inclusive of displaced people,” funded by the British Academy and led internationally by The International Institute for Environment and Development (IIED) and in Jordan by UN-Habitat-Jordan, responded to this gap. The project focused on one climate risk – drought – and generated evidence on how drought is experienced in low-income migrant-hosting neighbourhoods in secondary cities. It also identified how access to WASH services and infrastructure can support safe and resilient cities and communities in water-stressed neighbourhoods.

The research was grounded in the recognition that equitable and sustainable responses to urban drought must explicitly include displaced populations. By focusing on drought in sites of reception rather than drought as a driver of displacement, the project shifts the policy and research lens toward the everyday realities of refugees living in water-insecure cities. The overarching objective is to generate policy-relevant evidence that supports water security for migrant-hosting secondary cities, including enabling displaced communities to claim their right to water and ensuring their priorities are integrated into municipal and national WASH planning.

Local and national governmental entities including Greater Mafrq Municipality (GMM), Yarmouk Water Company (YMC), and the Ministry of Water and Irrigation (MWI), played key roles in supporting the project, including sharing data that supported secondary data analysis. They also provided feedback on, and endorsed, the recommendations that conclude this report and

that outline actionable ways forward for municipal and national WASH plans that promote inclusive urban water governance and sustainable water futures.

### Key findings and recommendations

Drought is having a pronounced impact on the local environment of migrant-hosting low-income neighbourhoods. Green cover is eroding at alarming rates, biodiversity is reducing, and ability to sustain crops and livestock is diminishing.

Residents of migrant-hosting low-income neighbourhoods are experiencing severe water insecurity. Refugees living in urban areas experience disproportionate challenges in accessing adequate, affordable, and reliable water services. Barriers include limited access to formal water connections, reliance on shared or informal arrangements, higher debts to private water tankers, and difficulties in reporting service disruptions or requesting infrastructure improvements. These challenges are compounded by refugees’ limited legal and institutional pathways to make claims on service providers and municipal authorities.

Water insecurity was also found to emerge from several interlinked challenges, including the lack of proactive urban planning for rapidly urbanising neighbourhoods. Bringing actually inhabited areas into planning will enable the water utility company to expand its network in displacement-impacted neighbourhoods, bringing a significant number of people – refugees and hosts – into the network, and reducing reliance on private water tankers.

As water insecurity intensifies, displaced communities are increasingly vulnerable to exclusion from water governance processes, further undermining their right to water. Without deliberate efforts to include refugees in planning and response mechanisms, urban drought strategies risk reinforcing existing inequalities. As key findings from this project demonstrate, this lack of representation is reducing their ability to collectively raise concerns, claim rights, and influence service delivery in relation to essential resources such as water.

Planning for water security requires integrated planning that proactively responds to natural, climatic, social, and economic realities, and that moves rapidly growing and structurally underserved neighbourhoods from the margins to the centre of long-term, sustainable, and climate-resilient urban development and planning.



## Project Aims



### Research Drought & Displacement

Policy Agenda



### Inform Planning Strategies

Urban & National



### Amplify Displaced Voices

Community Dialogues



### Strengthen Water Governance

Equitable Futures in Jordan



### Inclusive WASH Solutions

Water Priorities





## Study site: Dahiyyat Al-Malik Abdullah in Mafraq City

Secondary cities are some of the fastest growing urban areas worldwide, and are increasingly home to the urban displaced (Davidoff-Gore and Le Coz 2023). Mafraq in Jordan is one such example. The population of The Greater Mafraq Municipality doubled within a timeframe of 5 years (2011-2016) as Syrian refugees settled there (World Bank 2016).

Mafraq is also a drought vulnerability hotspot (Fragaszy et al 2022), facing a combination of climatic exposure, groundwater depletion, and socio-economic pressures. These risks are further amplified in urban areas hosting displaced populations, where infrastructure systems are already under strain.

The Greater Mafraq Municipality (GMM) was first established in 1944 as Mafraq Municipality and later expanded into its current form in 2002. GMM sits within Mafraq Governorate, one of 12 administrative divisions across Jordan. GMM is home to Mafraq City, the governorate's largest urban centre. Mafraq City has always been a migrant hosting centre. Historically, Mafraq's urbanization was shaped by rural-to-urban migration because of its role as a hub for economic activity and services. The single most transformative factor in the past two decades has been the settlement of large numbers of Syrian refugees.

According to the last Census conducted in 2015, GMM had a population of 122,028 people; around 22% of the governorate's total (Department of Statistics 2016). The municipality's population density, based on 2015 figures, reached 1,060 persons per km<sup>2</sup>, with an annual growth rate of 2%.

Refugees now represent a defining demographic feature of the city. Within GMM, 43% of residents are non-Jordanians: the vast majority of those are Syrian (88%), followed by Egyptians (7%), Palestinians (4%) and others (1%) (Department of Statistics 2016). This clustering underscores Mafraq's role as a front-line city in hosting displaced populations. Unlike other parts of Mafraq Governorate, there are no formal refugee camps within GMM's boundaries. This means that refugees are primarily urban refugees living side by side with host communities and utilising existing municipal systems and services. The municipality reports that migration impacts every sector in different ways, including health, education, labor markets, housing, energy, water, and the environment.

GMM covers an area of 115.1 km<sup>2</sup> (representing less than 0.5% of Mafraq Governorate's vast territory). Within this area, approximately 45% falls under the officially regulated zone, where municipal planning and service delivery are directly applied. As the main local authority, GMM is responsible for a wide range of public services, including road maintenance, street lighting, solid waste management, building permits, tax collection, and other municipal functions. These responsibilities have become increasingly complex as the city's population and service demands have expanded dramatically over the past decades.

Amid these dynamics, Dahiyyat Al-Malik Abdullah was selected as the focus neighbourhood for this study. Identified in the Mafraq City Spatial Profile (UN-Habitat, 2024) as one of the city's most vulnerable areas, it faces overlapping socio-economic, environmental, and infrastructural challenges that make it especially sensitive to climate stresses such as drought. It sits partially outside of municipal planning zones, and the reach of water and sanitation networks in the neighbourhood is variable, falling below the national average. According to the last Census, refugees represent approximately 37% of the neighbourhood's population, making it a critical site for examining the intersections of drought, displacement, vulnerability, and service delivery.

While findings presented here as specific to a single neighbourhood, Dahiyyat Al-Malik Abdullah serves as a reflection of broader urban challenges in Mafraq and other secondary cities more widely. Lessons from this neighbourhood can inform not only local responses but can also be scalable strategies for inclusive, climate-resilient urban WASH planning at the city, regional, and national levels – and beyond.

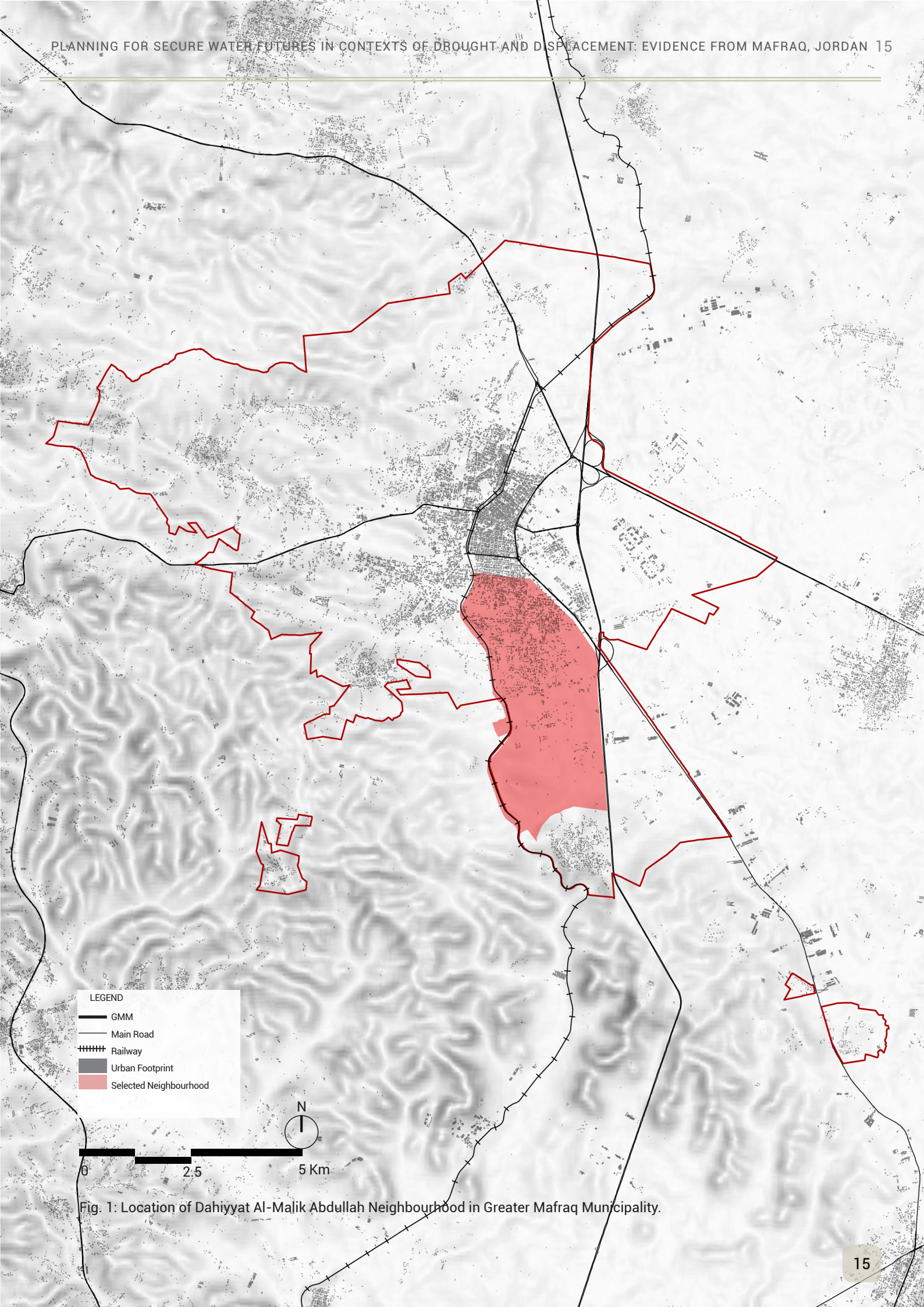


Fig. 1: Location of Dahiyat Al-Malik Abdullah Neighbourhood in Greater Mafraq Municipality.

## Methodology

This study adopted a mixed-methods approach to generate evidence-based and actionable recommendations. The methodology combined desktop research, geo-spatial mapping, a survey of residents, and validation workshops with neighbourhood residents (refugees and hosts) and municipal and national stakeholders. This approach ensured data was triangulated across different sources and validated by different stakeholders.

The research employed the following methodologies:

(1) Desktop research and secondary data review: this included secondary data analysis of datasets previously compiled for the Mafraq City Spatial Profile (UN-Habitat, 2024), this time with a focus on drought and water infrastructures at the neighbourhood level in Dahiyyat Al-Malik Abdullah. This was supported by gathering and studying national and regional policy frameworks, sectoral strategies, and published assessments, and supplemented with data and insight shared by key institutional stakeholders.

(2) Field Observations and analysis: on-site surveying and direct observation were undertaken to map the current physical, functional, and infrastructural conditions of the neighbourhood. This was conducted with the support of students enrolled in the "Urban Planning & Design" course at the Hashemite University.

(3) A survey with residents: Dahiyyat Al-Malik Abdullah was divided into 10 zones to account for zoning and service disparities. Four different typologies covering planning and water access were identified: areas that fall under planning zones and are also connected to the water network, areas that are regulated but unconnected to water networks, areas that are unregulated but connected to the water network, and areas that are unregulated and unconnected. Sampling quotas were allocated proportionally based on estimated population density in each zone (gathered based on the GIS modelling). In total, 70 households were interviewed across all zones, achieving a 90% confidence level with a 10% margin of error in relation to the neighbourhood's population.

(4) Participatory workshops with community members, municipal, and national stakeholders: this included an introductory workshop with municipal and national government and utility stakeholders to present project objectives, and a validation workshop (with residents and representatives of communities as well as municipal and national government and utility stakeholders) where findings from the above methodologies were presented alongside proposed recommendations. This step ensured that the outcomes were grounded in local realities, technically feasible, and practically implementable. Feedback from these workshops was integrated into the final analysis, strengthening ownership and increasing the likelihood of uptake and implementation.

### Report Structure

The report is organised around five sections. The first four sections present new and original evidence generated through

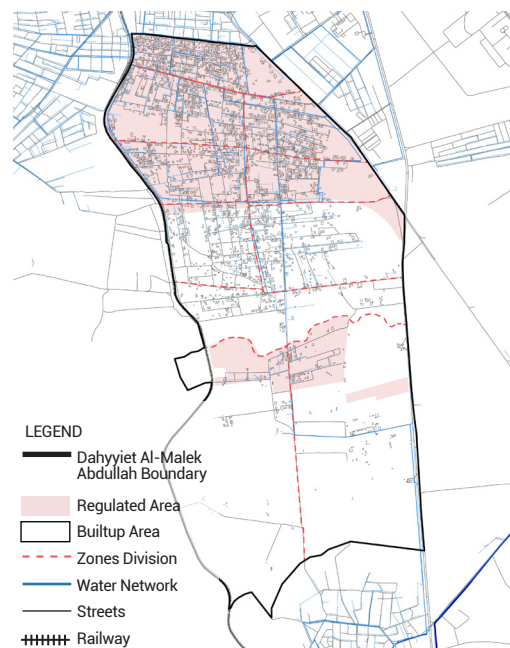


Fig. 2: Division of the Neighbourhood into Zones.

primary and secondary data collation and analysis by the project. The final section brings together recommendations derived from the findings shared in those four sections. Those recommendations were discussed and validated by community members and municipal and national government and utilities stakeholders.

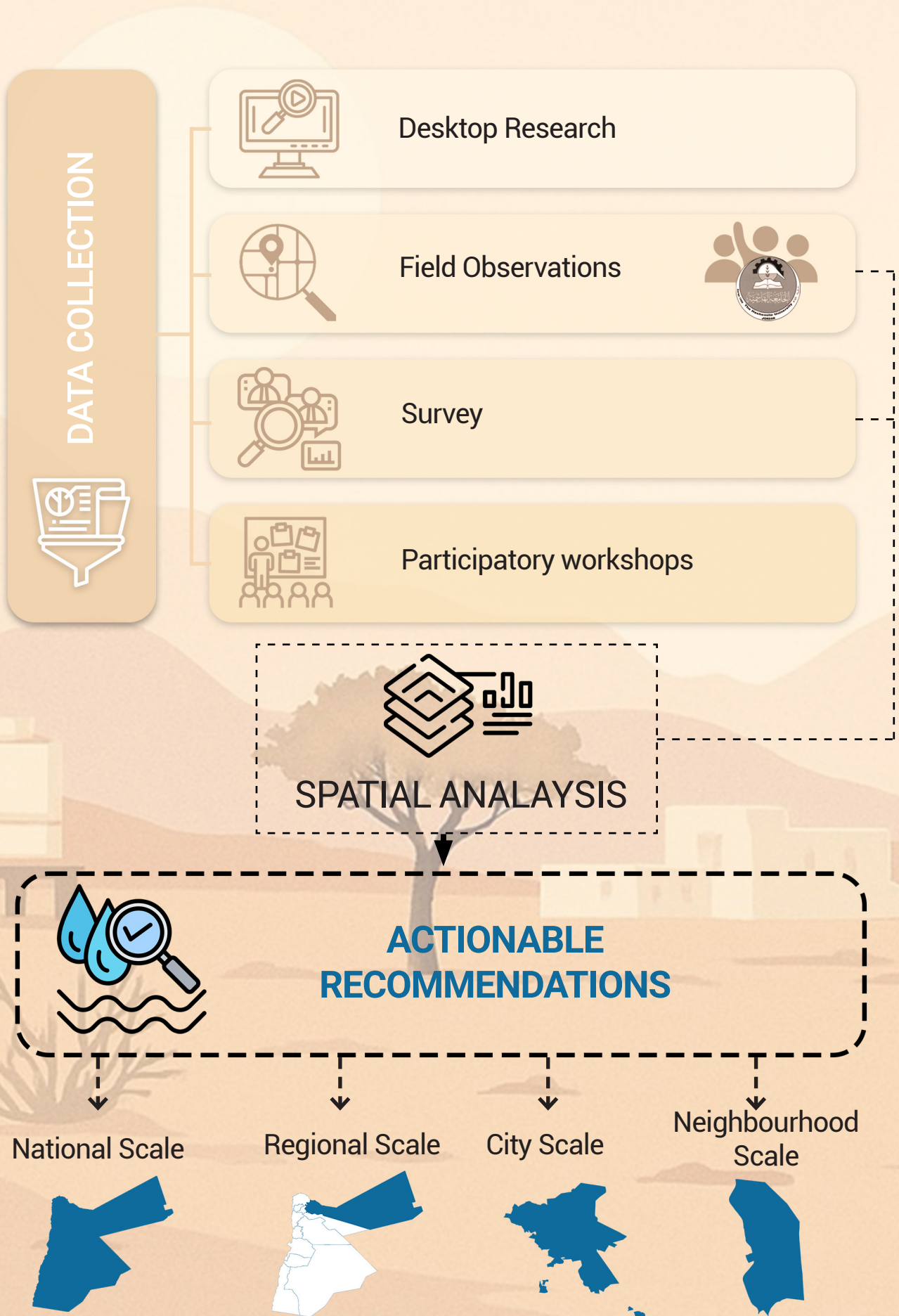
The first section, on drought, combines historical data, including satellite imagery, geo-spatial data gathered through GIS, and survey data, to present an outline of how drought is shaping the ecology and landscape of Dahiyyat Al-Malik Abdullah, particularly its freshwater resources and green cover.

The second section, on displacement, combines geo-spatial data and survey data, to map the neighbourhood's urban growth and present a picture of the multi-layered vulnerabilities of its residents.

The third section, on water governance, draws principally on the survey data to outline uneven and unequal access to water within the neighbourhood, drawing comparisons between refugees and hosts where these are statistically significant.

The fourth and final section, on urban planning, draws on geo-spatial data to outline what a proactive urban plan for Dahiyyat Al-Malik Abdullah would look like.

Sections are preceded by brief introductions to provide background, followed by a presentation of findings. While presented separately for readability, the report aims to advance an understanding of how drought, displacement, water governance, and urban planning are deeply intertwined. Taken together, the report underscores the importance of Mafraq's experience as a front-line city facing multiple global challenges. Its experience reflects how urban planning is not adequately responding to climate and demographic changes, and fragile water systems, and demonstrates the need for integrated, proactive, and inclusive approaches to urban drought resilience.





02

DROUGHT



## Background: Droughts in Mafraq

Jordan is one of the most water-scarce countries in the world, with annual renewable freshwater resources estimated at only 61 m<sup>3</sup> per person in 2025, among the lowest globally and far below the 500 m<sup>3</sup> per person threshold that defines absolute water scarcity (MWI 2023). Water consumption in the municipal supply sector quadrupled over the past 30 years. Despite rapidly increasing supply, produced liters per capita per day have decreased due to population growth and reduced from 141 l/capita/day in 1990 to 126 l/capita/day in 2017 (MWI 2018b, CBJ 2018 ). The country's water supply depends on four main resources: groundwater, surface water, and treated wastewater. In 2022, Jordan's water supply was derived primarily from groundwater (58%), followed by surface water (26%) and treated wastewater (16%) (MWI 2022). Groundwater depletion remains the most urgent challenge.

Jordan's water resources are under extreme pressure from over-abstraction, trans-boundary limitations, climate change impacts, and rising domestic demand (Earle et al. 2025). Without significant improvements in efficiency, trans-boundary water-sharing agreements, and investment in non-conventional water sources, the country's water insecurity will continue to deepen, posing serious risks for both host communities and refugees.

According to the Intergovernmental Panel on Climate Change (IPCC), drought can be defined as a prolonged period of below-average precipitation that results in significant water shortages, affecting freshwater availability and impacting various sectors such as agriculture, water supply, and local ecosystems. However, drought is not solely characterized by a lack of rainfall; it is also influenced by other critical factors, such as the rate of evapotranspiration, soil moisture levels, and temperature, all of which determine the actual water demand and availability in the affected area.

Droughts are generally classified into three main types: meteorological, agricultural, and hydrological (though studies have argued for a wider typology that recognize environmental/ecological drought and socioeconomic drought) (Srivastava et al 2025; NDCM 2026; Wilhite and Glantz 1985). Meteorological drought refers to periods of below-average rainfall, agricultural drought occurs when soil moisture is insufficient for crops and pasture, and hydrological drought refers to stream-flow and emerges when rivers, reservoirs, or groundwater fall below sustainable levels. In Jordan, while meteorological droughts

are the increasing in frequency and duration (Al-Qinna et al 2011) but hydrological drought is chronic, particularly in northern areas like Mafraq, where prolonged rainfall deficits combined with heavy withdrawals from dams, reservoirs, and aquifers have depleted water resources beyond sustainable levels (UN-Water 2024). Drought has had a particularly significant impact on Jordan's water scarcity challenges, which in turn increased exposure and sensitivity to drought's impacts (Fragaszy et al 2022).

Historical records show that meteorological droughts have occurred in modern day Jordan for centuries, with notable dry years in the 18th and 19th centuries and more frequent multi-year droughts in the 20th century. Severe meteorological droughts in 1958–1962, 1997, and 1999, for instance, devastated rain-fed agriculture and grazing lands, reduced dam storage to historic lows, and directly impacted the livelihoods of over 180,000 farmers and herders (Bazza et al. 2018) . Since 2000, major drought events were documented in 2001, 2008–2009, 2011, and most recently in 2021 (Bazza et al 2018, Fragaszy et al 2022). In 2002 and 2012, drought conditions almost exclusively affected the Badia (Bazza et al 2018), in which Al-Mafraq Governorate is situated.

Jordan has recently shifted from reactive drought response to a proactive drought risk management approach, as articulated in the National Drought Action Plan published in 2023. Although the plan has not been formally approved as official government policy, the Water Sector Policy for Drought Management was endorsed by the cabinet, with components of the broader drought strategy already being implemented (MWI 2023). This framework is structured around three core pillars: drought monitoring and early warning systems, vulnerability and impact assessment, and mitigation and preparedness planning across sectors. Despite this policy progress at the national level, there are limited localized drought-specific planning or implementation mechanisms in Mafraq. This creates a gap between national frameworks and neighbourhood-level realities, particularly in high-risk areas such as Dahiyat Al-Malik Abdullah.

**LEGEND**

- GMM
- Dahiyyat Al-Malik Abdullah
- Main Road
- Railway
- Urban Footprint

**DROUGHT EVENTS - 1981 - 2017**

- 4.6 - 4.9
- 5 - 5.2
- 5.3 - 5.6



Fig. 3: Historical Drought Events Recorded in Mafraq City (1981–2017)



## Meteorological drought indicators for Mafraq

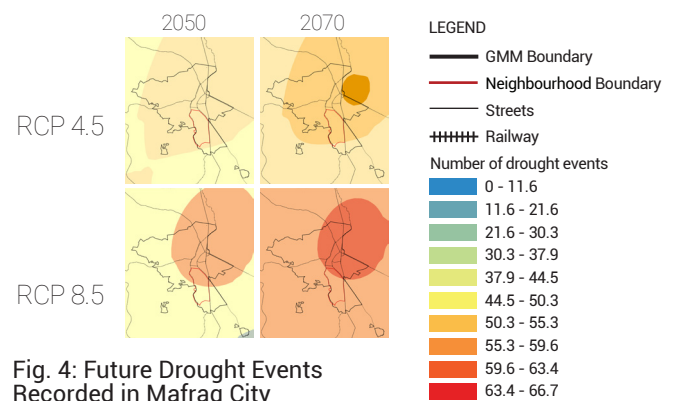
To identify historical drought patterns at the city scale, a drought map for Mafraq was developed using long-term rainfall data from meteorological stations across Jordan covering the period 1980 to 2017, based on records from the MWI and the Jordan Meteorological Department. Rainfall trends were analyzed using the Standardized Precipitation Index (SPI), which enables the identification of years with below-average rainfall. Years with significantly reduced precipitation were classified as drought years.

Based on this analysis, Mafraq experienced an average of approximately 5 to 5.2 drought events between 1981 and 2017, as illustrated in Figure 3.

Based on statistically downscaled climate projections from Global Climate Models (GCMs) from Jordan’s Meteorological Department stations, the analysis indicates that Mafraq is likely to experience more frequent and prolonged meteorological droughts throughout the 21st century. The standardized precipitation index models suggest that drought probability in the north will rise from historical levels of 10–14% under the moderate scenario (RCP 4.5) to 60–70% under the high-emission scenario (RCP 8.5). Droughts are also expected to last longer, with single episodes potentially extending beyond five consecutive years.


These projections are consistent with the National Drought Action Plan (MWI 2023), which anticipates greater rainfall variability, delayed rainy seasons, and extended dry periods across northern governorates. This reinforces the urgency of strengthening early warning systems and integrating climate projections into local planning processes.

In GMM, projections under RCP 4.5 indicate around 15 drought events by 2050 and 18 by 2070, whereas under RCP 8.5 the number rises to 18 by 2050 and 21 by 2070 as shown in Figure 4.



**Fig. 4: Future Drought Events Recorded in Mafraq City**

For Mafraq specifically, increasing meteorological drought will not only affect rainfall-dependent systems but will also intensify pressure on already overstretched groundwater resources, accelerating the transition from meteorological to hydrological drought conditions. These historical patterns and future projections highlight the need to treat Mafraq as a priority city for drought management.

 **Alert: Rising Drought Risks in Mafraq**

In Mafraq Municipality, projections under RCP 4.5 indicate around 15 drought events by 2050 and 18 by 2070, whereas under RCP 8.5 the number rises to 18 by 2050 and 21 by 2070 as shown in the figure below. For urban areas like Mafraq; already under pressure from rapid population growth and displacement; these trends imply that future droughts will not only challenge water security but also increase pressures on health, housing, infrastructure, and municipal services.

## Agricultural Drought in Mafraq

These events severely undermine agriculture and livestock, once the backbone of local livelihoods, as reduced rainfall and groundwater and surface water depletion eroded productivity. These cycles underscore a pattern of intensifying meteorological and hydrological drought stress, leading to agricultural drought conditions. This accelerated rural-to-urban migration from surrounding rural areas into Mafraq City, adding further pressure on already fragile municipal systems.

Mafraq Governorate is a key agricultural hub in Jordan, accounting for approximately 10% of cultivated land and 21% of national livestock, including 25% of sheep and 15% of cattle (Fragaszy et al 2022). Agriculture is split between rain-fed systems—notably cereals and olives—and groundwater-dependent irrigation, making it highly vulnerable to drought (ibid).

Drought is driving a rapid structural decline in the sector. Between 2015 and 2020 agricultural land decreased by nearly 50%, and Mafraq's contribution to national crop production dropped from ~33% to 10%. This reflects increasing crop failure, rising irrigation costs, and declining pasture availability. The decline is contributing to rural-to-urban migration, increasing pressure on Mafraq's already strained urban water systems.



## Hydrological drought indicators for Mafraq

Alongside meteorological drought, hydrological drought has progressively intensified. Over the past 30 years, groundwater levels in northern Jordan have been dropping by about one meter per year. Springs have dried, baseflows of side wadis have declined, and major dams now operate at less than half their original storage capacity (Bazza et al 2022 ). Jordan is currently extracting ground water well beyond sustainable capacities to meet demand, and its surface water's contribution has become unreliable due to both trans-boundary challenges and water quality deterioration (ibid.). These conditions place it in a state of chronic hydrological drought.

Hydrological drought in Mafraq is chronic rather than episodic, driven primarily by sustained groundwater over-abstraction that exceeds natural recharge rates. Groundwater is the primary source of domestic water supply in Mafraq but is heavily overexploited, particularly by agricultural irrigation, Despite a regulatory framework being in place, groundwater governance is not effective (Fragaszy et al 2022 ).The National Drought Action Plan identifies groundwater depletion as the most critical structural driver of drought in Jordan, emphasizing the need for demand management, abstraction control, and aquifer recharge interventions.

Jordan has 12 main groundwater basins. For GMM, the two key aquifers are the Amman–Zarqa aquifer and the Yarmouk aquifer. Secondary data analysed by the project indicates the Amman-Zarqa aquifer is being overextracted:

- Amman–Zarqa Aquifer: In 2022, its safe yield was estimated at 87.5 MCM, but actual abstraction reached 162.4 MCM, resulting in a critical deficit of –74.9 MCM.
- Yarmouk Aquifer: Managed more sustainably, with abstraction at 35.75 MCM, remaining within the safe yield of 40 MCM.

Aside from aquifers, data analysed by the project reveals that, across the country, more than 3,400 wells are operational, many exceeding their sustainable pumping limits. In Mafraq Governorate, there are 21 government wells and 10 private wells. Within Dahiyyat Al-Malik Abdullah, there are two private wells that serve two of the remaining irrigated farms. These wells are critical for sustaining agricultural activity, but they draw from the Amman-Zarqa Basin, where groundwater abstraction far exceeds the safe yield.



### Alert: Groundwater Use Exceeds Safe Yield

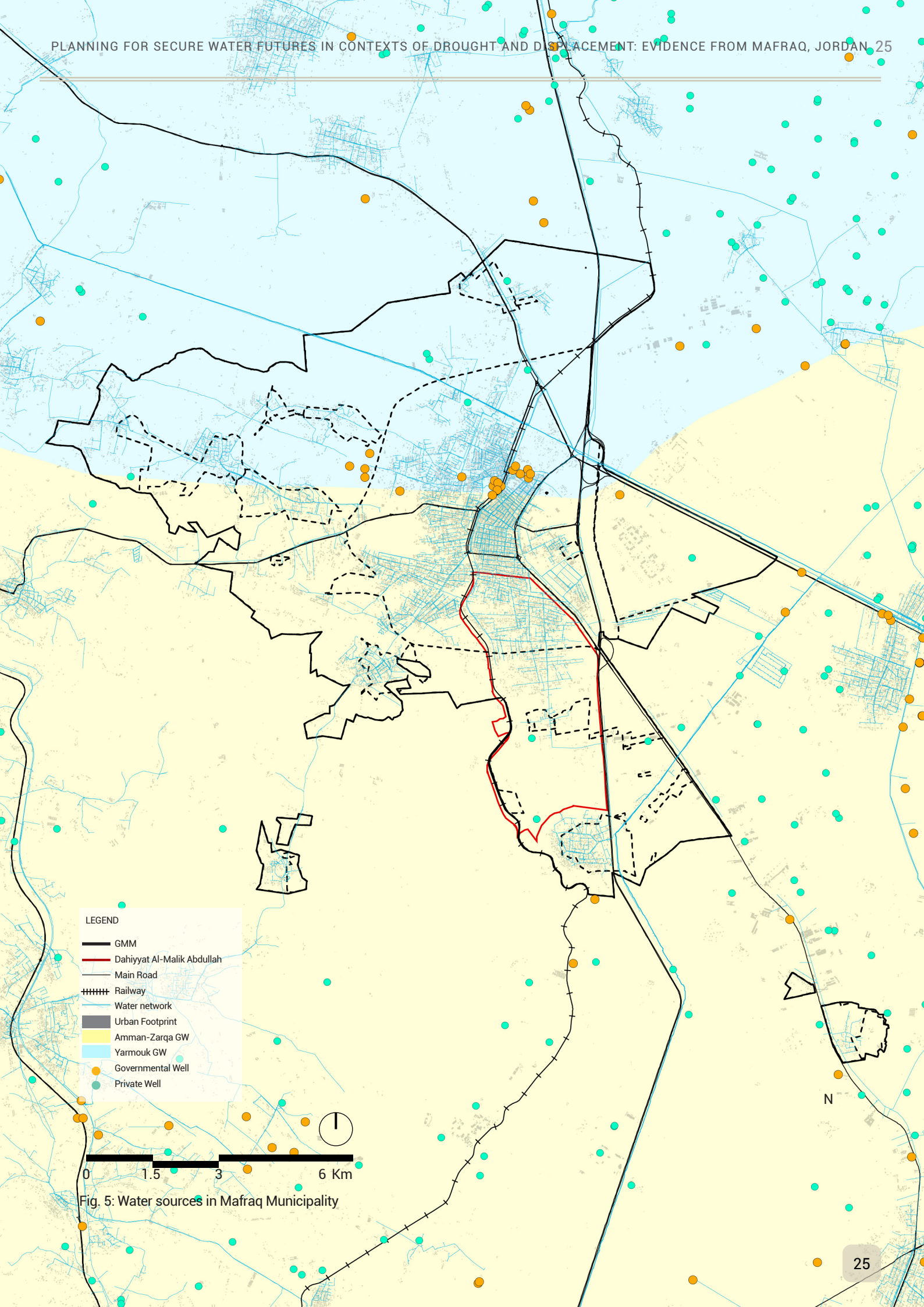
In 2022, 162.4 million cubic meters (MCM) were extracted from the basin against a safe yield of 87.5 MCM, resulting in a critical deficit of –74.9 MCM. Although extraction has slightly declined from 166 MCM in 2015, this reduction is partly linked to the decreasing green cover explained in the next pages.

Other sources of domestic water supply are surface water, but the availability and quality of surface water have declined sharply. Contributing to Mafraq's water supply are the Yarmouk River and the Zarqa River:

- Yarmouk River: Shared with Syria in the north, the river provides good-quality water, but availability is heavily constrained by upstream abstractions and damming.
- Zarqa River: Entirely within Jordan, but heavily polluted due to industrial discharges, domestic wastewater, and over-abstraction.

Overall, surface water's contribution to Mafraq Governorate's supply has become unreliable due to both trans-boundary challenges and water quality deterioration.

Together, these dynamics confirm that Mafraq is experiencing a state of structural hydrological drought, where water deficits persist regardless of short-term climatic variability.




- LEGEND**
- GMM
  - Dahiyyat Al-Malik Abdullah
  - Main Road
  - +—+— Railway
  - Water network
  - Urban Footprint
  - Amman-Zarqa GW
  - Yarmouk GW
  - Governmental Well
  - Private Well



Fig. 5: Water sources in Mafraq Municipality

## Declining green cover in Dahiyyat Al-Malik Abdullah

Analysis of historical satellite imagery of Dahiyyat Al-Malik Abdullah conducted for the project demonstrated how meteorological drought and agricultural drought are changing the environment at the local level in GMM, clearly presenting steep declines in green cover of up to 67% over the past 10 years.

 **Alert: Alarming Decline in Vegetation**

Over the past decade, Dahiyyat Al-Malik Abdullah has witnessed a steep decline in green cover, shrinking from 534,800 m<sup>2</sup> in 2014 to a projected 176,400 m<sup>2</sup> by 2025—a reduction of nearly 67%, as shown in the figure below.

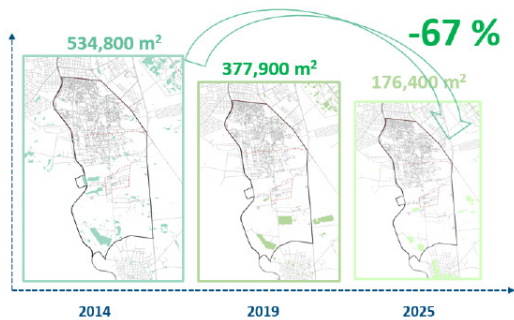


Fig. 6: Green cover in Dahiyyat Al-Malik Abdullah from 2014 to 2025.

There are five main irrigated farm plots within the neighbourhood, of which 38% are tree crop farms and 62% are vegetable crop farms. At the time the imagery was captured, the neighbourhood's two irrigated vegetable fields appeared devoid of green cover. Though this may be attributed to seasonal cycles, the dramatic contraction is most likely primarily linked to recurring droughts, heatwaves, prolonged dry seasons, and increasing water shortages, which have made it increasingly difficult to sustain irrigated agriculture and maintain green cover.

The neighbourhood's predominantly xeric soil conditions exacerbate this vulnerability, as these soils retain very little moisture and require higher volumes of irrigation to support plant growth, significantly increasing water demand and the cost of cultivation. This accelerates the depletion of both shallow and deep aquifers, making irrigation both technically and economically challenging. Many farmers are unable to maintain cultivation, resulting in land abandonment and a progressive loss of agricultural green spaces.

The ecosystem within the neighbourhood is primarily steppe; a semi-arid landscape dominated by grasses, shrubs, and sparse vegetation adapted to dry conditions. Steppe ecosystems are naturally resilient to low and variable rainfall, but their xeric soils and limited water retention capacity make them moderately vulnerable to climate stressors. According to the ecosystem assessment conducted for Mafraq districts under the "Resilient Solutions Against Climate Change" project (UN-Habitat, 2025) the city's ecosystems are generally classified as being at moderate vulnerable. This underscores the sensitivity of the local environment to drought, heatwaves, and human pressures such as irrigation and land use change. The ongoing decline in green cover noted here not only reflects the fragility of agriculture in Mafraq but also reinforces the interconnection between environmental degradation, water scarcity, and the challenges of maintaining agricultural productivity.

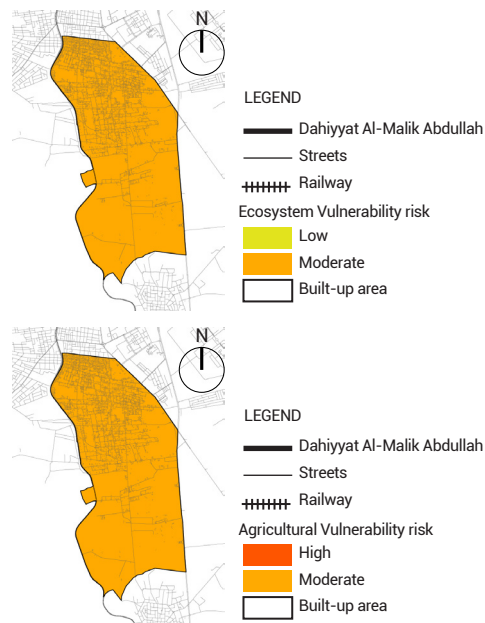


Fig. 7: Ecosystem and Agricultural Vulnerability Risk


Without targeted measures to improve water efficiency, enhance soil moisture retention, and safeguard groundwater, the erosion of green spaces will continue to undermine both livelihoods and resilience in the neighbourhood.

LEGEND

- Dahiyyat Al-Malik Abdullah
- Streets
- ++++ Railway
- Vegetables - Open fields
- Tree Crops
- Fodders and cereals
- Green Coverage 2025 based on satellite image



Fig. 8: Green Cover in Dahiyyat Al-Malik Abdullah Neighbourhood



## Lack of recreational green space and decreasing biodiversity in Dahiyyat Al-Malik Abdullah

Outside of shrinking agricultural green cover, GIS mapping revealed that there were no public recreational green spaces in the neighbourhood. Public spaces play a vital role in enhancing the quality of life for residents as well as delivering ecological solutions to climate change. Dahiyyat Al-Malik Abdullah currently lacks dedicated parks or recreational facilities. The nearest park is located to the east [outside the neighbourhood] within an affordable housing compound. However, it is not accessible within a 30-minute walking distance for neighbourhood residents.

In addition to the lack of green space, responses to the survey suggest decreasing biodiversity in the neighbourhood. When asked about whether they noticed a decrease in the variety of plants, trees, and birds in the area, there was a difference in perception based on length of stay. Longer-term Jordanian residents of the neighbourhood said they have (31%). The majority of residents (Jordanians and Syrians) who moved there more recently said they don't know (59%).

There is a pressing need to establish an inclusive, green public park within the neighbourhood to ensure equitable access for all residents and to enhance green cover and biodiversity, as well as strengthen social interaction and community cohesion. Locating the park centrally within the urban area would maximize accessibility and ensure that all residents can reach the space within a walking distance. This is aligned with GMM's endeavour outlined in project number 1.6 of their Local Development Plan (2024 - 2028), which is considered high priority and aims to establish multi-functional, green areas catering to various scales and purposes.

- LEGEND
- Existing Public Park
  - ★ Proposed Area for Public Park Implementation
- ACCESSIBILITY IN MINUTES
- 15
  - 30
- Dahiyyat Al-Malik Abdullah Boundary
  - - - Regulated Area
  - Streets
  - + + + + + Railway



Fig. 9: Recreational Facilities



03

DISPLACEMENT



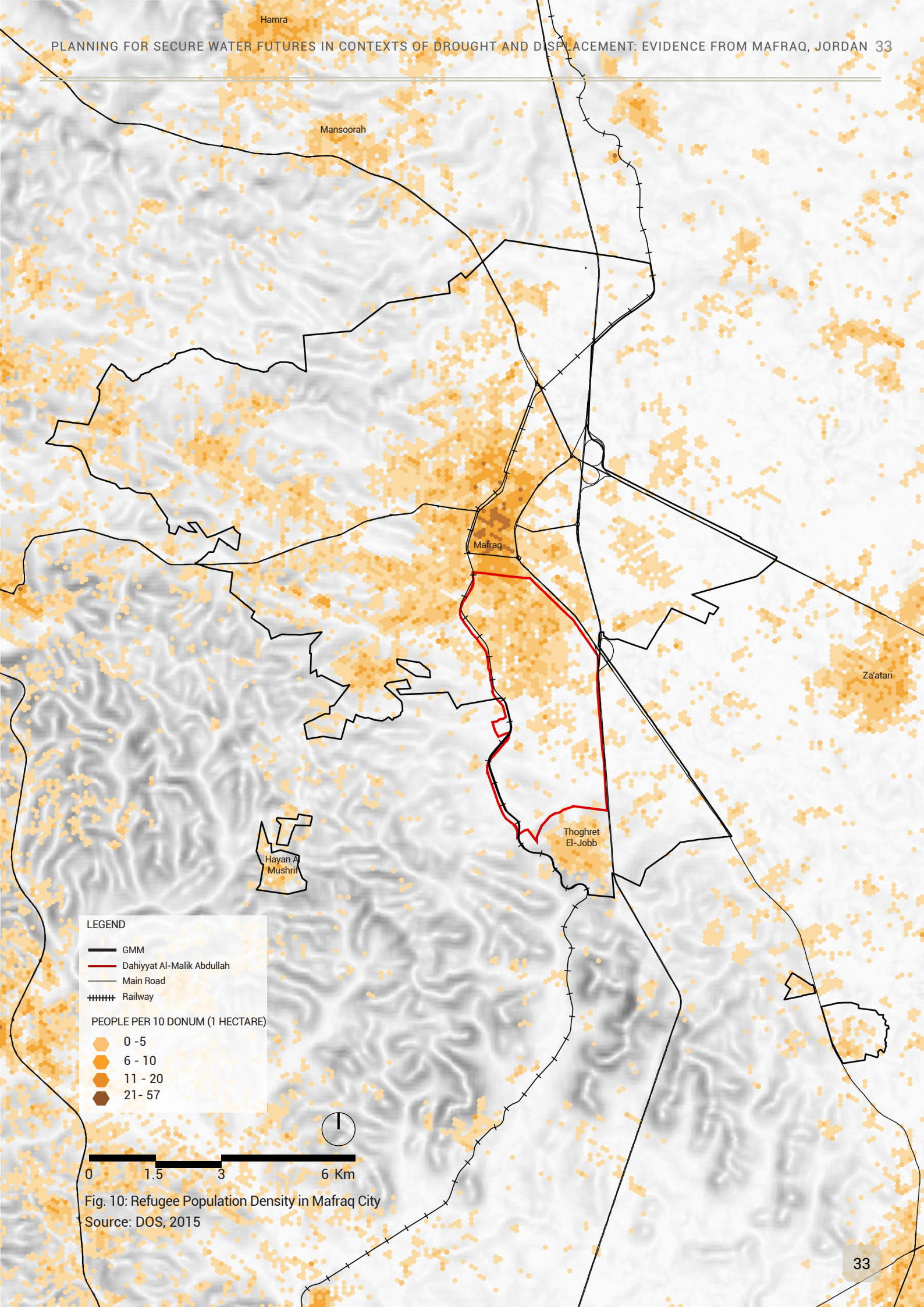
## Background: Cross-border displacement into Mafraq

Following Amman and Irbid, Mafraq Governorate hosts the third-largest share of Jordan's off-camp refugee and displaced population. According to UNHCR data from April 2026, 99,418 Syrian refugees are officially registered in the governorate. This accounts for the Syrians who have voluntarily returned to Syrian since December 2024, following the major political shifts there. In addition, small numbers of Iraqi and Palestinian refugees live in Mafraq (130,911 and 32,000 respectively according to the latest Census) (Department of Statistics 2016). The governorate is also home to Za'atari Camp, the world's largest Syrian refugee camp, which continues to underscore the magnitude of humanitarian needs in the region.

According to the 2015 census, the majority of refugees in Mafraq Governorate are concentrated within GMM. GMM's population nearly doubled within the span of four years (between 2012- 2016) due to the settlement of refugees (World Bank 2016). Within GMM, 42.9% of the population are non-Jordanians, Syrian refugees (88% of the "non-Jordanian" population, Egyptian migrant workers (7%), stateless Palestinians (4%), and 1% from other nationalities (Department of Statistics 2016). Despite the large proportion of refugees, there are no refugee camps within GMM, meaning these residents are categorized as urban refugees, further intensifying demand on municipal services such as health, education, infrastructure, labour, water, energy, and housing.

Dahiyyat Al-Malik Abdullah is one of Mafraq City's largest and most densely populated neighbourhoods. Covering an area of 12.84 km<sup>2</sup>, the neighbourhood accounts for 11.1% of GMM's total area (115.1 km<sup>2</sup>). Despite its relatively small share of land, it carries a disproportionate demographic weight, reflecting the pressures of both natural population growth and displacement-related settlement.

In 2015, the neighbourhood hosted around 15,745 residents, representing approximately 13% of Mafraq City's total population of 122,028 inhabitants at the time, with a population density of about 1,226 inhabitants per km<sup>2</sup> (Department of Statistics 2016). Of this population, 5,750 were Syrian refugees, underscoring the area's role as a key destination for displaced populations. The demographic significance of Dahiyyat Al-Malik Abdullah as a displacement impacted neighbourhood has only grown over the past decade.



**LEGEND**

- GMM
- Dahiyat Al-Malik Abdullah
- Main Road
- ++++ Railway

**PEOPLE PER 10 DONUM (1 HECTARE)**

- 0 - 5
- 6 - 10
- 11 - 20
- 21 - 57

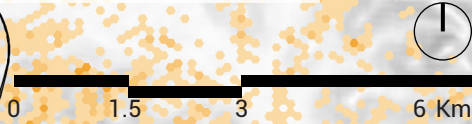


Fig. 10: Refugee Population Density in Mafraq City  
Source: DOS, 2015

## Cross-border and internal displacement into Dahiyyat Al-Malik Abdullah

According to the GIS data collected for the project, the neighbourhood’s population in 2025 had increased to 40,934 residents, reflecting a 38.5% growth over ten years. This population estimate was derived from mapping local housing typologies: for urban Residential Type C areas, it was assumed that each floor contained two apartments with an average household size of 5.2 persons (per Mafraq Governorate statistics), whereas for Rural Residential areas, one household per floor was assumed. Based on the neighbourhood’s land area, and imaging of built up areas, this corresponds to a population density of approximately 3,188 inhabitants per km<sup>2</sup>. The combined effect of rapid growth and displacement has placed the neighbourhood at the forefront of Mafraq’s demographic transformation.

Survey data collected by the study also suggests that demographic expansion in Dahiyyat Al-Malik Abdullah remains ongoing. While Syrian households show a strong presence of relatively recent arrivals (with 54% reporting residence of less than five years), Jordanian residents also reflect substantial recent movement into the area. A significant share of residents, both Syrian and Jordanian, said they settled in the neighbourhood within the past 5–10 years (46% of Syrians and 60% of Jordanians). Only 29% of residents (all Jordanians) said they have lived in Dahiyyat Al-Malik Abdullah for 16 years or more. This suggests that different migration flows have been concurrent rather than sequential, with host community and displaced populations expanding into the neighbourhood during the same period. These findings reinforce the characterization of Dahiyyat Al-Malik Abdullah as an active urban growth frontier shaped by both cross-border and internal migration

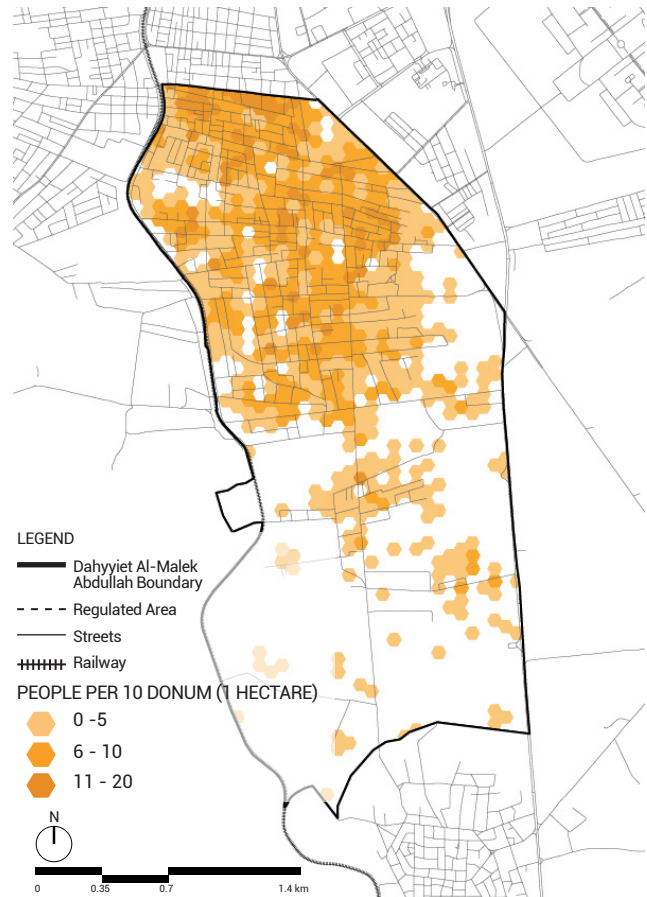


Fig. 11: Refugee Population Density in Dahiyyat Al-Malik Abdullah Neighbourhood

LEGEND

— Dahiyat Al-Malek  
Abdullah Boundary

- - - Regulated Area

— Streets

++++ Railway

PEOPLE PER 10 DONUM (1 HECTARE)

○ <50

○ 50-100

○ 101-200

○ 201-495



0 0.35 0.7 1.4 km

Fig. 12: Population Density in Dahiyat Al-Malik Abdullah Neighbourhood

## Mapping Urban Sprawl

Based on analysis conducted by the project, the urban footprint of Dahiyyat Al-Malik Abdullah is calculated at approximately 6 km<sup>2</sup> in size, with an average annual rate of increase of 6.3%. In 2005, urban development was largely concentrated in the northern and central parts of the neighbourhood and was mostly contained within regulated residential areas. Development followed relatively regular street patterns and was generally connected to basic services, including the piped water network. The southern part of the neighbourhood remained predominantly rural, with limited and scattered built-up areas.

By 2015, the urban footprint had expanded significantly, driven by population growth and the influx of Syrian refugees. Urban expansion occurred through both infill within existing residential areas and outward growth toward the south. As reflected in the regulated-area boundaries of Figure 4, a growing share of development took place outside formally regulated zones. This expansion increasingly intersected with rural land uses, introducing a more mixed and fragmented land-use pattern.

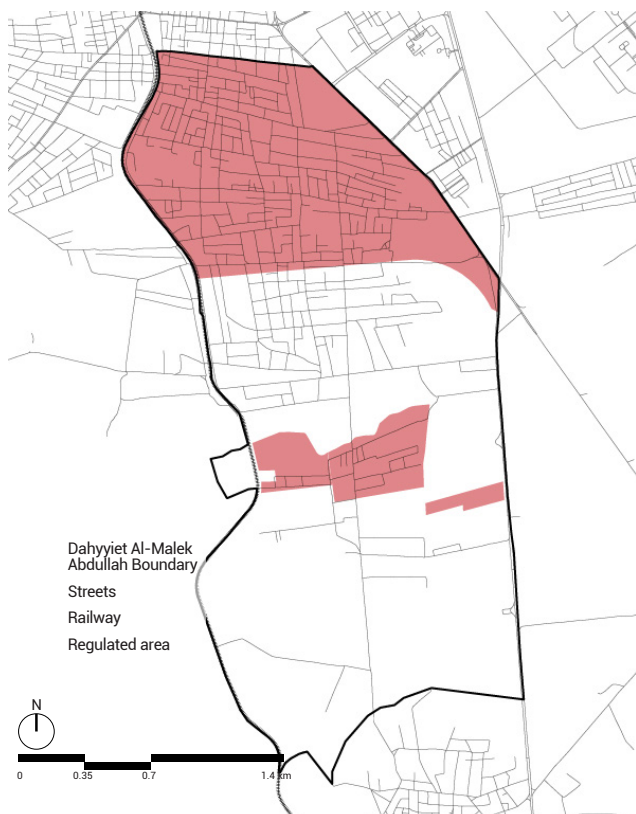


Fig. 13: Regulated area of Dahiyyat Al-Malik Abdullah Neighbourhood

By 2025, urban growth had accelerated further, particularly toward the southern part of the neighbourhood. Although the northern areas remain the most densely built-up, most recent expansion has occurred outside regulated zones. These areas are characterized by irregular layouts and limited access to infrastructure, especially water services, intensifying existing vulnerabilities.

Figure 14 illustrates this transformation across two decades from 2005 to 2025. It highlights that the northern part of the neighbourhood contains the highest population density, while density gradually decreases toward the south, which consists largely of unregulated areas, as illustrated in the subsequent pages.

Overall, the urban growth of Dahiyyat Al-Malik Abdullah reflects a pattern of rapid, largely unregulated expansion driven by population growth and multiple displacements. Its regulated sections consist of formal residential zones connected to basic services, including the piped water network. In contrast, unregulated areas lack proper planning and infrastructure, often resulting in limited or no access to piped water. These unregulated zones also contain rural and peri-urban mixed land uses. This mix of residential and rural functions within the same neighbourhood provides a unique opportunity to analyse how drought impacts vary across land uses, and how access, or lack of access, to water infrastructure shapes community resilience.

This trajectory highlights the neighbourhood's importance as a microcosm of Mafraq's urban transformation and underscores the need for proactive, inclusive, and climate-resilient planning to address mounting pressures on land, services, and water resources.

- LEGEND
- Dahyyiet Al-Malek Abdullah Boundary
  - - - Regulated Area
  - Streets
  - + + + + + Railway
  - 2005
  - 2015
  - 2025

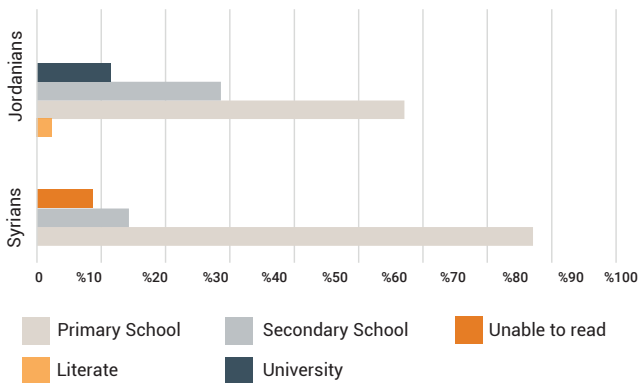


Fig. 14: Urban Growth in Dahyyiat Al-Malik Abdullah Neighbourhood

## Socio-economic Indicators and Intersecting Vulnerabilities

Data collected through the survey highlight the economic vulnerability characterizing the neighbourhood. A substantial majority of households (74%) reported earning less than JOD 290 per month, equivalent to the national minimum wage. An additional 13% reported monthly incomes between JOD 291 and 370, remaining below the estimated living wage threshold. Only a small proportion of respondents reported earnings above JOD 370, with 6% earning between JOD 371–599 and 7% between JOD 600–1000. Those latter household were all Jordanian. All Syrian households interviewed reported incomes below the living wage benchmark.

A majority of respondents also stated that their household’s primary income earner’s highest educational qualification was primary school (67%), followed by secondary school (22%). Around 1% said their primary income earner was literate but had not completed primary school, and 4% reported the primary income earner being illiterate, all of them Syrian. Syrian residents showed lower educational attainment by primary income earner overall. Figure 6 presented the data disaggregated by nationality.



**Fig. 15: Educational level of household’s primary income earner disaggregated by nationality**

The structure of income sources further illustrates this dynamic. Nearly half of all households (46%) depend primarily on pensions, humanitarian assistance, or remittances. Casual labour represents the second most common income source (30%), followed by public sector employment (13%), private sector employment (9%), and seasonal agriculture (3%). This distribution suggests that a large segment of the population relies on either informal employment or transfer-based income rather than stable salaried positions.

Taken together, the limited educational attainment, informal employment concentration, and low income levels creates layered economic vulnerability within Dahiyat Al-Malik Abdullah. In the context of drought and irregular water supply, this reduces households’ ability to absorb increased water costs, invest in storage infrastructure, or buffer against service disruptions, especially for Syrian displaced households.

## Tenure Security

Findings from the survey reveal pronounced differences in tenure security between Syrian and Jordanian residents of Dahiyat Al-Malik Abdullah, with important implications for adaptive capacity and resilience. Syrian households are overwhelmingly tenants (94%). In contrast, Jordanian respondents are predominantly property owners (88.6%), with a small minority renting (5.7%) or reporting other forms of housing tenure (5.7%). These figures highlight a clear structural divide in asset ownership within the neighbourhood.

Tenure insecurity has direct implications for climate adaptation and water resilience. Tenant households typically have limited authority to invest in housing improvements such as applying for water connections and water meters, expanding rooftop water storage, upgrading plumbing systems, or installing water-saving technologies. As a result, their capacity to buffer against irregular water supply or increased reliance on tanker water during drought periods is structurally constrained.

ميني ماركت  
مواد تموينية - م  
0777540041



صالون  
الريس  
للرجال  
دارة: الكوافير ماجد 6 55 24 97 077



ميني ماركت  
مواد تموينية. مسكرات  
تسعد لزيارتكم  
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04

**WATER GOVERNANCE**



## Background: Institutional Landscape for Water Governance in Mafraq

Water governance in Jordan is highly centralized, with oversight concentrated under the Ministry of Water and Irrigation (MOWI). Since its establishment in 1988, the MOWI has functioned as the country's central authority, setting national policies, strategies, and long-term master plans. The ministry's vision is operationalized through two main bodies:

- The Water Authority of Jordan (WAJ): WAJ manages groundwater extraction licensing, oversees the construction of dams and strategic water infrastructure, and monitors both water quality and water use. It is also responsible for water and wastewater services across the country through the supervision of utility companies.
- The Jordan Valley Authority (JVA): JVA governs the Jordan Rift Valley, focusing on irrigation, agricultural development, and integrated resource management in one of the country's most productive agricultural areas.

The delivery of water and sanitation services has shifted increasingly towards specialized regional utilities that operate with more flexibility but remain under WAJ's supervision. Today, three companies provide water and wastewater services across the country:

- Miyahuna in Amman and the central governorates
- Aqaba Water Company in the south
- Yarmouk Water Company (YWC) in the north

Each of these utilities is state-owned but managed along corporate lines, intended to improve efficiency and service quality while addressing the financial and technical challenges of water distribution in a water-scarce environment.

YMC, which manages water utility services in Mafraq Governorate, was established in 2011. It is responsible for supplying water and sanitation services in Irbid, Jerash, Ajloun, and Mafraq governorates; together home to nearly one-third of Jordan's population. YWC operates hundreds of wells, thousands of kilometers of water and sewer networks, and multiple treatment plants.

In Mafraq, these responsibilities are especially challenging. YMC's network was already considerably under strain prior to the settlement of refugees. The settlement of Syrian refugees has increased demand rapidly; according to information shared by YMC, the number of household water subscribers grew by more than 50,000 within just a few years and water demand by an estimated 40%. YMC

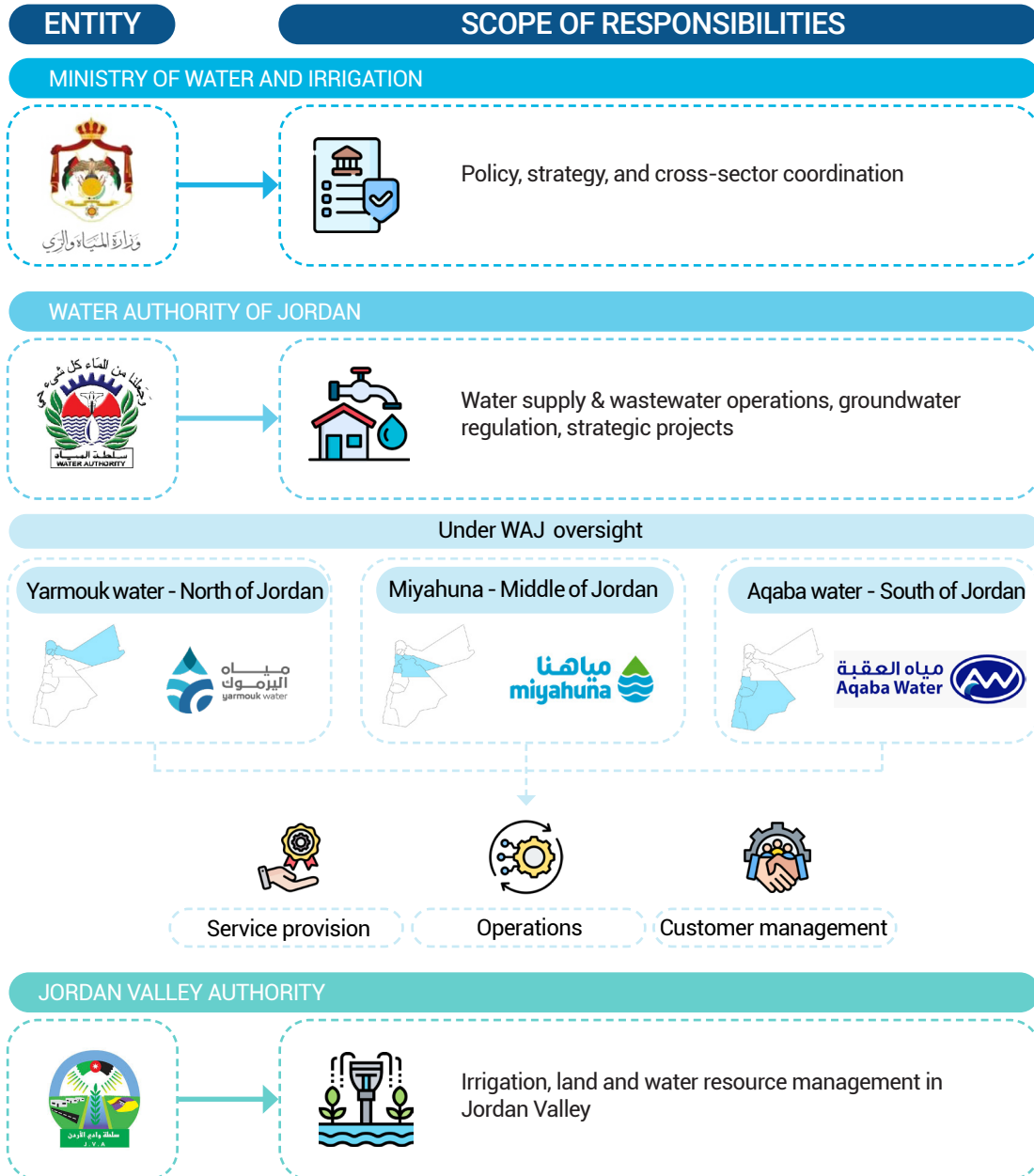
responded by expanding production while struggling with higher energy costs, limited finances, and rising operational pressures. Despite these constraints, YWC has managed incremental improvements. Water distribution in the north has risen, non-revenue water losses have been reduced, and investments in electronic services, customer management, and laboratory facilities have strengthened its overall performance.

Still, Mafraq continues to embody the difficulties of Jordan's water governance system: national-level institutions provide the framework and oversight, but the burden of daily service provision falls on regional utilities. Non-revenue water (NRW), which is the amount of water that is lost through the system (as a result of leaks, administrative errors, or illegal extraction) is higher in Mafraq Governorate than anywhere else in Jordan, and is estimated at approximately 78% (UN-Habitat 2024).

Approximately 95% of the population within GMM boundary is served by the water network (UN-Habitat 2024). The average daily water consumption stands at over 122 liters per person, equivalent to 4.3 m<sup>3</sup> per week or 0.86 m<sup>3</sup> per week per individual, considering an average household size of 5 people (approximately 46 m<sup>3</sup> per person annually) (AVSI 2023). This contrasts with Jordan's per-capita water consumption of 61 m<sup>3</sup> in 2022, equivalent to 167 liters per person per day, indicating that residents of Mafraq are particularly water insecure.

To manage limited resources, domestic water has been rationed since the 1980s. From then and until 2010, water was delivered through the network once a week for up to six hours, though this sometimes varied. Families rely on storage tanks to store water when it arrived through the network for use during the week.

Many households also install pumps to extract more water from the network, given the weak pressure of the supply. Many also resort to private tanker water to top-up their water, an expensive and unregulated alternative



## Dahiyyat Al-Malik Abdullah as an Underserved neighbourhood

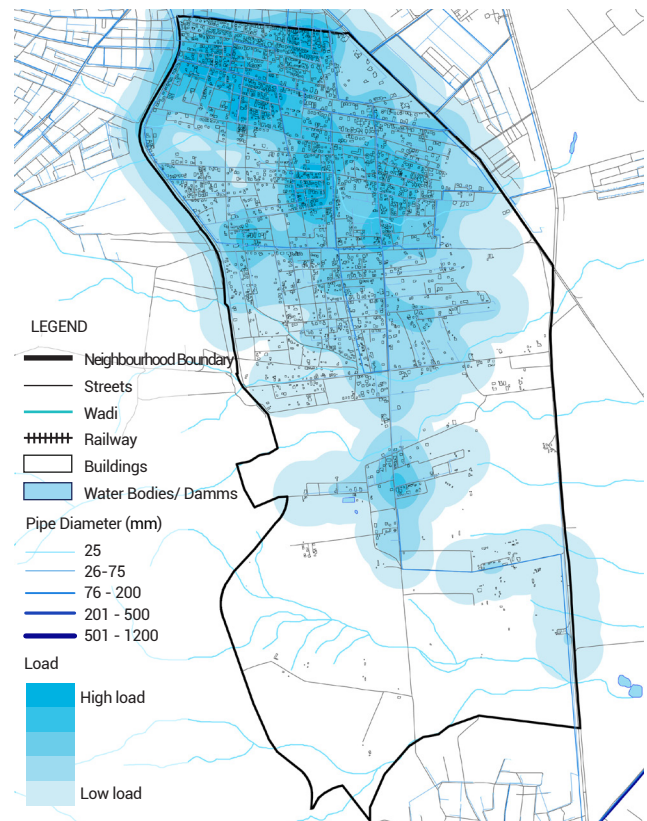
GIS mapping conducted by the project revealed that within the regulated area, 72% of the built-up area is connected to the water network, indicating that an estimated 87% of the neighbourhood's population has access to piped water. Triangulating this with survey data confirmed the finding and produced very similar assessments: 73% of all respondents said their household was connected to the water network, while 27% said their household was not connected. This connectivity level is lower than the average for urban areas in Jordan as well as for Mafraq, indicating that the neighbourhood is an underserved area.

Furthermore, reliability of the water supply to connected households varied significantly, particularly across seasons. In winter, 53% of respondents said they receive water once a week and a further 41% said they receive it twice or more times a week. Only 2% report receiving water less than once a week. However, in summer, the frequency declines markedly; 51% report receiving it once a week, 4% report receiving it twice a week or more, and 16% report receiving it less than once a week. This seasonal reduction reflects constrained system capacity during peak demand and reduced water supply in summer months rather than localized pipe failures.

As shown in Figure 16, a capacity versus demand assessment using GIS modelling highlights those challenges. By comparing the network's capacity against current demand, and accounting for pipe diameter, length, and population served, the analysis identified areas of high and low network sufficiency. Results show that approximately 30% of the neighbourhood currently experiences very high load on the existing water infrastructure.

This also explains the low-pressure reported by survey respondents: 63% of respondents reported that the water pressure was not adequate, and that they could not fill-up their tanks without a pump. Only 22% of respondents said their household was able to fill up their tanks every week. The majority of respondents (55%) said their ability to fill up their water tank varied week by week. A further 24% said they were never able to fill-up their tanks completely.

While experiences of reliability of the supply were similar between Jordanian and Syrian households connected to the water network, survey data indicate statistically significant differences between the storage capacity of Syrian and Jordanian households in Dahiyyat Al-Malik Abdullah. Differences in storage capacity shape resilience



**Fig. 16: Current load on the existing water network in Dahiyyat Al-Malik Abdullah Neighbourhood**

capacity to the water network's unreliability. The majority of Syrian households reported owning only one standard rooftop water tank (54%), compared to 14% of Jordanian households. Over 36% of Jordanian households reported owning two, and the majority (50%) reported owning more than two (compared to 43% and 4% of Syrian household respectively). Larger storage capacity enables households to buffer against irregular supply and seasonal interruptions, reducing immediate dependence on tanker purchases. Conversely, limited storage constrains the ability to retain water during supply days, increasing vulnerability during extended gaps in network delivery.

Together, unreliability of the network, low-pressure through the network, and differing storage capacity, reinforces dependence on supplementary sources such as private tankers, which respondents said increased during the summer months. While 35% of respondents reported resorting to private tankers all year round to top-up the municipal supply, this increased to 55% in the summer months. Syrian households were also more likely to report debt to private tankers than Jordanian residents (21% of Syrian households reported debt to private water vendors compared to no Jordanian households).

- LEGEND**
- Dahiyyat Al-Malek Abdullah Boundary
  - - - Regulated Area
  - Streets
  - Water Network
  - +++++ Railway
  - Water Bodies
  - Irrigated Farms
  - Built-up Area
  - Water Basin
  - Well

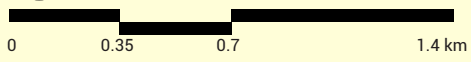


Fig. 17: Water Network in Dahiyyat Al-Malik Abdullah Neighbourhood

## Administrative Challenges Contributing to Uneven Water Access

While levels of connectivity and assessments of the network's reliability were similar between Syrian and Jordanian residents of the neighbourhoods (with differences noted in storage capacity and debts to private tankers), Syrian residents were more likely to face administrative challenges relating to the water they were able to access.

A significantly higher proportion of Syrian households reported never applying for a water connection (71%) compared to 25% of Jordanian households. Among those who had applied, waiting periods ranged between three to six months. Key barriers cited included properties falling outside municipal planning zones, inability to afford connection fees, and lack of landlord support for submitting applications. These findings suggest that institutional access is shaped not only by awareness or willingness to engage, but also by structural constraints linked to tenure status, regulatory boundaries, and financial capacity.

The project also found that shared metering remains a common practice, and one that impacts Syrian residents more than Jordanian residents. Approximately 52% of Syrian households reported being connected to a joint water meter, compared to 30% of Jordanian households. In some cases, a single meter was shared between multiple apartments, with a small proportion of Syrian households (7%) reporting being connected to up to six other households (the maximum number of connections reported by Jordanian residents was two). Shared metering can obscure consumption accountability, reduce households' ability to independently manage water use, and complicate billing arrangements, leading to higher payment per meter of water consumed. While illegal, this practice persists.

Under current regulations, Syrian residents are unable to register their own water meter under their own name, and landlords are not incentivised to resolve this. Without resolution, access (or lack thereof) to individual metering is producing differentiated water management capacity at the household level across socio-economic and tenure groups within the neighbourhood. This can be resolved by processes that enable Syrian residents to register water meters under their own names or incentivise landlords to do so on behalf of tenants.

The survey also revealed notable disparities in patterns of engagement with the water utility company, highlighting differences in institutional access and service governance.

While a majority of Jordanian respondents reported regularly contacting the water company to raise complaints or report supply disruptions (57%), a similar percentage of Syrian respondents indicated they had never contacted the utility (57%). Households connected through joint water meters or renting informally may have reduced incentive or authority to contact the utility directly, particularly when billing responsibility lies with a landlord or another registered account holder. Limited engagement with formal service providers can have tangible implications for water security: households that do not report disruptions or cannot formalize connections may experience prolonged service gaps, reinforcing reliance on private tanker vendors and informal coping strategies.

Taken together, disparities in both complaint mechanisms and formal connection processes constitute an additional layer of vulnerability. Water insecurity in Dahiyyat Al-Malik Abdullah is therefore mediated not only by network infrastructural, but also by unequal institutional access and governance pathways.

### Water Insecurity in Dahiyyat Al-Malik Abdullah

The convergence of reduced freshwater availability from meteorological and hydrological drought, and water governance challenges that produce unreliable and uneven access to water, leaves the residents of Dahiyyat Al-Malik Abdullah exposed to episodes of alarming water insecurity, especially in summer. A majority of residents (74%) said they have experienced having no access to water at all for more than one day regularly during the summer months. A further 9% said they experience this regularly during both summer and winter months. Access instability appears to be a structural feature of the local water system rather than an episodic shock. Only 18% said they experience this rarely or never. This indicates that intermittent supply has effectively become normalized within the neighbourhood.

Residents cited a wide range of impacts of water insecurity. Nearly all households (96%) reported experiencing at least one negative consequence, underscoring that water insecurity functions as a cross-cutting stressor affecting multiple dimensions of daily life. Data from the survey suggests water insecurity exacerbates gendered household labor dynamics, social reproduction roles, and psychosocial well-being. The overwhelming majority of respondents reported increased domestic workloads and time burdens (94%), hygiene challenges (92%), alongside elevated stress and anxiety levels (79%), with

higher frequencies of reporting by women respondents. These patterns suggest that unreliable water supply is compounding unpaid care responsibilities and reinforces gendered inequalities within the household, revealing the gendered nature of water stress).

Livelihood disruption affected 81% of households, and 42% reported missed work or school days. Other cited impacts included domestic violence (31%) and breastmilk production (18%).

A severity index was constructed based on how many impacts each household reported. Households that reported experiencing 6 or more impacts were considered "high severity" and this accounted for the majority of households (60%). A further 31% of households fell under the "medium severity" category (based on reporting 3-5 impacts), and 5% on the "low severity" category (1-2 impacts). Only 4% of households were considered water secure and did not report experiencing any impact. As Figure 8 demonstrates, disaggregating these findings to account for nationality demonstrates that Syrian residents were much more likely to fall under the "high severity" category.

Looking specifically at health, the most reported health conditions were blood pressure (considered a health risk in situations of over-abstracted aquifers from exposure to saline drinking water) (37%, higher amongst Jordanians at 50% compared to 26% of Syrians), loose or bloody stools that lasted 3 days or longer (34%, higher amongst Jordanians at 47% compared to 22% Syrians), kidney issues (28%; higher amongst Jordanians at 32% compared to 24% of Syrians), and dehydration (27%, higher amongst Syrians at 30% compared to 23% of Jordanian respondents). While dehydration is a more immediate health impact of water insecurity, the rest of the health conditions – especially blood pressure and kidney issues – are longer term and progressive. Their higher prevalence amongst Jordanian respondents is consistent with the assumption that longer cumulative exposure to saline drinking water could lead to higher rates of longer-term conditions such as hypertension and kidney issues.

### Greywater reuse as a possible adaptation strategy

Emerging household-level water innovations reflect adaptive responses to water insecurity. Approximately 67% of households reported reusing grey-water, primarily from laundry and dish-washing. Only 11% reported harvesting rainwater, with higher uptake among Syrian

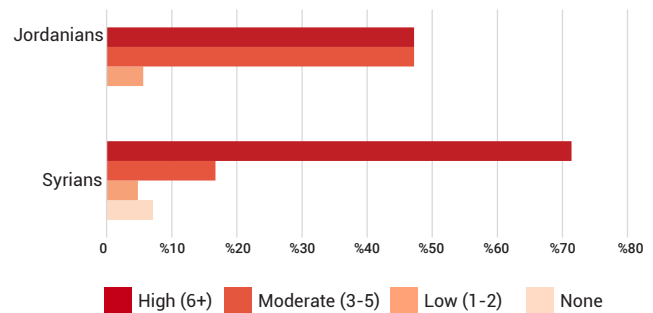


Fig. 18: Water insecurity severity index disaggregated for nationality

households (20%) compared to Jordanians (3%). These additional sources of water are mainly used for cleaning and garden irrigation. Validation workshops revealed the majority of those practices are informal (for example, collecting rainwater in buckets) and that water re-use is not necessarily safe (for example, impacts of detergents used on soil and crops). Further studies are needed to identify and promote healthy water reuse at the neighbourhood level.

These practices indicate an existing behavioural foundation for household-level greywater reuse. However, they remain largely informal and unregulated. This presents an opportunity to formalize safe grey-water reuse and rooftop rainwater harvesting systems, particularly in high-density and rental contexts, as part of a broader neighbourhood-level resilience strategy.



# 05

## URBAN PLANNING





## Background: City-level planning, coordination, and resilience efforts

GMM is currently implementing a variety of development projects. The most prominent and urgent initiatives focus on climate change adaptation and water management, as GMM faces increasing challenges related to drought, extreme heat, and water insecurity. In line with Jordan's national climate commitments, such as its Nationally Determined Contribution (NDC). Mafraq has aligned its local strategy with national and regional frameworks, including the UNFCCC and the Jordan Climate Change Policy 2013–2020.

GMM has recently developed a Climate-Resilient Urban Master Plan (CRUMP). This comprehensive initiative seeks to tackle climate change challenges, promote gender equality, enhance social inclusivity, and address displacement challenges. The CRUMP's primary goal is to guide sustainable urban development that aligns with climate projections and vulnerability assessments, ensuring the city's resilience against climate-related impacts. An Urban Observatory has also been set-up in GMM for urban risk assessment, climate change vulnerability evaluation, and integrated planning and management. Most initiatives and programmes currently being implemented are focussed on flood risk and mitigation.

Num.	Project
1	Flash Flood Risk Assessment and Hazard Mapping in Wadi Al Mafraq
2	Nature-Based Intervention in Wadi Al Mafraq

LEGEND







-  GMM
-  Dahiyat Al-Malik Abdullah
-  Main Road
-  Railway
-  Wadi
-  Urban Footprint
-  Projects



Fig. 19: Projects in Mafraq Municipality



## Landuse and Zoning

GMM covers an area of 115.1 km<sup>2</sup> (representing less than 0.5% of Mafraq Governorate's vast territory) and is subdivided into six districts. Within this area, approximately 45% falls under the officially regulated zone, where municipal planning and service delivery are directly applied, with more than half the territory remaining unregularized. Dahiyat Al-Malik Abdullah reflects this wider pattern and contains two spatial typologies: regulated and unregulated areas.

The regulated area represents 38% of the total neighbourhood's territory (4.87 km<sup>2</sup>). It is formally planned and subdivided into designated land-use categories, including residential zones, commercial zones, and public services. These areas are governed by planning controls, ensuring relatively organized urban development supported by structured infrastructure provision and service delivery. Residential land in Jordan is classified into seven main types: Residential A, B, C, and D, agricultural residential, rural residential, and residential with special regulations. Type A is the least affordable, while Type D is the most affordable. Analysis conducted for the study shows that in Dahiyat Al Malik Abdullah Neighbourhood, residential typologies are limited to Residential Type C, the most prevalent at 45.5%, followed by Rural Residential at 2.2%.

It should be highlighted that 48.6% of the regulated area remains without a designated land-use category, a gap that contributes to haphazard development. It also contributes to barriers to the accessibility of public services (more under 5.3 below). To address this, it is recommended to assign appropriate residential land-use classifications to the existing built-up areas. In parallel, the remaining vacant lands should be allocated to essential services, such as parks, schools, health facilities, and mosques, in order to balance community needs within the regulated area and enhance equitable service provision.

In contrast, the unregulated area represents the majority share of the neighbourhood, covering 62% (7.96 km<sup>2</sup>). Land-use in these zones is still governed by the 2007 Land Use Map adopted by the Ministry of Local Administration (MoLA) (see Figure 19). According to this framework, the unregulated area within the neighbourhood is designated as rural land, despite significant urbanisation. Licensed buildings are frequently located in areas still classified as unregulated, preventing the YMC from extending services to these households.



### Mismatch between Official Boundaries and Land Use Allocation

According to the figures 19, which depict the official regulated boundaries of the neighborhood alongside land-use allocations, there is a clear discrepancy between the planned boundaries and actual land-use patterns. This mismatch poses a significant challenge for urban planning and service delivery, particularly in ensuring equitable access to the water network. Licensed buildings are frequently located in areas still classified as unregulated, preventing the Yarmouk Water Company from extending services to these households.

Findings from this study demonstrate the importance of proactive zoning to ensure implemented programmes respond to the city's actual growth. This requires updating the regulated boundaries on a consistent basis to reflect actual urban expansion.

Furthermore, clear and functional land-use categories must be assigned to the 48.6% of regulated areas that currently lack designation to support coherent planning and effective service delivery. Built-up lands within the 'no land use' category must be designated to the relevant land use category, while the vacant lands in these areas must be regulated as service lands to accommodate schools, mosques, health facilities, and parks that are badly needed (more under 5.3 below).

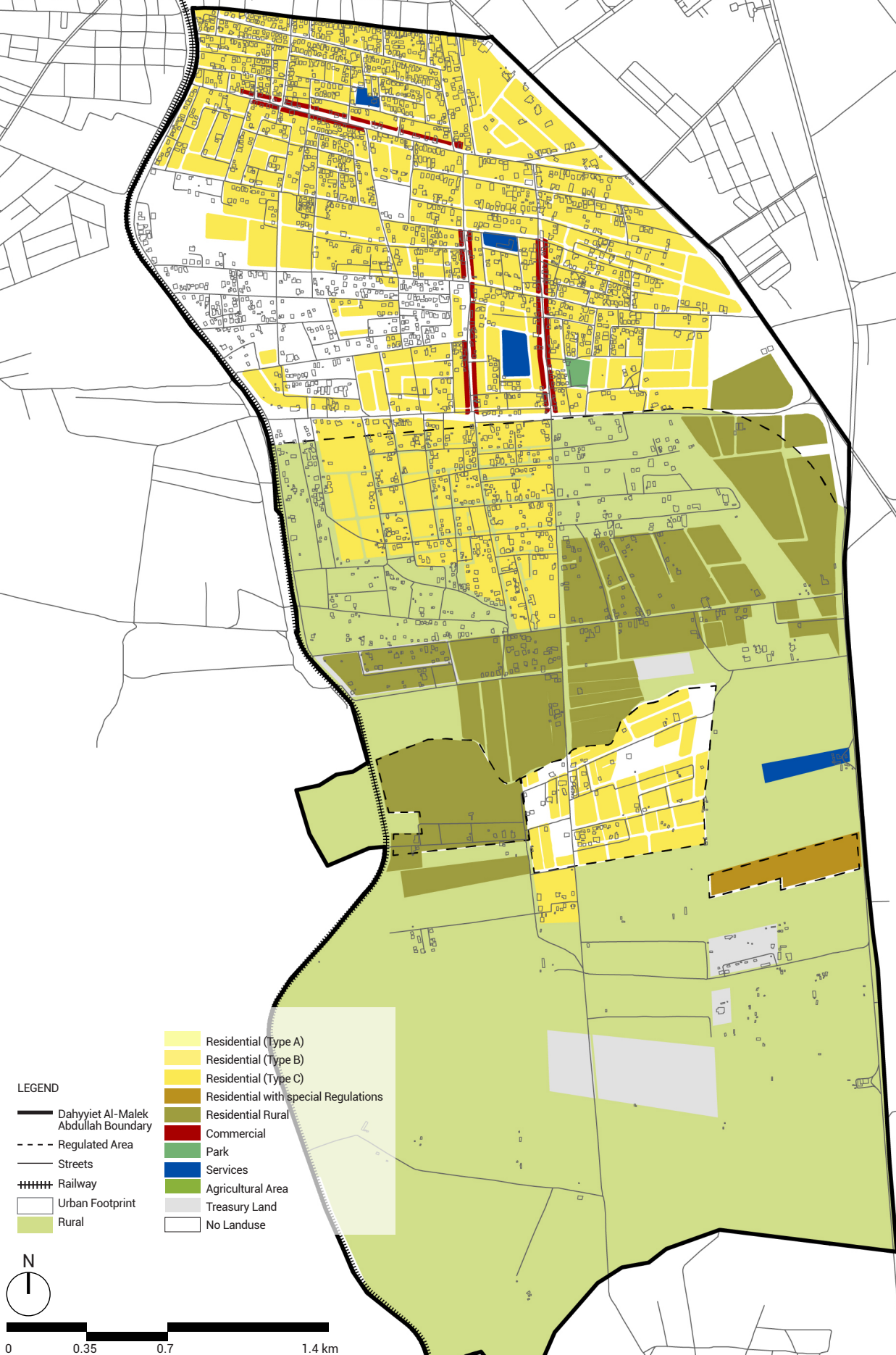


Fig. 20: Land uses of Dahiyat Al-Malik Abdullah Neighbourhood



## Population Growth Projections

To plan for resilient futures, land use, zoning, and service provision must take population growth projections into account. Mafraq Governorate has an estimated annual population growth rate of 2.2%. As aforementioned, Dahiyat Al Malik Abdullah has an estimated total population of 40,934 inhabitants in 2025 based on the GIS mapping. Three growth outcomes are predicted for the neighbourhood based on low, medium, and high population growth, as shown in Figure 20.

- Low growth outcome: under this projection the population growth rate will decrease to 1%. The population growth rate in Mafraq Governorate has decreased by 0.1% since 2020. Based on this, an estimate of 1% was calculated to be the lowest possible reasonable growth rate in the coming years.
- Medium growth outcome: under this projection the population growth rate will follow the same annual growth rate of Mafraq Governorate at 2.2%.
- High growth outcome: under this projection the population growth rate will increase to 3.1%. This rate is based on the highest population growth rate reached in Mafraq Governorate under 'normal' circumstances and before the Syrian refugee settlement. 'Normal' circumstances in this context refers to a stable situation where no internal or external conflict occurs in the area that would cause sudden demographic changes.

If the neighbourhood's population growth rate were to gradually decrease over the next fifteen years to 1%, this would still result in a population of 47,523 by 2040 (an additional 6,589 residents, or an increase of approximately 16%). If the neighbourhood was to maintain an annual growth rate of 2.2% , matching the current estimated growth rate of Mafraq Governorate, this would result in an a total population of 56,735 inhabitants by 2040 (an additional 15,801 person, a 39% increase from the current population). Finally, if the growth rate in the neighbourhood was to increase to a growth rate of 3.1%, this would result in a population of 64,709 by 2040 (an additional 23,775 residents, a 58% increase from the current population).

Refugee arrival and settlement is difficult to predict. Still, to account for this possibility, an additional 6.3% population growth rate can be added to the projections, to accommodate for any possible unanticipated settlement, once every decade. The suggested percentage is based on the highest previous increase in the growth rate that occurred in 2013 due to the Syrian refugee settlement in Mafraq

Governorate. Under this scenario, the neighbourhood's population under the medium growth outcome is projected to reach approximately 60,309 inhabitants by 2040.

Another potential outcome to consider is the voluntary repatriation of a portion of the remaining refugee population, though the exact percentage remains highly unpredictable. It is likely that most of those who want to return have done so.




Fig. 21: Dahiyatt Al Malik Abdullah Neighbourhood Population Growth Outcomes



## Neighbourhood Capacity Projections

Figure 21 illustrates the neighbourhood's built-up footprint, including existing structures and their number of floors. The total built-up area amounts to 0.58 km<sup>2</sup>, of which 76% lies within the regulated area and 24% within the unregulated area.


Given that the current residential land uses in the neighbourhood are limited to Residential Type C and Rural Residential, estimating the maximum neighbourhood capacity is essential for future planning, particularly to ensure equitable and efficient water service provision. This can be approached through two main scenarios:

(1)  Infill & vertical densification scenario:

Under this scenario the calculation of maximum neighbourhood capacity considers the following factors:

- The neighbourhood's land use plan
- Vacant lands that already have designated land uses, regardless of their location inside or outside regulated boundaries
- The average household size in GMM, estimated at 5.2 persons.
- The assumed number of apartments per floor by land use type: two apartments per floor for Residential Type C areas, and one apartment per floor for Rural Residential builds.

Consequently, if all available vacant lands are in-filled according to the land use typology and regulations, and if the existing buildings are upgraded to the maximum number of residential floors according to the by-law, then the maximum capacity of the neighbourhood would be 260,478 inhabitants (assuming no new lands are regulated). If the current 'no land-use' area within the regulated boundary is designated as Residential Type C, the maximum capacity would increase to 279,500 inhabitants. While this figure is unlikely to be reached in the near future, it provides an upper threshold for planning purposes. Under the highest growth outcome (3.1%), the neighbourhood would not reach full capacity before year 2088.

(2)  Limited to infill development scenario:

If future growth in the neighbourhood is limited to infilling vacant land with a maximum of four floors in Residential Type C and two floors in Rural Residential areas, the neighbourhood could accommodate up to 164,194 inhabitants, a capacity projected to be reached by 2071 under the highest growth rate scenario.

Therefore, the maximum residential capacity of currently developed lands is estimated at 164,194 inhabitants under an infill-only scenario, and up to 279,500 inhabitants if infill is combined with vertical densification and applied in areas where there is current residential use.

LEGEND

- Dahiyyat Al-Malek Abdullah Boundary
- - - Regulated Area
- Streets
- Wadi
- +++++ Railway
- 1 Floor
- 2 Floors
- 3 Floors
- 4 Floors
- Other Buildings



Fig. 22: Built Up within Dahiyyat Al-Malik Abdullah Neighbourhood

## Basic Services Provision

Based on the GIS data collected for the study, outside of WASH (discussed under 4.2), residents of Dahiyyat Al-Malik Abdullah do not have adequate service provision in the following sectors:

- **Education Facilities:**

Dahiyyat Al-Malik Abdullah has five public primary schools (three boys only schools and two mixed-gender schools), and only one public secondary school, limited to male students, resulting in a significant gap in access to secondary education for girls.

It is estimated that the neighbourhood currently has 14,327 residents aged 5–19 years, representing the school-age population. However, data received from the Ministry of Education (MoE) indicates that only 3,245 students are currently enrolled in public schools within the neighbourhood. This suggests that approximately 11,082 students either attend private schools, commute to public schools outside the neighbourhood, or have dropped out of the education system altogether. Survey findings corroborate the educational access gap, with 16% of households reporting at least one child under 16 out of school (this was higher amongst Syrian households at 23% compared to 9% amongst Jordanian households).

- **Commercial Facilities:**

The spatial distribution of commercial facilities within Dahiyyat Al-Malik Abdullah is uneven and highly concentrated in the northern part of the neighbourhood, while the central and southern areas, particularly within unregulated zones, remain under-served. Accessibility analysis indicates that only 35% of residents can reach basic commercial services such as markets and a pharmacy within a 15-minute walk, while 71% must walk 30 minutes or more to access essential facilities. This imbalance disproportionately affects vulnerable groups, including women, children, and the elderly.

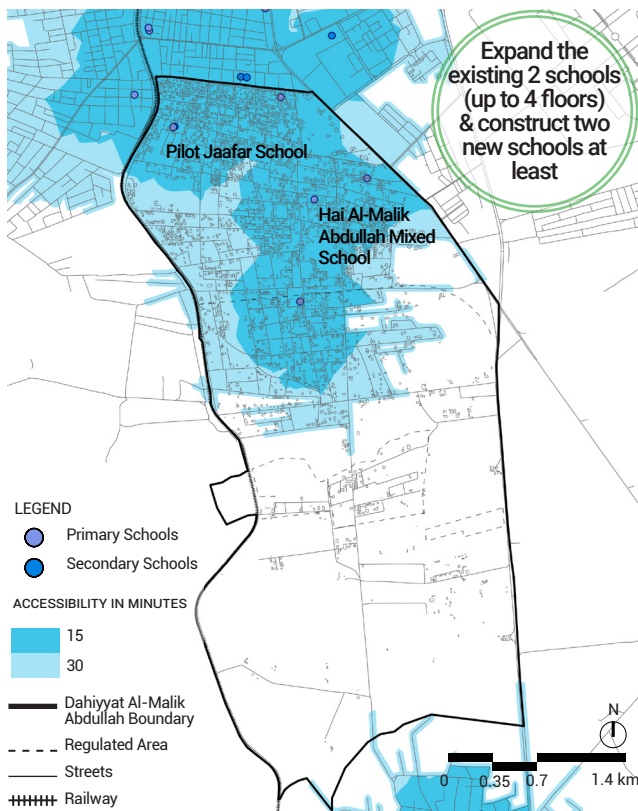


Fig. 23: Educational Facilities

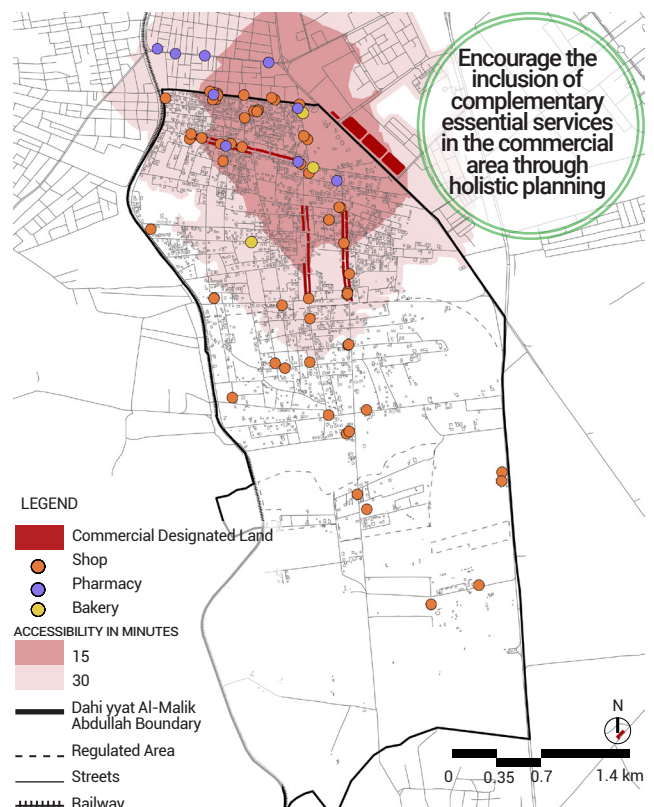


Fig. 24: Commercial Facilities

• **Health Care Facilities**

Based on data received from the Ministry of Health (MoH), there are no health facilities located within the boundaries of the neighbourhood. Several facilities are located in the surrounding area, including the Al-Hayy Al-Janoubi Primary Health Centre, a specialized Gynaecology and Paediatrics Hospital, and the King Talal Military Hospital, which serves exclusively military personnel and their families. The specialized Gynaecology and Paediatrics Hospital was excluded from the service coverage analysis as it does not provide comprehensive healthcare services or respond to the full range of emergency cases. Similarly, the King Talal Military Hospital was excluded, as its services are restricted to military personnel and their dependants. Accordingly, the only public health facility considered to be serving the neighbourhood's population is the Hayy Al-Janoubi Primary Health Centre, located on the northern boundary of Dahiyyat Al-Malik Abdullah. According to MoH by-laws and regulations, a comprehensive health centre is designed to serve a population ranging between 15,000 and 50,000 inhabitants. Given that Dahiyyat Al-Malik Abdullah's population along is estimated at 40,934 inhabitants based on GIS data analysis conducted for this project, the existing health service provision is insufficient to adequately meet current demand. This analysis therefore highlights a clear need to establish a comprehensive health centre within the neighbourhood boundaries to ensure adequate and equitable access to healthcare services for the resident population.

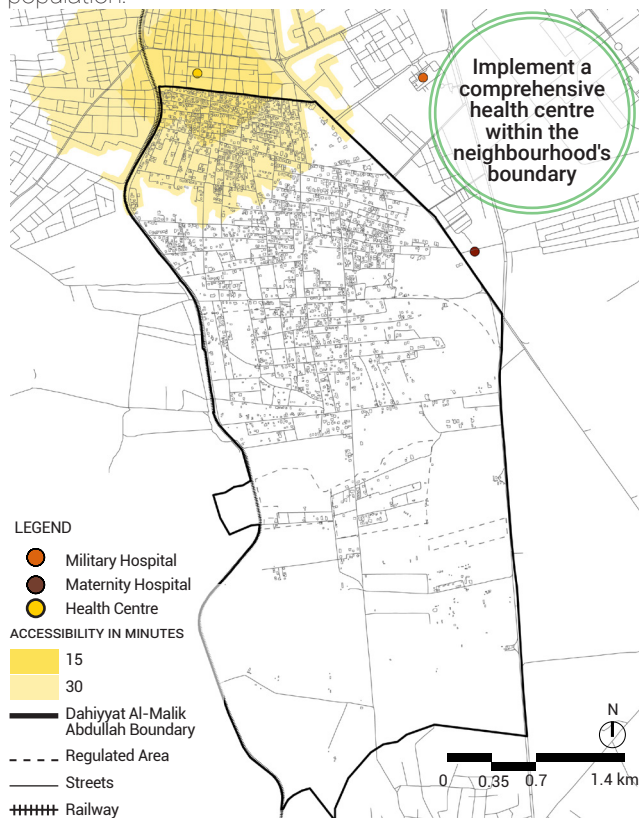


Fig. 25: Health Care Facilities





## Planning for resilient futures in Dahiyyat Al-Malik Abdullah

Taking into consideration the data gathered by the study and presented above, the need for immediate regularisation of inhabited areas of Dahiyyat Al-Malik Abdullah is clear and urgent. If land without land use is corrected to reflect actual usage (including Type C in the regulated area and as Rural Residential in unregulated areas), MoWI would become responsible for supplying those areas with water connections, immediately covering an additional 22,000 inhabitants by the network.

YMC should consider that by 2040, the neighbourhood's population is projected to range between 56,735 and 60,309 inhabitants on a medium growth projection. Any new extended water networks should take that into consideration when designing extensions (see Earle et al 2025 for a proposed loop system water network expansion for Dahiyyat Al-Malik Abdullah).

Regularisation should also account for strengthening and diversifying neighbourhood-level commercial uses by consolidating essential services—such as grocery shops, pharmacies, bakeries, and water stores—within existing designated commercial lands through targeted licensing incentives, improving walkability and overall liveability in the neighbourhood.

Services also need to expand to improve quality of life for residents of Dahiyyat Al-Malik Abdullah. Health care provision is not adequate for the existing population, and will not be able to cope with the projected population growth range. Furthermore, by 2040, projections conducted by the study expect an additional 6,781 students will reach school age, further intensifying pressure on existing educational infrastructure.

To address these growing educational needs, it is recommended to vertically expand existing public schools, specifically Jaafar School for Boys and Hai Al-Malik Abdullah Primary Mixed School (currently accommodating 841 students across three floors and 853 students across two floors, respectively). If one floor is added to Jaafar School and two additional floors to Hai Al-Malik Abdullah Primary Mixed School, in line with the MoE's maximum limit of four floors for public school buildings, these expansions would increase their capacities to approximately 1,121 students and 1,706 students respectively.

Nearby public schools within a 15-minute walking distance were also considered as part of the service coverage analysis. However, even with potential vertical expansion of these facilities, there will remain a shortfall in capacity, necessitating the construction of at least two new public schools. In this context, it is strongly recommended that

the Ministry of Education prioritise the establishment of new schools that specifically address the lack of girls' schools and secondary education facilities within the neighbourhood, to ensure equitable access to education and to respond to current and projected demographic needs. Without more secondary school coverage, only a small percentage of students leaving primary school in the next 15 years will continue with their education, and girls are particularly likely not to. This will reinforce the current educational attainment profile of the neighbourhood, compounding vulnerabilities.

It is important to note that a key priority is to review and update the land use plan to accurately reflect designated land uses within the regulated area, particularly in locations that currently lack defined land use classifications. In addition, the regulated area boundary should be reviewed and updated to align with the actual extent of regulated areas on the ground.





# 06

## CONCLUSION AND RECOMMENDATIONS

## Conclusion

The case of Dahiyat Al-Malik Abdullah in Mafraq highlights how drought, climate change, urbanization, and displacement intersect to intensify stress on already fragile urban water systems. The findings demonstrate that water insecurity in the neighborhood cannot be understood solely as a technical challenge related to infrastructure deficits or water scarcity. Rather, it is produced through intersecting environmental, socioeconomic, and governance dynamics that shape unequal access to water and increase the vulnerability of both refugee and host communities.

At the national and regional levels, Jordan's chronic water scarcity and increasing exposure to climate-related shocks continue to place unprecedented strain on urban systems, particularly in northern municipalities hosting large refugee populations. In Mafraq, rapid urban growth driven by displacement has intensified demand on aging infrastructure and widened existing service gaps. Within Dahiyat Al-Malik Abdullah, these dynamics are experienced most acutely at the household level through irregular water supply, reliance on expensive coping mechanisms, deteriorating infrastructure, and growing financial burdens associated with securing adequate water.

The research further demonstrates that vulnerability is unevenly distributed and structurally produced through unequal access to infrastructure, planning systems, and institutional pathways. Refugees, low-income households, tenants, and residents living in informally developed areas face compounded barriers in accessing safe, affordable, and reliable water services. The findings illustrate how insecure tenure arrangements, limited financial capacity, and exclusion from planning and decision-making processes reduce households' ability to adapt to worsening water stress. As drought conditions intensify, these inequalities risk becoming further entrenched.

At the same time, the study highlights the importance of community knowledge and locally grounded adaptation practices. Residents have developed a range of adaptive practices to manage chronic shortages, including rooftop water storage, water conservation measures, informal water-sharing arrangements, and household-level infrastructure adjustments. While these practices reflect resilience and adaptive capacity, they also demonstrate the extent to which households are forced to individually absorb the costs and risks associated with inadequate urban water governance.

The assessment further underscores the need to move beyond reactive and emergency-oriented responses toward more integrated, inclusive, and forward-looking urban planning approaches. Addressing the multiple challenges facing Mafraq requires coordinated action across sectors and scales, linking water management, urban planning, climate adaptation, housing, and service delivery policies. Investments in infrastructure rehabilitation, nature-based solutions, groundwater recharge, and climate-resilient urban planning must be accompanied by stronger community participation and more equitable governance mechanisms.


Importantly, the findings suggest that refugee-hosting urban areas should not only be viewed through the lens of humanitarian response, but also as critical spaces for advancing long-term urban resilience and climate adaptation. Strengthening local institutions, empowering communities to participate in decision-making, and ensuring that vulnerable groups are included in planning and service delivery processes are essential for building more just and sustainable urban futures.

Ultimately, the experience of Dahiyat Al-Malik Abdullah reflects broader regional and global challenges facing cities located at the intersection of climate stress and displacement. The neighborhood offers important lessons on the urgent need for integrated urban resilience approaches that recognize water not only as a resource challenge, but also as a question of equity, dignity, and the right to the city. By centering the experiences of affected communities and connecting local realities with broader structural dynamics, this study contributes evidence to inform more inclusive drought responses and climate adaptation strategies in refugee-hosting urban contexts.

## Recommendations: Multi-Scalar Pathways for Water Security and Urban Resilience

Water insecurity in Dahiyat Al-Malik Abdullah is shaped by the interaction between drought, displacement, unequal infrastructure provision, and institutional barriers to equitable access. Addressing these interconnected challenges requires integrated responses that move beyond sectoral approaches and link climate adaptation, urban planning, water governance, and social inclusion.

The recommendations below are therefore organized thematically to reflect the core findings of this study and to support coordinated action across governance scales. Together, they aim to strengthen climate resilience, improve equitable access to water and services, and support more inclusive and sustainable urban futures in displacement-affected cities.

 Drought and Climate Adaptation	Recommendation	Key Finding Addressed	Relevant Actors	Action Scale
	Strengthen groundwater abstraction monitoring and enforcement mechanisms	Over-abstraction of aquifers is accelerating hydrological drought and threatening long-term urban water security	MoWI; MoENV	National / Regional
	Develop regional drought preparedness and early warning systems	Increasing climate variability requires anticipatory planning and coordinated response systems	MoENV; MoWI; MoLA	National / Regional
	Expand nature-based solutions, urban greening, and groundwater recharge interventions to strengthen drought resilience	Declining green cover and ecosystem degradation reduce natural water retention capacity and urban resilience	Mafrqq Governorate; MoLA; GMM; MoENV; MoA; MoWI	Regional / City
	Integrate climate projections and drought-risk assessments into urban and infrastructure planning processes	Existing planning systems insufficiently account for future climate and water stress scenarios	MoLA; GMM; MoWI; MoENV;	National / City
	Formalize rooftop rainwater harvesting and grey-water reuse systems through technical standards, incentives, and community support	Household-level alternative water solutions remain largely informal and unsupported despite their growing importance	GMM; YMC; MoWI	City / Neighborhood
	Promote household and community-level water conservation practices through awareness and technical support programmes	Water insecurity is intensified by high demand pressures and limited awareness of efficient water use practices	YMC; NGOs; community-based organizations	City / Neighborhood



Displacement, Equity, and Social Inclusion

Recommendation

Key Finding Addressed

Relevant Actors

Action Scale

Strengthen integrated climate-water-displacement governance frameworks

Fragmented governance structures limit effective responses to overlapping drought, displacement, and urban water insecurity challenges

MoLA; MoENV; MoWI; MOI

National

Review administrative barriers preventing refugees from obtaining individual water meters or formal service registration

Current metering and registration arrangements contribute to unequal access and reliance on informal systems

MoWI; WAJ; YMC; MOI

City / Neighborhood

Conduct targeted awareness and outreach campaigns on water rights, complaint mechanisms, connection procedures, and conservation practices

Refugee and low-income communities often lack information on legal access pathways, available support, and grievance mechanisms

GMM; YMC; NGOs; community-based organizations

City / Neighborhood

Strengthen participatory and community-inclusive governance mechanisms in water and urban planning processes

Limited community engagement reduces responsiveness and accountability of planning processes

GMM; YMC; NGOs

City / Neighborhood

Establish a Community Water Committee with inclusive representation of refugees, women, tenants, and host communities

Existing governance mechanisms insufficiently reflect the needs and experiences of vulnerable groups

GMM; YMC; NGOs; community-based organizations

Neighborhood

Prioritize investments in underserved neighborhoods hosting displaced populations

Refugee-hosting neighborhoods experience disproportionate infrastructure stress and service deficits

MoLA; MoWI; GMM; donor agencies

City



Water Governance and Infrastructure

Upgrade and rehabilitate aging water infrastructure and reduce non-revenue water losses

Aging and overstressed networks contribute to leakage, irregular supply, and inequitable access

YMC; WAJ; GMM

National / City / Neighborhood

Extend piped water coverage to unconnected areas, calibrated to projected 2040 population growth

Existing infrastructure is unable to adequately meet growing demand in high-density neighborhoods

YMC; GMM; MoWI; WAJ

City / Neighborhood

Audit and resolve regulatory boundary misalignments and establish accelerated service extension processes for eligible built-up areas

Informal and unregulated urban expansion limits infrastructure provision and service connectivity

GMM; MoLA; Department of Lands and Survey

City

Replace shared water meters with individual household meters where feasible

Shared metering contributes to inequitable cost-sharing, disputes, and reduced accountability over water use

YMC

City / Neighborhood

Establish formal coordination mechanisms between municipalities, utilities, ministries, and humanitarian actors on drought and urban water management

Fragmented institutional roles reduce service efficiency and coordinated planning

MoWI; WAJ; YMC; GMM; humanitarian actors

National / Regional

Strengthen municipal technical and financial capacity for climate-responsive water management

Municipalities and utilities face technical and financial constraints in responding to climate and displacement pressures

MoLA; GMM; YMC; donor agencies

City

Incorporate study findings into the GMM Urban Observatory, including indicators tracking water equity by nationality and gender

Existing urban monitoring systems insufficiently capture inequalities affecting refugees and vulnerable populations

GMM

City



Urban Planning and Resilient Urban Growth

Recommendation	Key Finding Addressed	Relevant Actors	Action Scale
Adopt proactive climate-sensitive urban planning approaches based on projected population growth and climate risks	Reactive planning fails to address long-term infrastructure and water stress in rapidly growing urban areas	GMM; MoLA; MoENV; MoWI	National / Regional / City
Review and update regulated boundaries to reflect actual urban expansion and inhabited areas	Significant portions of the neighborhood remain outside formal planning boundaries despite urban growth	GMM; MoLA	City
Assign appropriate land-use classifications to areas currently lacking formal designation	Undefined land-use categories contribute to haphazard development and service provision gaps	GMM; MoLA	City
Integrate water-sensitive urban design and climate adaptation measures into municipal planning frameworks	Limited drainage and water-sensitive planning increase vulnerability to climate stress	GMM; MoENV; MoWI	National / Regional / City
Expand access to public green and recreational spaces within the neighborhood	Lack of green public space reduces environmental resilience and quality of life	GMM; MoENV	Neighborhood
Prioritize the construction of a comprehensive health facility and expansion of existing schools in line with projected population growth	Existing social infrastructure is insufficient to meet current and future demographic needs	MoE; MoH; GMM	Neighborhood
Strengthen neighborhood-level commercial and service accessibility through integrated land-use planning	Uneven spatial distribution of services limits accessibility for vulnerable groups	GMM; MoLA	Neighborhood



07

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**UN-HABITAT**

63, Tayseer Na'na'ah Street,  
South Abdoun, Amman, Jordan.  
Telephone: +962799 1222 23,  
[unhabitat-jordan@un.org](mailto:unhabitat-jordan@un.org)  
UNH Project Manager: [ayah.hammadmohd@un.org](mailto:ayah.hammadmohd@un.org)  
IIED Project Manager: [deena.dajani@iied.org](mailto:deena.dajani@iied.org)  
[www.unhabitat.org](http://www.unhabitat.org)