RISE UP for Sustainable Urban Resilience

Multi-layered Vulnerability Profile for Sahab City

United Nations Human Settlements Programme

UN-HABITAT

بلدية سحاب

aecid

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Source: Sahab City, Jordan, (c) Sahab Municipality

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Foreword from Head of UN-Habitat Jordan Office

Climate change risks, such as floods, droughts, and heatwaves, are increasingly affecting vulnerable communities in Jordan. UN-Habitat's programme in Jordan is committed to enhancing climate resilience in Jordanian cities, particularly by addressing water and food insecurities and improving the adaptive capacities of vulnerable groups, including refugees, the urban poor, people with disabilities, and women.
The Multilayered Vulnerability Profile for Sahab City represents a significant step forward in our collective efforts to foster sustainable urban development and strengthen urban resilience in Jordanian cities. Developed under the UN-Habitat's RISE UP programme and funded by the Spanish Agency for International Development Cooperation (AECID), this profile underscores our commitment to resilience through evidence-based analysis, participatory planning, and capacity building.

Sahab City, with its diverse industrial activities, vibrant commercial sectors, and growing population, faces a range of challenges, including rapid urbanization, climate change impacts such as flash floods, droughts, heatwaves, air pollution, and biodiversity loss. This comprehensive assessment presents a holistic, evidence-based approach to understanding these challenges, providing key stakeholders—including decision-makers, Urban and climate change experts and local communities—with valuable insights into the city's vulnerabilities.

The development of this profile involved extensive data collection, in-depth analysis, and close coordination with national and local governments, including Sahab Municipality, the Ministry of Local Administration, and the Ministry of Environment. This partnership ensures that the findings accurately reflect the realities on the ground. By examining the urban, climate change, and biodiversity dimensions, this profile identifies vulnerable areas and lays the foundation for sustainable and resilient interventions.

Key findings highlight critical areas requiring immediate attention, particularly those facing environmental degradation, socio-economic challenges, and heightened climate-related risks. These insights will inform policies, programs, and local plans aimed at improving the quality of life for Sahab's residents while safeguarding both its natural and built environments.

We encourage international organizations, donors, and the private sector to leverage this profile as a guiding framework for future initiatives. Together, we can build a resilient, inclusive, and sustainable Sahab City, which can serve as a model for urban resilience and sustainable development in Jordan and beyond.

We extend our sincere gratitude to AECID and our governmental partners in Jordan for their invaluable support in making this initiative a reality.

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

Abbreviations

AI	Aerosol Index
AECID	Agency for International Development Cooperation
AIE	Abdullah II Ibn Al-Hussein Industrial Estate
ASEZA	Aqaba Special Economic Zone Authority
ALOS	Advanced Land Observing Satellite
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
CVDB	Cities and Villages Development Bank
DEM	Digital Elevation Models
DoS	Department of Statistics
GAM	Greater Amman Municipality
GACDP	Greater Amman Comprehensive Development Plan
GDP	Gross Domestic Product
GIS	Geographic Information System
IPCC	Intergovernmental Panel on Climate Change
GoJ	Government of Jordan
GWh	Gigawatt Hours
HUDC	Housing and Urban Development Corporation
IIED	International Institute for Environment and Development
JEPCO	Jordan Electric Power Company
JIEC	Jordan Industrial Estates Company
JIC	Jordan Investment Commission
JMD	Jordan Meteorological Department
JOD	Jordanian Dinar
JVA	Jordan Valley Authority
LDC	Least Developed Countries
LTRC	Land Transport Regulatory Commission
LST	Land Surface Temperatures
MEMR	Minister of Energy and Mineral Resource
MoENV	Ministry of Environment
MoH	Ministry of Health
MoI	Ministry of Interior
MoLA	Ministry of Local Administration
MoPIC	Ministry of Planning and International Cooperation
MOWI	Ministry of Water and Irrigation
MVA	Multi-layered Vulnerability Assessment
NAP	National adaptation plan
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organisation
NRW	Non-Revenue Water
OHL	Overhead Lines
PDTRA	Petra Development and Tourism Region Authority
RCP	Representative Concentration Pathway
RISE UP	Resilient Settlements for the Urban Poor
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goal
SEAP	Sahab Environmental Action Plan
SIDA	Swedish International Development Cooperation Agency
SIDS	Small Island Developing States
SM	Sahab Municipality
SWM	Solid Waste Management
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
UHI	Urban Heat Island
UNFCCC	United Nations Framework Convention on Climate Change
UN-HABITAT	United Nations Human Settlements Programme
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
USAID	United States Agency for International Development
WHO	World Health Organization
WWTP	Waste Water Treatment Plant

Definition of Terminologies

Liwa: refers to the Ministry of Interior's first division after the governorate.
Qada: refers to the Ministry of Interior's second division after the liwa.

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Executive Summary

This document presents the results of a comprehensive multi-layered profiling effort for Sahab City, focusing on three key dimensions: urban vulnerability, climate change hazards, and biodiversity. The analysis integrates these dimensions to identify vulnerability hotspots and understand their interconnectedness, ensuring that actions are responsive and appropriately localized. By examining urban, climate, and biodiversity factors together, the Multi-layered Vulnerability Assessment (MVA) identifies areas with high vulnerabilities and highlights regions where low biodiversity can buffer climate impacts. Critical hotspots are then prioritized for targeted interventions, including enhancing infrastructure resilience, sustainable urban planning, and ecosystem protection to strengthen climate resilience.

City Context Analysis
Sahab Municipality, strategically located in the central part of Jordan, is currently undergoing rapid urban and industrial transformation. As the municipality expands, it faces a series of intertwinedchallengesthatposesignificantriskstobothitshuman and natural systems. These challenges stem from urbanization, climate change, and the degradation of biodiversity, with long-term consequences for the resilience of the area. Sahab's geography, situated at the confluence of two biogeographical zones—the Saharo-Arabian and Irano-Turanian—creates a delicate balance of arid and semi-arid ecosystems. While these ecosystems are resilient, they are increasingly stressed by human activities and environmental changes.

Urban Dimension
The urban dimension of the MVA for Sahab City highlights the interconnected challenges arising from rapid urbanization, industrialization, and socio-economic disparities, which together shape the municipality's resilience to climate change and urban growth pressures. Population density in Sahab is a key indicator of the strain on urban infrastructure and services. High population concentrations contribute to congestion, inadequate public services, and environmental degradation, underlining the need for strategic planning that balances growth with equitable access to resources. As Sahab City expands, the indicator of urbanization and urban growth reveals the municipality's transformation, driven by its proximity to major industrial zones. This growth increases demand for residential and commercial services, creating tensions between industrial expansion and the need for sustainable urban development. The land use patterns in Sahab further reflect this challenge, with limited allocation of land for recreational spaces and green areas. Inefficient land management practices exacerbate vulnerabilities, including reduced environmental quality and lack of accessible public spaces. The socioeconomic vulnerability indicator sheds light on the economic disparities within Sahab City, revealing that vulnerable groups, such as low-income residents and marginalized populations, are disproportionately exposed to environmental and economic risks. These social inequities heighten the municipality's overall vulnerability, making it more challenging to address both climate change impacts and the needs of the population. Access to services remains uneven across Sahab, with gaps in healthcare, education, and transportation, particularly in under served areas. These service gaps increase vulnerability, limiting the municipality's ability to provide equitable access to essential resources. Environmental quality is a pressing concern in Sahab, with industrial activities, transportation, and waste management contributing to high levels of air and water pollution. This degradation negatively impacts public health and the local ecosystem, creating an urgent need for interventions to improve environmental standards. Additionally, the urban heat island (UHI) effect is a significant issue, as dense infrastructure and a lack of green spaces lead to elevated temperatures in parts of the city. This phenomenon exacerbates heat-related health risks and increases energy consumption, making it a critical area for mitigation efforts.

A GIS analysis was conducted to assess urban vulnerability in Sahab City, identifying areas with varying levels of risk. High vulnerability areas, including the Downtown, Southern Neighbourhood, and Industrial Area Neighbourhood, face challenges such as high population density, rapid urbanization, inadequate infrastructure, air pollution, and limited access to essential services. Medium vulnerability areas, like parts of the Western, Eastern, and Southern Neighbourhoods, and Salboud, experience moderate pressures due to proximity to industrial zones. Lower vulnerability areas, such as the Abdullah II Ibn Al-Hussein Industrial Estate and Hirayeh Area, have fewer residential pressures but still require attention to mitigate environmental risks from industrial activities.

Climate Change Dimension

Jordan's vulnerability to climate change is growing, driven by its semi-arid climate, limited water resources, and increasing environmental pressures such as water scarcity, droughts, and desertification. Rising global temperatures are intensifying extreme weather events like heat waves, floods, and droughts, which not only strain the environment but also threaten agriculture, water availability, livelihoods, and public health. The National Climate Change Policy (2022-2050) addresses these challenges through local adaptation strategies, focusing on regions like Sahab City, where efforts include improving infrastructure, water management, and sustainable agricultural practices to reduce climate impacts.

In Sahab City, the MVA evaluates the city's exposure to three key climate hazards: flooding, drought, and extreme heat. These indicators were selected for their significant and widespread effects on the city's environment, infrastructure, and livelihoods. The MVA utilizes geospatial analysis to assess the combined impacts of these hazards and provides insights into how they interact over time. While all three hazards are high-impact, their spatial variability differs. Extreme heat and drought were assigned equal weights of 25%, as they affect most areas uniformly, while flooding was weighted at 50% due to its localized impact across different city zones.
Hazard mapping reveals that high-risk areas, such as Downtown, Southern Neighbourhood, and parts of Salboud, Western, and Eastern Neighbourhoods, face the combined effects of these climate hazards, with inadequate infrastructure exacerbating vulnerabilities. Medium-risk areas are less prone to flooding but still vulnerable to heat and drought, while low-risk zones in Salboud and Western Neighbourhoods are relatively more resilient.

Biodiversity Dimension
Jordan's diverse landscapes, ranging from the fertile Mediterranean highlands to the arid deserts of the Saharo-Arabian region, support a rich array of flora and fauna. The Sahab Municipality, situated near Amman, exemplifies this diversity, featuring Mediterranean non-forest vegetation and steppe ecosystems. These areas are home to species such as Artemisia herba-alba and Anabasis syriaca, adapted to the region's semi-arid conditions.

The biodiversity dimension focused on Biodiversity Connectivity Indicator. This indicator examines how urbanization, population density, and access to services impact the continuity of natural habitats. Rapid urban growth in Sahab has disrupted natural corridors, hindering species migration and adaptation to climate change. To gain a clearer understanding of biodiversity vulnerability hotspots, a comprehensive GIS analysis was conducted. This approach integrated multiple land cover layers, each given equal weighting, to provide a detailed assessment of biodiversity vulnerability throughout the municipality. The analysis identified areas of high, medium, and low vulnerability based on connectivity and surrounding land cover types.

Multi-Layered Vulnerability Assessment
The multi-layered vulnerability assessment integrates urban, biodiversity, and climate risks to provide a comprehensive understanding of Sahab City's most vulnerable areas. The assessment highlights areas where urban vulnerability intersects with climate hazards and biodiversity degradation, creating a clear picture of where intervention is most urgently needed. These areas represent the highest-risk zones, where compounded vulnerabilities from urbanization, climate change, and biodiversity loss converge.

These hotspots are characterized by high levels of urbanization, poor infrastructure, significant biodiversity loss, and increased exposure to climate hazards. Areas most affected by the UHI effect, flooding, and water scarcity coincide with regions where natural habitats have been degraded or lost. This overlapping vulnerability makes these areas critical for intervention, as addressing these compounded risks will require integrated solutions that address the root causes of urban expansion, climate hazards, and biodiversity loss. The multi-dimensional mapping process has been a crucial tool in identifying these hotspots and guiding the development of targeted, evidence-based interventions.

Stakeholder Engagement and Validation
The stakeholder validation workshop held in September 2024 was a key component of this assessment, ensuring that the findings and recommendations were aligned with local realities and community needs. The workshop brought together key stakeholders from Sahab Municipality, the Ministry of Environment, the Ministry of Local Administration, and other relevant governmental entities. Through collaborative exercises, stakeholders identified key areas of vulnerability and validated the findings of the multi-layered vulnerability mapping.

Participants in the workshop identified critical hotspot areas where urban, climate, and biodiversity vulnerabilities intersect, confirming the need for urgent intervention in these regions. The workshop also provided an opportunity for stakeholders to propose needed mitigation actions, such as the creation of green infrastructure, the restoration of ecological corridors, and the enhancement of stormwater management systems. These actions will be incorporated into the Resilience Action Plan, which will be developed in the next step and will outline specific measures to address the identified vulnerabilities and promote resilience in Sahab.

Conclusion and Next Steps
The integration of high vulnerability areas from the urban dimension with high hazard zones from the climate change dimension, alongside low vulnerability areas from the biodiversity dimension, has led to the identification of critical multi-layered hotspot areas. These areas represent regions where all three dimensions intersect, with the Salboud neighbourhood in the southwest of the city being the primary concentration.

Additionally, the hotspots resulting from the overlap of two dimensions, reflecting areas with combined vulnerabilities and hazards were identified. These hotspots are distributed across various neighbourhoods, with the highest concentration found in the Eastern Neighbourhood, located in the northeast of the city.

The next step involves conducting a detailed analysis of these identified areas to gain a deeper understanding of the specific vulnerabilities associated with each dimension. Based on this analysis, targeted actions will be developed to address the unique challenges faced by these hotspots. A comprehensive list of potential projects for these hotspot areas will be identified and validated through engagement with key stakeholders. This list will then undergo a prioritization process to produce a short-list of actions aimed at addressing the most pressing vulnerabilities and challenges.

Buildingonthisprocess,avisionwillbeformulated,andaResilience Action Plan will be developed. Furthermore, action sheets for the short-listed actions will be prepared to secure funding and support for implementing the necessary interventions.

01

INTRODUCTION

Introduction

Climate Change, Urbanization, and Biodiversity
The climate emergency is fundamentally an urban crisis, affecting every aspect of city life. With over 55% of the global population living in cities—expected to exceed 67% by 2050—urban areas face increasing vulnerability to climate change. Rising temperatures, sea levels, and extreme weather events are straining infrastructure, disrupting services, and impacting housing, livelihoods, health, and wellbeing. These pressures are exacerbated by rapid urbanization, population growth, migration, rising poverty, inequality, and biodiversity degradation. Addressing these interconnected issues through urban climate adaptation and resilience building remains one of the most significant challenges faced by cities, particularly in the global South.

Over 90% of cities lie within the world's 36 global biodiversity hotspots, where urban expansion threatens both biodiversity and climate resilience. The loss of natural habitats accelerates as human settlements expand, further exacerbated by climate hazards. Cities are increasingly recognizing the importance of spatial planning and urban land management in safeguarding ecosystems and natural assets. These strategies not only support biodiversity but also enhance climate resilience, delivering co-benefits for both people and nature. Effective spatial planning is crucial to prevent the degradation of settlements that rely on the ecosystem services that biodiversity provides. Targeted pro-biodiversity interventions are urgently needed, both within and beyond urban areas, backed by robust tools and strategies.

UN-Habitat emphasises the necessity of a multidimensional, multidisciplinary approach to understanding and addressing these overlapping challenges in cities, with a focus on building resilience for the one billion urban poor in informal settlements. These marginalized communities are particularly vulnerable to climate hazards and disaster risks, living in fragile areas where unplanned urban growth encroaches on natural habitats. Informal urbanization deepens their vulnerability, while also intensifying the challenges of climate change, urban poverty, and biodiversity loss.

Addressing urban poverty, spatial inequality, and informality is crucial to building systemic climate resilience and promoting sustainable urban futures.

Resilient Settlements for the Urban Poor Programme
In a rapidly urbanizing world facing the climate emergency, RISE UP is UN-Habitat's flagship programme, driving critical investments to build climate resilience and create sustainable urban futures. Supported by key partners such as the Adaptation Fund, Green Climate Fund, the Spanish Agency for International Development Cooperation (AECID), and the Swedish International Development Cooperation Agency (SIDA), RISE UP has mobilized over USD 150 million to accelerate global climate action, particularly in cities most vulnerable to climate change.

RISE UP projects range from constructing flood-resistant infrastructure in South-East Africa to enhancing green spaces in Malaysia and restoring mangrove ecosystems in urban Cambodia. These efforts underscore the interconnectedness of climate resilience and biodiversity. Urban ecosystems like wetlands and green spaces play a critical role in mitigating climate impacts and providing essential services for human wellbeing. Since 2019, RISE UP has worked in over 28 countries, reinforcing UN-Habitat's commitment to urban resilience and biodiversity conservation.

RISE UP delivers impact through the following key pillars:

Strengthening climate plans
Provides technical expertise to support inclusive, evidence-based climate plans at urban, regional, and national levels.

Increasing investment for climate resilience
Innovates financing schemes and mobilizes resources for cities at high risk; fostering climate resilience with social and economic co-benefits.

Increasing capacities
Delivers training to enhance governments' and local stakeholders' capabilities empowering them to implement successful, locally-driven climate projects.

Amplifying expertise
Ensures key stakeholders benefit from UN-Habitat's successful initiatives, contributing to the SURGe initiative to advance sustainable urban resilience.

Through these initiatives, UN-Habitat fosters transformative urban resilience and impactful climate action for a sustainable, inclusive future.

Assessing multi-layered vulnerabilities in cities and urban areas
Multi-layered vulnerabilities in urban environments encompass various interconnected challenges that extend beyond physical infrastructure to include spatial, social, economic, climatic, environmental, political, and technological dimensions. Issues like income inequality, environmental degradation, inadequate housing, and insufficient emergency preparedness contribute to a city's multidimensional vulnerabilities.

In this context, multi-layered vulnerability refers to the extent to which an urban system, community, or ecosystem is exposed to, sensitive to, and unable to cope with the adverse impacts of interrelated climate change, urbanization, and biodiversity loss. Factors such as geographical location, socio-economic status, infrastructure quality, and governance structures influence this vulnerability. The aggregation of multiple and cascading vulnerabilities exacerbates the overall susceptibility, risk, and adaptive capacity of people, infrastructure, and the environment.

Addressing these challenges to strengthen urban resilience requires comprehensive urban planning and management strategies. Policymakers and practitioners face several obstacles in conducting multi-layered vulnerability assessments, including:

- The fragmentation of climate change, biodiversity, and urbanization in policy and practice.
- A lack of evidence-based approaches to mapping multidimensional and interrelated vulnerabilities.
- Limited capacities and resources for conducting comprehensive assessments.
- The urban poor and residents of informal settlements being the most affected yet least engaged in decision-making processes.
- Insufficient tools for predicting future land-use changes and urban growth patterns.
- A lack of coordination and cooperation in trans-boundary and multidisciplinary planning.
- Minimal application of coherent, prioritized interventions and solutions.

These challenges highlight the need for a more integrated approach to vulnerability assessment and management. To address this, UN-Habitat's RISE UP programme has developed the Multi-layered Vulnerability Assessment (MVA) tool, whose purpose is to help communities, cities, and local leaders to comprehensively map and assess multi-layered vulnerabilities. The tool addresses the nexus between climate change hazards and risks, urbanization and spatial trends and characteristics, and biodiversity loss and land degradation to identify vulnerability hotspots arising from spatial overlaps and conflicts.

By deploying the MVA tool in communities, cities and urban areas, local and national leaders and policymakers in climate-vulnerable cities and communities can better plan and deliver inclusive, sustainable, and resilient urban development strategies for human and non-human inhabitants. This enables decision-makers to make informed choices about urban expansion and adapt to urgent climate-related challenges.

Implementation of the Multi-layered Vulnerability Assessment Tool
This report is part of the "Accelerating the Implementation of the Paris Agreement by Building the Climate Resilience of the Urban Poor in Bolivia, Colombia, Ethiopia, Jordan, and Tunisia" RISE UP project in collaboration with the Spanish Agency for International Development Cooperation (AECID). It presents the vulnerability profiles of the selected project cities, detailing the outcomes of Stages 1 and 2 of the MVA, including preparation, and mapping and analysis, that will inform Stage 3: action planning. The project engages communities in Cobija and Charagua in Bolivia, San Juan de Pasto in Colombia, Debre Birhan in Ethiopia, Sahab Municipality in Jordan, and Kerkennah in Tunisia.

The MVA implementation in Bolivia, Colombia, Ethiopia, Jordan, and Tunisia lays the groundwork for targeted climate resilience interventions. With a focus on high-risk areas, strong community engagement, and collaboration with local governments, the project leverages local capacities for effective action.

The MVA in Sahab, Jordan
Cities in Jordan are highly vulnerable to the impacts of climate change. Rising global temperatures are causing sea levels to rise and increasing the number, frequency, and severity of extreme weather events, exposing urban populations to climate related hazards such as floods and droughts. These trends have costly impacts on cities' basic services, infrastructure, housing, livelihoods, health, biodiversity, and ecosystems. Such adverse impacts are most pronounced for marginalized, urban poor communities where people live without basic access to services, shelter, security, and infrastructure.

The adverse effects of climate change are increasingly evident in Jordan. One of the world's most water stressed countries, it suffers from heightened heat stress, desertification, drought and water scarcity. In cities, people's health, wellbeing and livelihoods are at risk as extreme weather events become more recurrent, longer, and severe. This is further compounded by urban challenges, such as population growth, rural-to-urban migration, and inadequate urban infrastructure and services. While some municipalities in Jordan possess a solid understanding of spatial and urban planning, there is limited understanding on comprehensive multi-layered vulnerability assessments which should provide the evidence-base for project development. There is also a gap in finance dedicated to addressing vulnerability and enhancing resilience. In light of these considerations, there is a clear need for institutional capacity enhancement in understanding multi-layered vulnerabilities and responsive resilience solutions within municipal governments and the National Development and Planning Units.

A vital industrial and commercial hub located about 20 kilometres southeast of Amman. The city is characterized by a diverse urban landscape, with a blend of residential areas, industrial zones, and commercial centres, which create unique planning and development challenges. Sahab's population has been steadily increasing, placing significant pressure on its infrastructure, services, and resources. Furthermore, the city has seen a growing influx of refugees and migrant workers, further diversifying its demographic composition and intensifying the strain on local systems. Like many cities in Jordan, Sahab faces rising temperatures, which contribute to frequent heat-waves and extreme heat events, exacerbating its urban challenges.

Further climate induced issues such as water stress, urban flash flooding, and soaring air pollution pose substantial threats to the health and wellbeing of citizens. Vulnerable groups, such as the urban poor, women and children, refugees and migrants are particularly susceptible to shocks and stresses in Sahab.

These challenges require a proactive approach to sustainable development and climate resilience to ensure the well-being and quality of life for the city's residents. The comprehensive vulnerability assessment undertaken in Phase I will help to advance understanding of the multidimensional nature of risk and vulnerability in Sahab. In Phase II, adaptation strategies and actions that can strengthen overall climate resilience will be co-created. These may include integrated interventions that improve access to clean water, develop heatwave preparedness plans, strengthen infrastructure against floods, and promote clean air initiatives to reduce air pollution.

By prioritizing the health and well-being of vulnerable communities in Sahab through the preparation of bankable gender-responsive urban climate adaptation projects, Jordan can align its efforts with the goals outlined in the Paris Agreement and strengthen climate resilience for the most marginalized communities.

There is a lack of comprehensive understanding of the nexus of vulnerability between climate change, urbanization, and biodiversity at municipal and local levels. These interrelated dimensions are often addressed in silos in both policy and praxis. There is a critical need to enhance the capacities of municipal and local governments in order to better understand multidimensional vulnerabilities and to better plan, design, and implement evidence-based urban climate adaptation actions.

Objectives

The overall objective of the project is to build the capacity towards climate resilience of urban poor communities in Bolivia, Colombia, Ethiopia, Tunisia, and Jordan, achieving global climate and development goals. The project aims to enhance understanding of multi-layered and interconnected climate, urban, spatial, socio-economic and biodiversity risks and vulnerabilities of the most vulnerable communities in secondary and tertiary cities. Through a rigorous, spatial vulnerability assessment methodology, localised hotspots of vulnerability was identified and analysed. Potential climate resilience and adaptation actions at municipal and local levels will then appraised and prioritized through participatory urban planning and decision making processes with local stakeholders and urban poor communities. Feasible and bankable pipeline projects that reduce vulnerabilities in hotspots will be prepared in coordination with municipal governments and partners.

Target Audience

This document is designed to be valuable for a wide range of stakeholders, including national and local government authorities, key development actors, active NGOs (both international and national), donor organizations, development agencies, local community representatives, engaged youth leaders, climate change advocates, and the academic community.

About this Document

The purpose of the vulnerability profile is to provide a rapid, holistic assessment of the city's contextual background and identify any key characteristics, challenges, or opportunities relevant to climate change, urbanization, and biodiversity. It serves to provide insights into the social, economic, environmental, and cultural dynamics which shape the urban landscape in Sahab City.

This profile is organized into eight comprehensive chapters, each detailing key aspects of the implementation of the Multi-layered Vulnerability Assessment (MVA) in Sahab City, as outlined below.

Chapter One
Introduction: provides an overview of the interconnected challenges of climate change, urbanization, and biodiversity loss in cities. It highlights the RISE UP programme, which seeks to strengthen climate resilience in vulnerable urban communities. The chapter also presents the MVA tool and outlines the report's objectives, while identifying its target audience.

Chapter Two
Methodology: explains the methodology and approach of the MVA to identify and address vulnerability hotspots in Sahab City.

Chapter Three
City Context Analysis: examines the key factors influencing urban development in Jordan. It covers the institutional and policy frameworks, urban growth dynamics, and the country's geographical features. The chapter also explores the governance and administration structures and discusses urban morphology and density.

Chapter Four
Urban Dimension: explores various indicators that highlight the city's vulnerability to urbanization, socio-economic pressures, and environmental challenges. It examines factors such as population density, urban growth, land use, access to services, socioeconomic vulnerability, environmental quality, and urban heat islands.

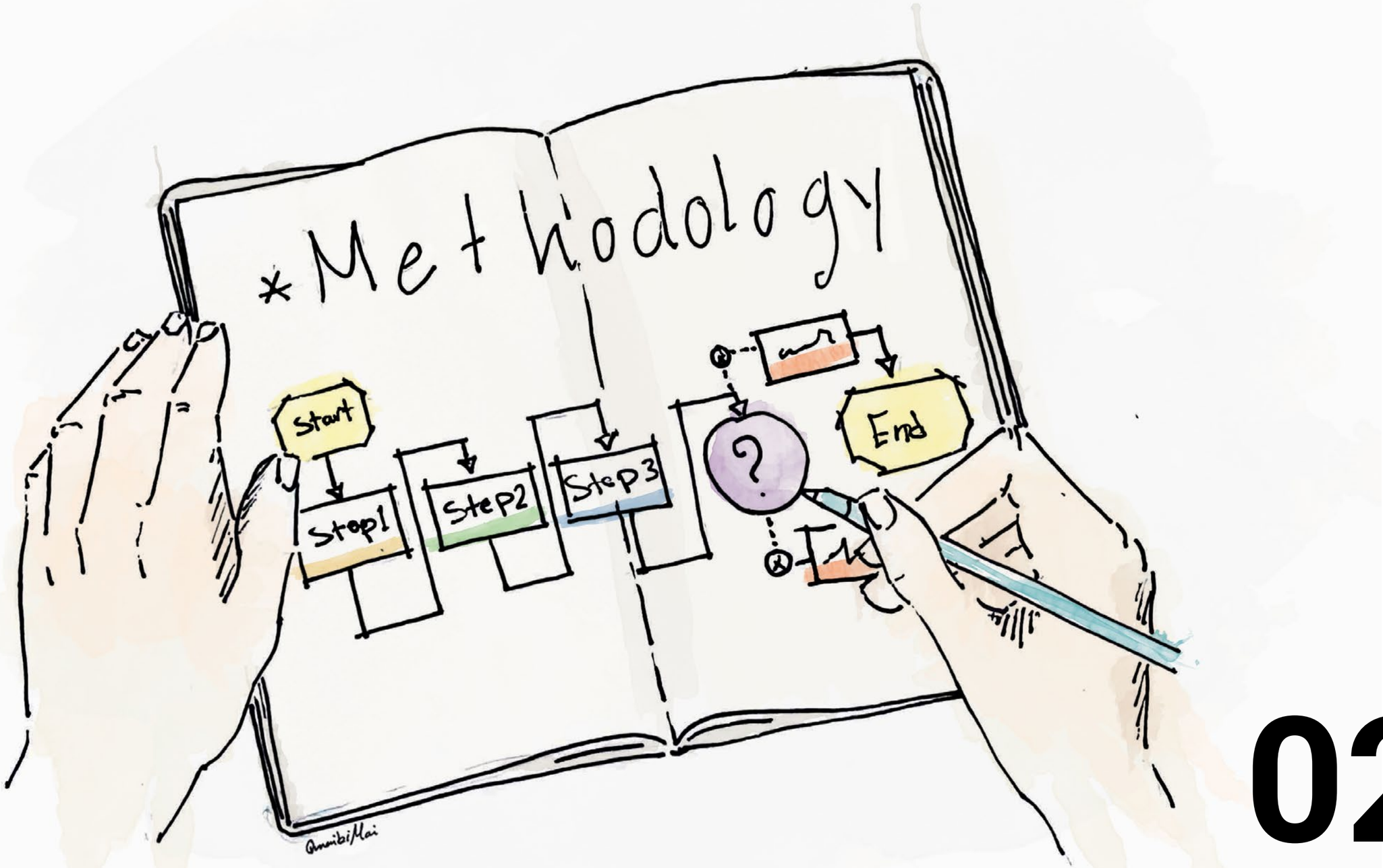
Chapter Five
Climate Change Dimension: focuses on the city's vulnerability to climate hazards including flooding, droughts, and extreme heat. It highlights Jordan's susceptibility to climate change, exacerbating challenges like water scarcity and environmental degradation. The chapter discusses key indicators that assess Sahab's exposure to these climate risks and their potential impacts on infrastructure, livelihoods, and public health.

Chapter Six
Biodiversity Dimension: focuses on biodiversity connectivity, which was identified as the primary indicator for assessing the city's vulnerability to biodiversity loss.

Chapter Seven
Stakeholder Validation: focuses on stakeholder validation, detailing the process of engaging stakeholders to review, refine, and validate the findings of the MVA.

Chapter Eight
Multi-layered Vulnerability Assessment: examines the interconnected dimensions of urban, biodiversity, and climate vulnerabilities in Sahab City, identifying critical hotspots for targeted adaptation interventions.

Source: Sahab City, Jordan, (c) UN-Habitat /Rahaf Nabil

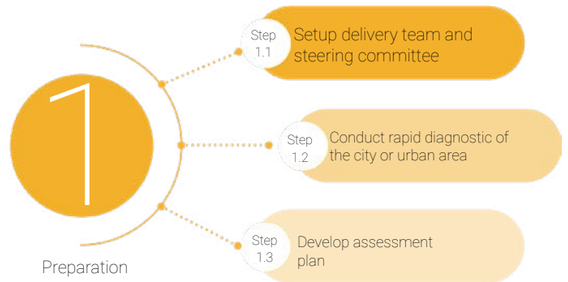


02

METHODOLOGY

Approach and Methodology

The Multi-layered Vulnerability Assessment (MVA) tool employs a three-stage methodology designed to help countries, cities, and communities effectively incorporate, adapt, and operationalise the assessment. This structured and phased approach facilitates improved resilience planning and decision-making. Each stage comprises specific steps and activities, outlined as follows:



Stage 1: Preparation

This stage focuses on establishing the groundwork for the MVA and the framework for the assessment process. Key contributors are identified, and relationships necessary for completing the MVA and analysis are established. This initial phase is crucial for ensuring that the assessment is comprehensive, well-organized, and aligned with the goals and objectives of the organization or community involved. Stage 1 consists of three steps (e.g., Step 1.1: Set up delivery team and steering committee; Step 1.2: Conduct rapid diagnostic of the city or urban area) and eight activities.

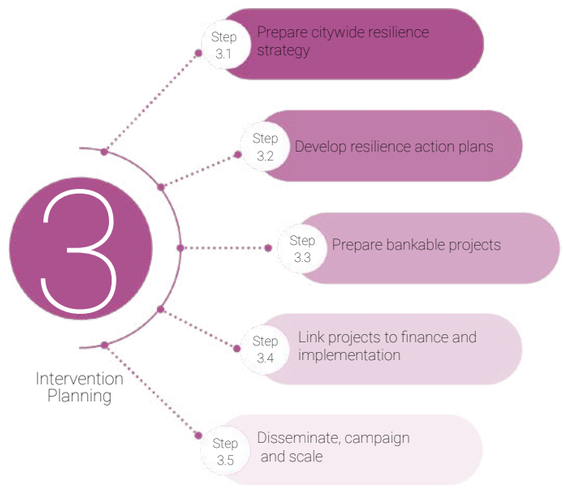
Stage 2: Mapping and Analysis

This stage involves sourcing and applying data to provide a detailed analysis of vulnerability hotspots within urban areas, examining factors related to climate change, biodiversity, and urban dimensions. The maps produced in this stage are key outputs of the MVA, allowing for the overlaying of outputs to identify and analyse areas of conflicting vulnerabilities and vulnerability hotspots. Stage 2 is articulated in five steps (e.g., Step 2.2: Data acquisition and collection; Step 2.3: Mapping historic, current, and future vulnerabilities; Step 2.5: Interpretation and analysis of vulnerability hotspots) and encompasses 19 activities.

Stage 3: Intervention Planning

Stage 3 consists of three key steps, including Step 3.1: Visioning and Objective Setting and Step 3.2: Developing Resilience Action Plans. This stage encompasses 12 activities, which will be outlined in the upcoming Sahab Resilience Action Plan.

Building on the findings from Stage 2, bankable projects will be identified to strengthen resilience against climate, urban, and biodiversity-related shocks and stresses. Through collaboration with a diverse range of stakeholders, 10 to 12 resilience-building actions will be formulated, ensuring both financial and technical feasibility while addressing the vulnerabilities highlighted in the Multi-Vulnerability Assessment (MVA).




Source: Sahab City, Jordan, (c) UN-Habitat /Rahaf Nabil

The Multi-Vulnerability Assessment (MVA) for Sahab City was developed using a risk-based approach, with the risk equation defined as Risk = Hazard × Vulnerability (Exposure × Sensitivity/ Adaptive Capacity). In this context, the hazard represents climate change risks, while the vulnerabilities encompass urban and biodiversity dimensions. Each dimension includes a set of specific indicators that were assessed to understand the overall vulnerability of the area.

For the urban dimension, key indicators such as population density, urban growth, socioeconomic vulnerability, access to services, and environmental quality were considered to determine the city's susceptibility to climate risks.

Under the biodiversity dimension, biodiversity connectivity was the primary indicator used, reflecting the remaining natural areas and their ability to maintain ecosystem functions.

Theclimatechangedimensionincludedhazard-relatedindicators such as temperature rise, flooding, drought, and extreme heat to map areas most exposed to environmental changes. The analysis was conducted by integrating these three dimensions: high urban vulnerability, high climate hazards, and low biodiversity vulnerability. Areas with high urban vulnerability were mapped to identify regions where infrastructure, population density, and expansion trends increase susceptibility to climate risks. Simultaneously, the high climate hazard areas were analysed to pinpoint regions most exposed to extreme weather events or environmental changes. In contrast, low vulnerability biodiversity areas were mapped to identify regions with stronger ecological resilience that could buffer climate impacts.

By overlaying these layers, the MVA identified multi-layered hotspots—critical areas where high urban and climate vulnerabilities intersect with low biodiversity vulnerability. These hotspots represent zones where both urban populations and natural ecosystems are at heightened risk.

These areas were then prioritized for further action in Stage 3: Vision and Action Plan Development, where targeted interventions will be proposed based on the type of vulnerability in each hotspot. For urban areas, interventions will focus on infrastructure resilience and sustainable urban planning, while for biodiversity areas, efforts will prioritize conservation and ecosystem protection to enhance climate resilience.

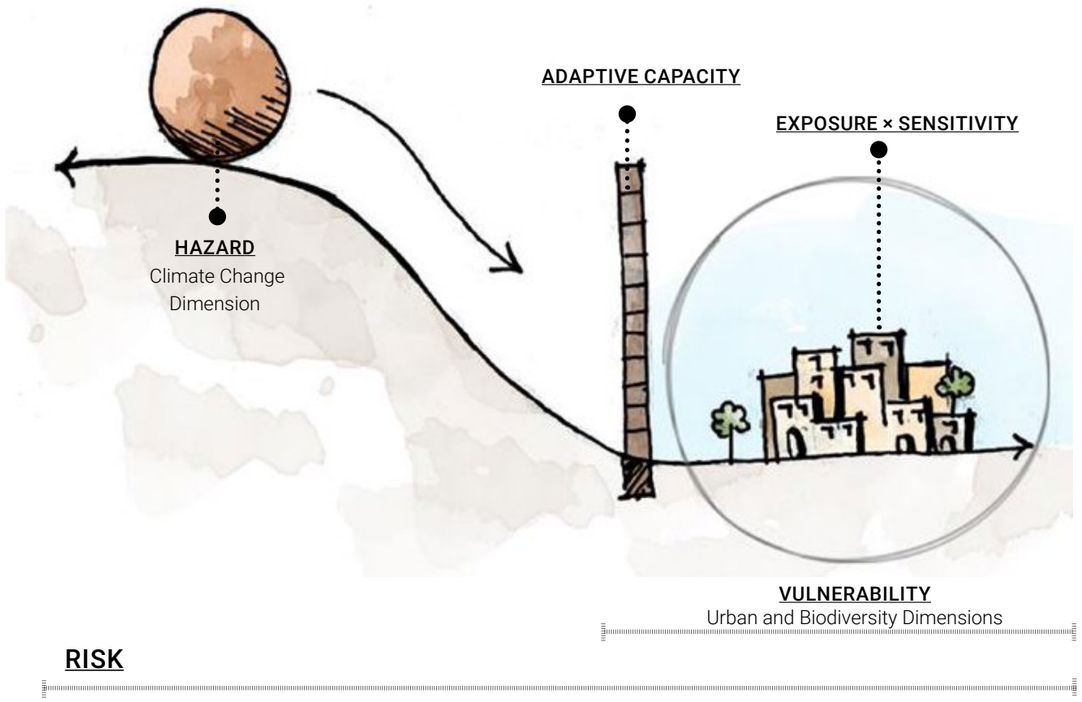
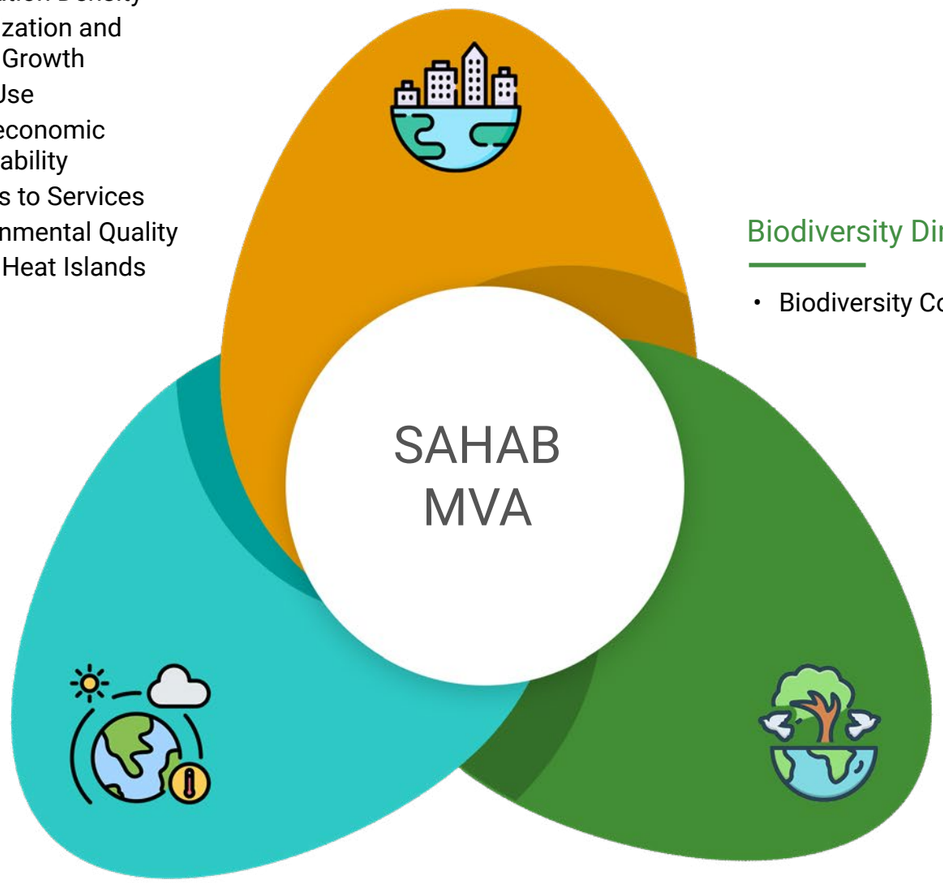


Fig. 1: Illustration of the Risk Equation for Sahab Context

Urban Dimension

- Population and Population Density
- Urbanization and Urban Growth
- Land Use
- Socioeconomic Vulnerability
- Access to Services
- Environmental Quality
- Urban Heat Islands



Biodiversity Dimension

- Biodiversity Connectivity

Climate Change Dimension

- Flooding
- Drought
- Extreme Heat

Fig. 2: Selected Indicators under the Urban, Climate Change, and Biodiversity for the MVA of Sahab City

03

CITY CONTEXT ANALYSIS

Institutional and Policy Frameworks in Jordan

Jordan's urban development is governed by a complex framework of institutions and policies that work together to address the diverse needs of urban areas. These frameworks are designed to promote sustainable urban growth, manage resources effectively, and ensure that urban planning aligns with both national and local development goals.

At the national level, the central government plays a crucial role in setting national policies and development strategies. The Ministry of Planning and International Cooperation (MOPIC) coordinates between international donors, financial institutions, and government bodies to ensure that development projects are funded and implemented according to national priorities. The Ministry of Local Administration (MOLA) oversees planning in general for municipalities, and the Higher Planning Council that is affiliated with MoLA approves master plans and urban policies. The Ministry of Environment (MOENV), through its Directorate of Climate Change, manages environmental policies and climate change initiatives, ensuring they are integrated into national planning efforts. In addition, the Ministry of Public Works and Housing is responsible for overseeing infrastructure projects such as roads, railways, airports, and ports, while housing policies are monitored through the Housing and Urban Development Corporation.

Supporting these national ministries are various independent entities that contribute to urban development and planning, including the Jordan Investment Commission (JIC), Jordan Valley Authority (JVA), Petra Development & Tourism Region Authority (PDTRA), Aqaba Special Economic Zone Authority (ASEZA), Jordan Free and Development Zones Company, and Jordan Industrial Estates Company (JIEC). These bodies manage specific sectors and regions, such as industrial zones, tourism regions, and free zones, providing critical input into the broader national urban planning agenda.

Jordan is divided into 12 governorates, each led by a Governor and supported by a Deputy Governor. These governorates form the highest regional level of administrative divisions in the country. Each governorate operates with an elected Governorate Council, which collaborates with an Executive Council to manage local development, infrastructure, and governance. The governorates are further divided into Liwa (48 districts) and Qada (38 sub-districts).

In terms of municipal governance, there are 106 municipalities within these governorates, each led by a Mayor, with support from a Deputy Mayor and an Executive Manager. Municipal councils, composed of elected members, oversee the management of Districts and Neighbourhoods within each municipality. Municipalities are further equipped with Environmental Departments, which handle issues related to sustainability, urban environmental management, and solid waste management.

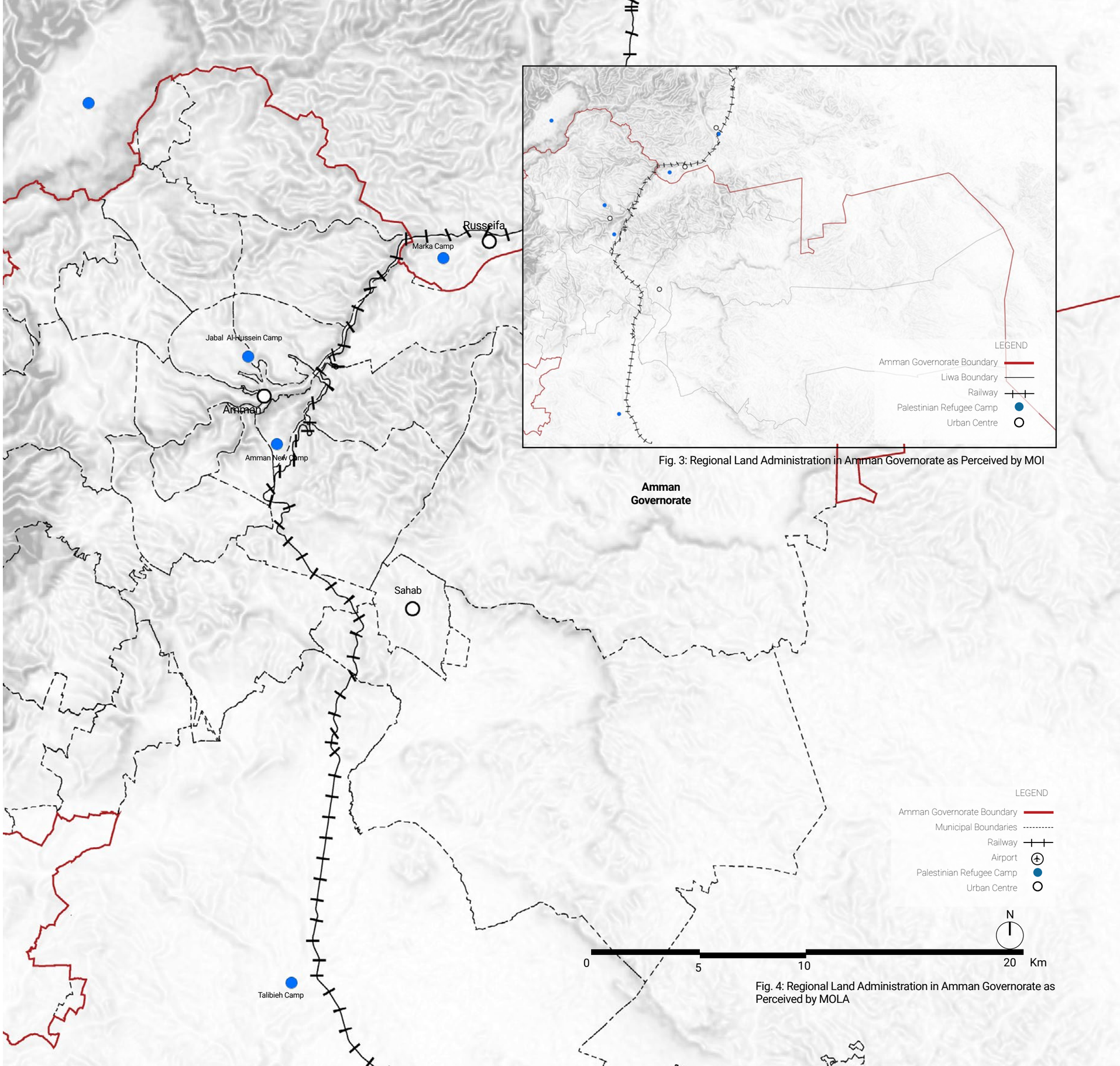
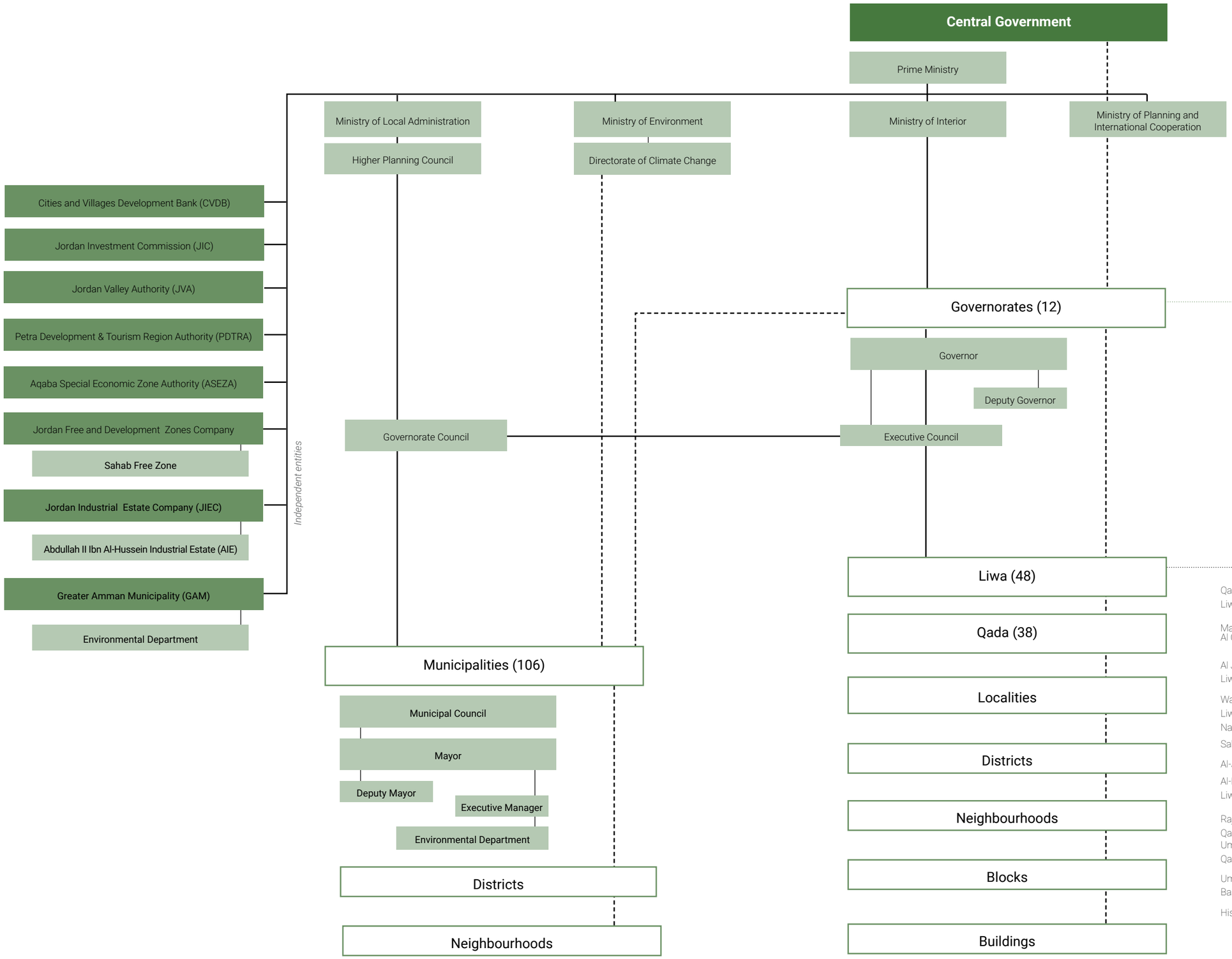
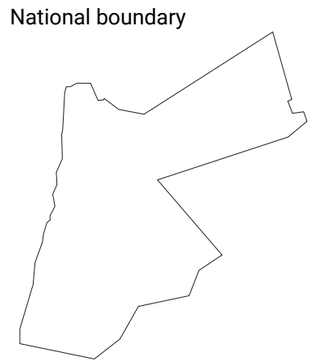
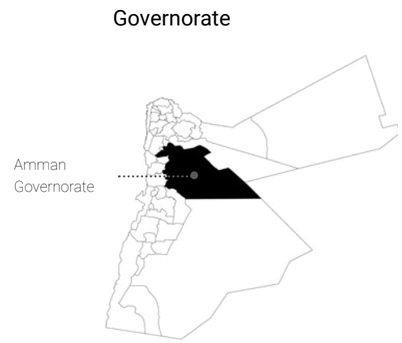


Fig. 3: Regional Land Administration in Amman Governorate as Perceived by MOI

Fig. 4: Regional Land Administration in Amman Governorate as Perceived by MOLA







Qasabet Amman Liwa

Marka Liwa
Al Qwesmeh Liwa

Al Jamea (university) Liwa

Wadi Al Seer Liwa
Na'ur Liwa

Sahab Liwa

Al-Jiza Liwa

Al-Mwaqqar Liwa

Rajm al-Shami Qada
Umm al-Rasas Qada

Umm Al-Basateen Qada

Hisban Qada

Planning Administration and Governance System in Jordan

Navigating Urban Growth and Interconnected Development

Sahab, established as a municipality in 1962, has played an evolving role within the broader metropolitan framework of Greater Amman. Initially, it was a modest municipality, but its strategic location near the capital has caused it to become deeply integrated into the urban and industrial dynamics of Greater Amman. In 1986, Sahab was designated as a satellite town in the Greater Amman Comprehensive Development Plan (GACDP), marking the beginning of its role as a supporting urban center for the capital. Its inclusion in the Amman Master Plan of 2008 further emphasized Sahab's importance in the region. However, Sahab Municipality's administrative boundaries and governance have been repeatedly altered, complicating its development trajectory. Annexed by the Greater Amman Municipality in 2006 and then re-established as an independent municipality in 2013, Sahab City has struggled to define its urban identity. This back-and-forth annexation has created complex dynamics in urban growth management, service provision, and planning for future development. The continual shift between GAM's control and local governance has led to challenges in maintaining consistent and coherent urban planning, and any efforts focused on climate change and biodiversity conservation.

Despite these challenges, Sahab's role in Jordan's national economic growth is substantial, primarily due to its status as an industrial hub. The industrial base in Sahab has attracted significant investment and created job opportunities, transforming the city into a key player in the country's economic landscape. This industrialization has bolstered national GDP, contributed to Jordan's export economy, and supported employment in both skilled and unskilled labour sectors.

However, the rapid industrialization and urbanization of Sahab City have come at the expense of rural and agricultural land. What was once predominantly rural and agricultural territory has been re-purposed for industrial use, resulting in the loss of farmland and open spaces. This shift raises concerns about the sustainability of land use in Sahab and the potential long-term impacts on food security and environmental health.

Sahab City's development has been heavily influenced by its proximity and interdependence with Greater Amman. Its infrastructure, urban planning, and economic policies are deeply intertwined with the broader metropolitan policies of the capital. While this interconnectedness has brought economic benefits, it has also created challenges in maintaining Sahab's urban cohesion. The city's infrastructure and services, such as transportation, waste management, and housing, must balance the demands of a growing industrial base with the needs of its residential population. Moreover, the influence of Amman's metropolitan policies often takes precedence, leading to issues in local governance and urban management.

The continuous expansion of Greater Amman has placed additional pressure on Sahab's urban planning. As Greater Amman grows, Sahab City must navigate the challenges of suburban sprawl, industrial expansion, and limited land resources. The city's repeated annexation and detachment from GAM have exacerbated these issues, leading to inconsistencies in urban development strategies, service provision, and planning for future growth.

In summary, Sahab's transformation from a rural municipality to a national industrial powerhouse highlights the complexities of urban growth in Jordan. Its relationship with Greater Amman has provided economic benefits, but it has also led to challenges in land use, planning, and sustainability. Moving forward, a more integrated and sustainable approach to urban planning is critical for balancing the city's economic contributions with its environmental and community needs.

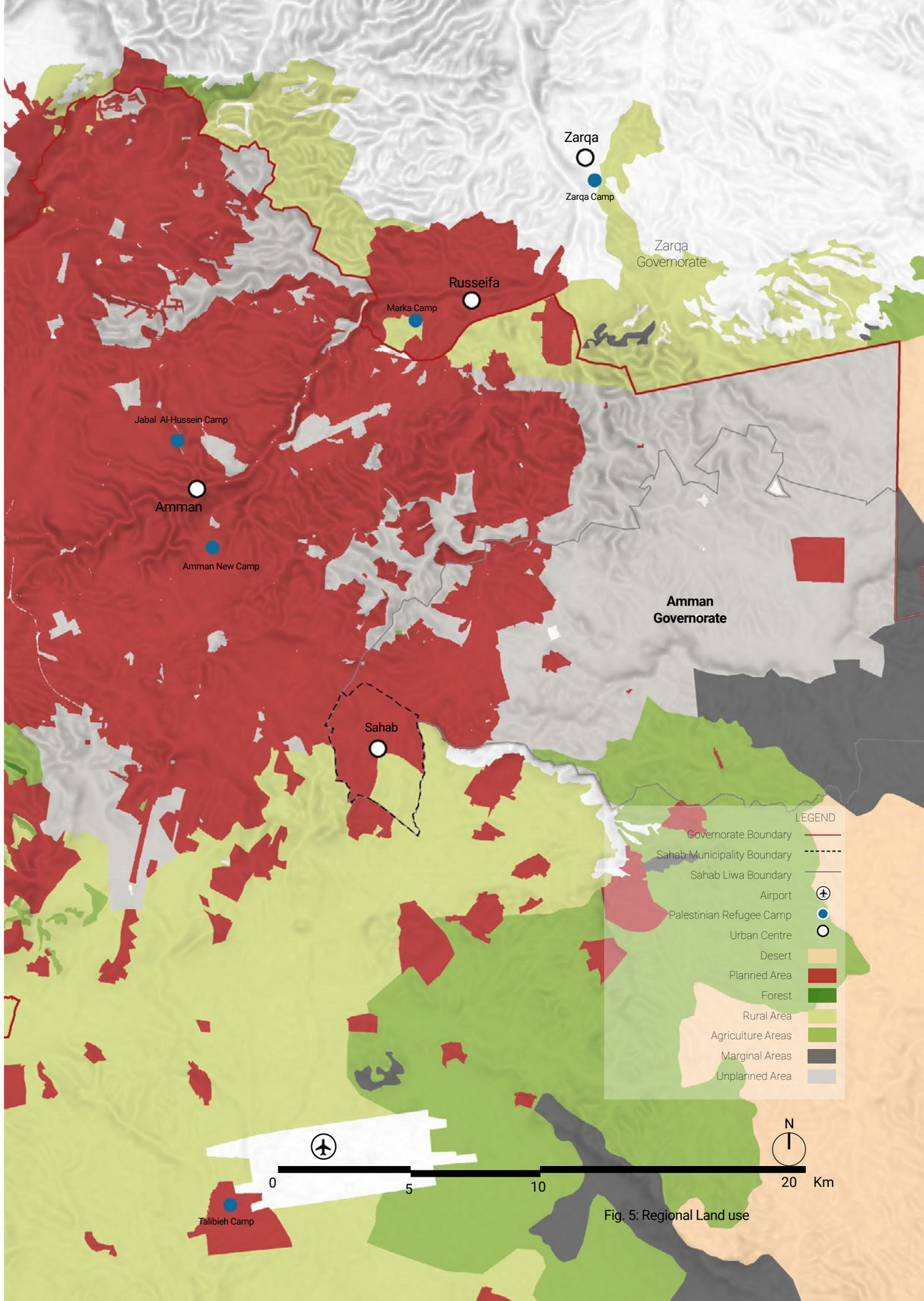


Fig. 5: Regional Land use

Degree of Urbanization (DEGURBA)

The map shown in Fig. 6 illustrates the Degree of Urbanization (DEGURBA) classification of the Greater Amman region, where Sahab City is identified as part of the larger Amman region. The degree of urbanization (DEGURBA), which was endorsed by the UN Statistical Commission during its 51st session (March 2020) as the recommended method for defining urban and rural areas for statistical comparisons of SDG indicators, uses population size and density at varying thresholds to classify the entire territory of a country into cities, towns and semi-dense areas, and rural areas. By using these three classes instead of only two (urban and rural), it captures the urban-rural continuum. The method is applied in a two-step process. First, grid cells measuring 1 km2 are classified based on their population density, contiguity and population size. Subsequently, local units are classified as city, urban or rural based on the type of grid cells in which majority of their population resides.

The first level of the degree of urbanization classification may be extended in two ways. The first extension is a more detailed territorial typology: it identifies, cities, towns, suburban or peri-urban areas, villages, dispersed rural areas and mostly uninhabited areas. The second extension defines functional urban areas (otherwise referred to as metropolitan areas), covering cities and the commuting zones around them.

This tool ensures a consistent and spatially detailed representation of population distribution, leveraging built-up density and other ancillary data to guide the allocation and disaggregation process. The next process generates the classification of urbanization levels ranging from most urban to most rural classification. Built-up density is calculated for each grid cell, using a 1 km² spatial resolution. These grids are analysed for population density and the extent of built-up areas. The classification is guided by predefined thresholds:

- Urban centres: Population density greater than 1,500 people per km², total population of connected urban grid cells exceeding 50,000 people and built-up density (the proportion of the grid area covered by built structures) of more than 50%.
- Peri-Urban clusters: Population density between 300 and 1,500 people per km². These areas typically form transitional zones between urban cores and rural regions, with moderate levels of both population and built-up presence.
- Rural clusters: Population density below 300 people per km². These regions are characterized by sparse populations and minimal built-up structures, often dominated by natural or agricultural landscapes.

This classification process is implemented using the DEGURBA-DUG tool, which automates the application of these thresholds. The tool processes population and built-up data to produce a gridded map, categorizing each cell into urban, peri-urban, or rural classes. The final output enables detailed analysis and consistent comparisons of urbanization patterns across regions, supporting global urban and rural development initiatives.

Based on DEGURBA criteria, Sahab City is classified as an urban centre, reflecting its high population density, significant built-up area, and integration within the larger Amman region. This classification indicates that Sahab City functions as a critical hub for population concentration and economic activity, playing a pivotal role in driving regional development, providing essential services, and facilitating connectivity within the broader urban network of Amman governorate. However, this urban centre status comes with challenges, including infrastructure strain, and traffic congestion. Environmental issues such as air pollution, limited green spaces, and inadequate stormwater management further complicate its development.

Additionally, social inequities, governance constraints, and the need for balanced integration with peri-urban and rural areas demand strategic urban planning and sustainable resource allocation.

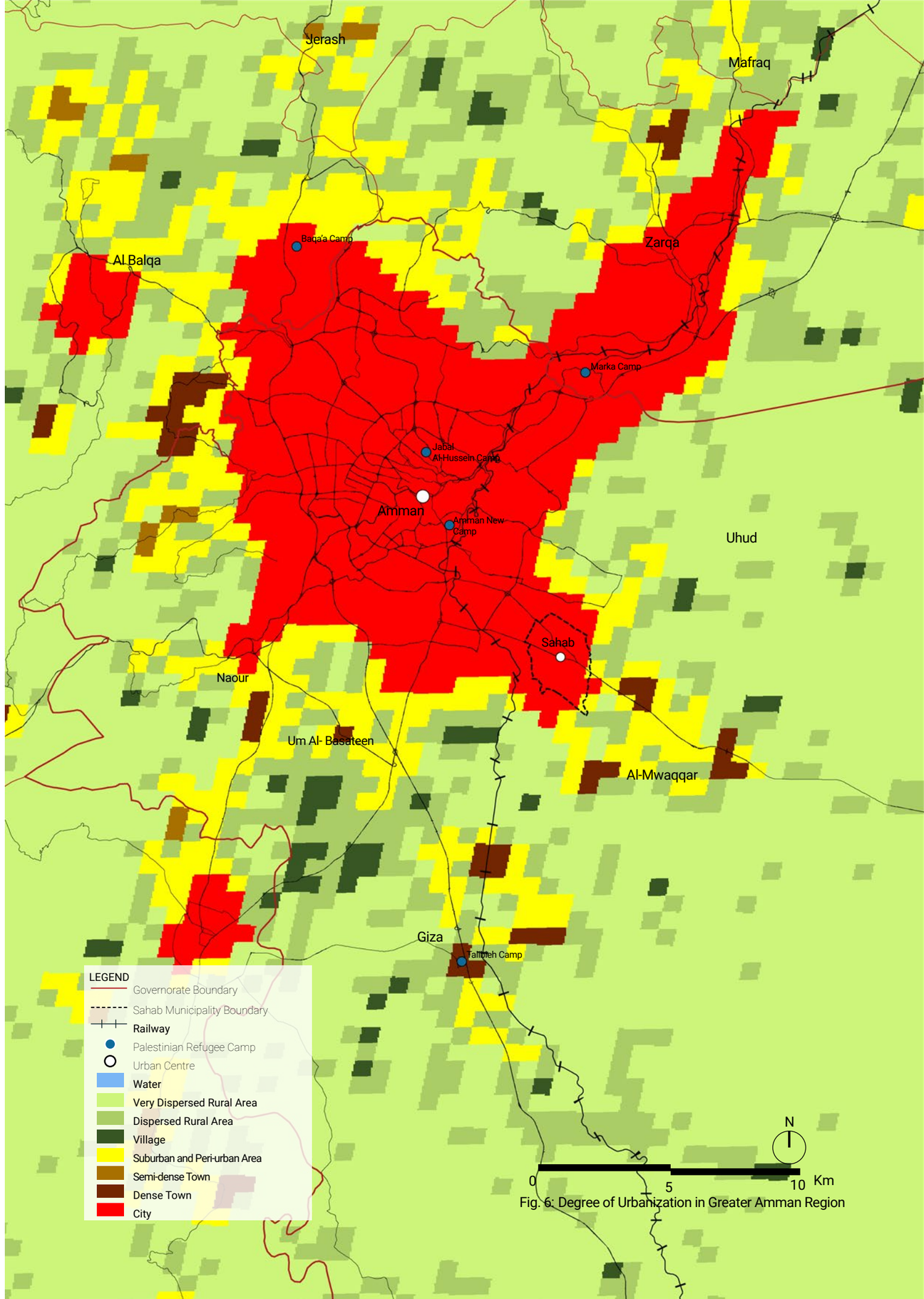


Fig. 6: Degree of Urbanization in Greater Amman Region

Location and Geography

The city of Sahab is located within the central region of Jordan and 16 km southeast Amman, the capital city of Jordan. Amman Governorate consists of nine Liwas, four Qadas, and nine municipalities. These divisions correspond to different institutions, and particularly 3 different divisions. The administrative boundaries outlined by the Ministry of Interior (MoI) include the Liwas and Qadas, which are under the administration of the Governorate of Amman. These divisions cover the entire area of the governorate, and are essential for census, which is conducted by the Department of Statistic, and Sahab City is located within the Liwa of Sahab.

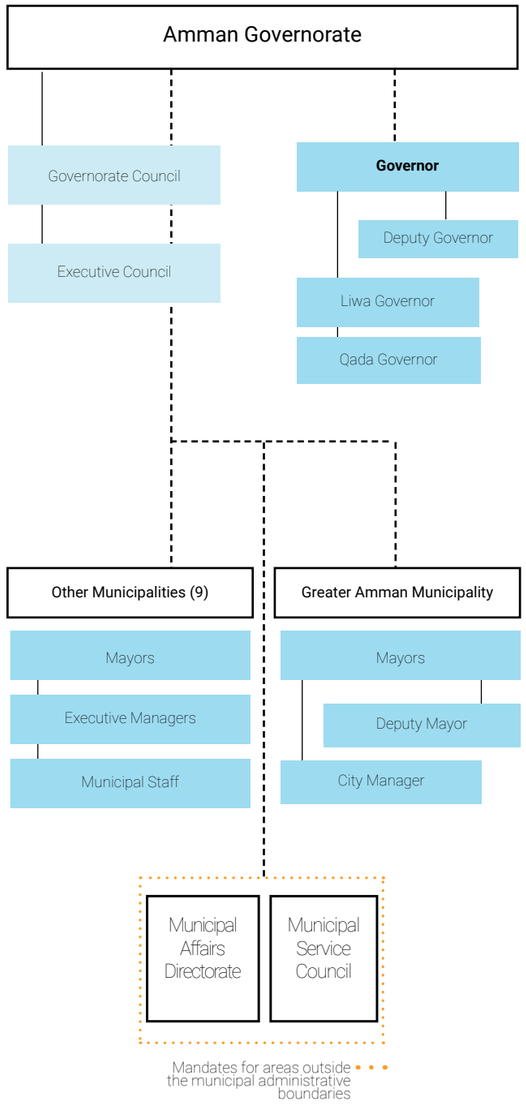
Sahab City is located within one of these 9 Liwas, which is Sahab Liwa. Sahab City is considered to be the center of the Liwa, and an incubator for governmental and private service institutions and departments, economic and commercial activities. Within the liwa's borders, there is a government hospital, an electricity generation station of east Amman, a city for industrial clusters, Abdullah II Ibn Al-Hussein Industrial Estate (AIE), Free Zone, several cultural centres, youth and social sports clubs, an Islamic and Christian cemetery, and a livestock market[1]. Alongside the City of Sahab, the Liwa includes the following cities and villages: Abdaliyah, Zamlah Al-Ulia, Al-Khashafiyah Al-Maliyah, Al-Khashafiyah Al-Janubiyyah, Al-Manakhar, and Qafour.

This strategic positioning places Sahab city within the immediate economic and administrative influence of Amman while allowing it to maintain a distinct industrial identity.

The Sahab Liwa's total area is 482.7 km² which is almost 6% of the total area of Amman Governorate, and the city of Sahab covers an area of 13.7 km² of this area, featuring a mix of industrial, residential, and commercial zones.

Geographically, Sahab lies in a relatively flat area, which has facilitated its development as an industrial hub. The terrain is primarily urbanized with limited natural vegetation. The city's proximity to major highways and transport networks enhances its connectivity to other parts of Jordan, making it an attractive location for industries, yet makes it potentially vulnerable to flash floods due to the impermeability of the majority of the land and infrastructure in the city which means it has very little capacity to cope with heavy rainfall.

Sahab Municipality's close proximity to Amman, with a driving distance of just 15 to 30 minutes as shown in Fig. 6, and its status as an industrial hub centred around the Abdullah II Ibn Al-Hussein Industrial Estate, significantly contribute to the high volume of daily commuter traffic between the two cities. Many workers travel to Sahab for employment in its industrial sector, while residents commute to Amman for various services, creating a strong and consistent flow of commuters between the areas.



Amman's Governorate Planning Administration and Governance System

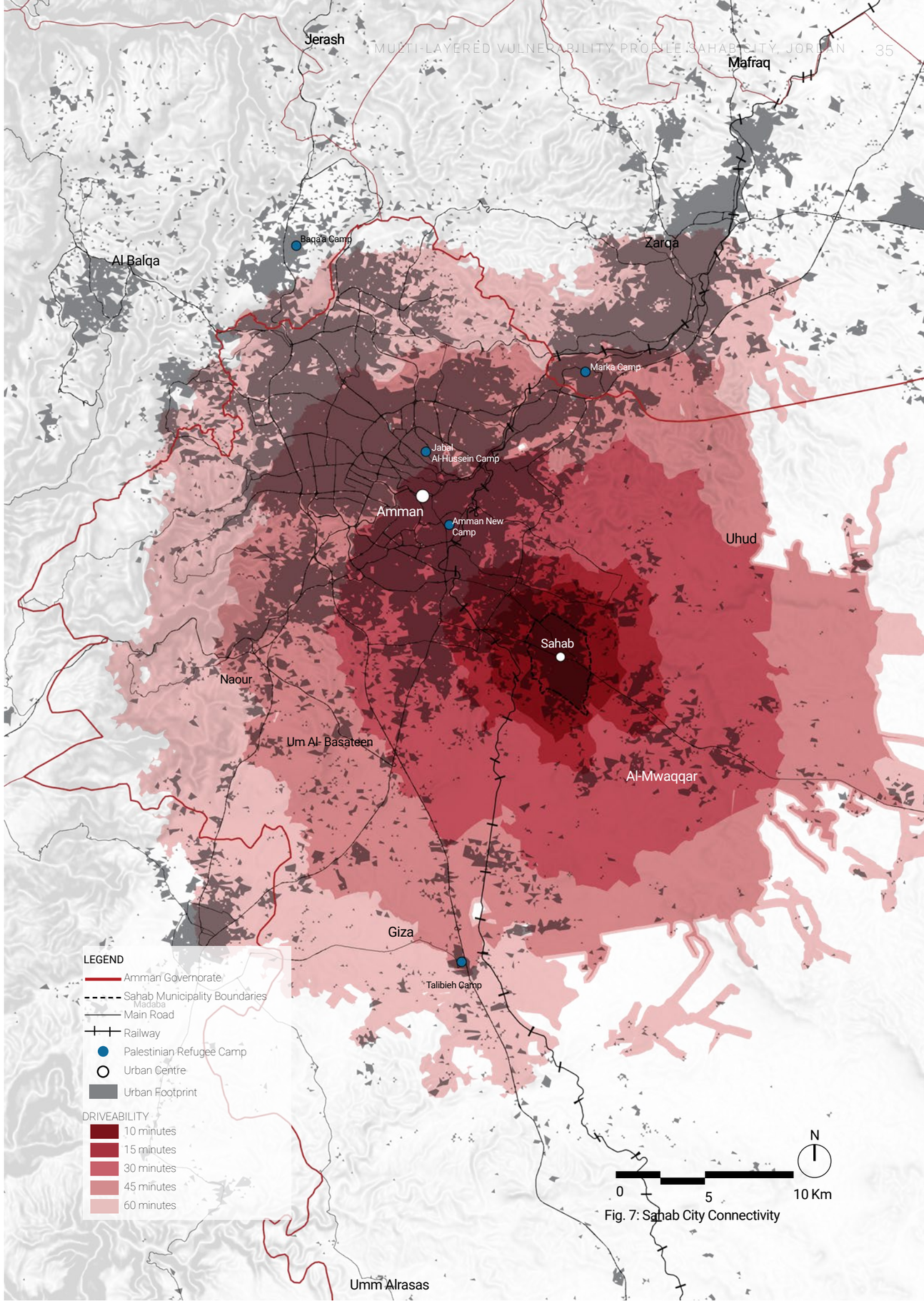


Fig. 7: Sahab City Connectivity

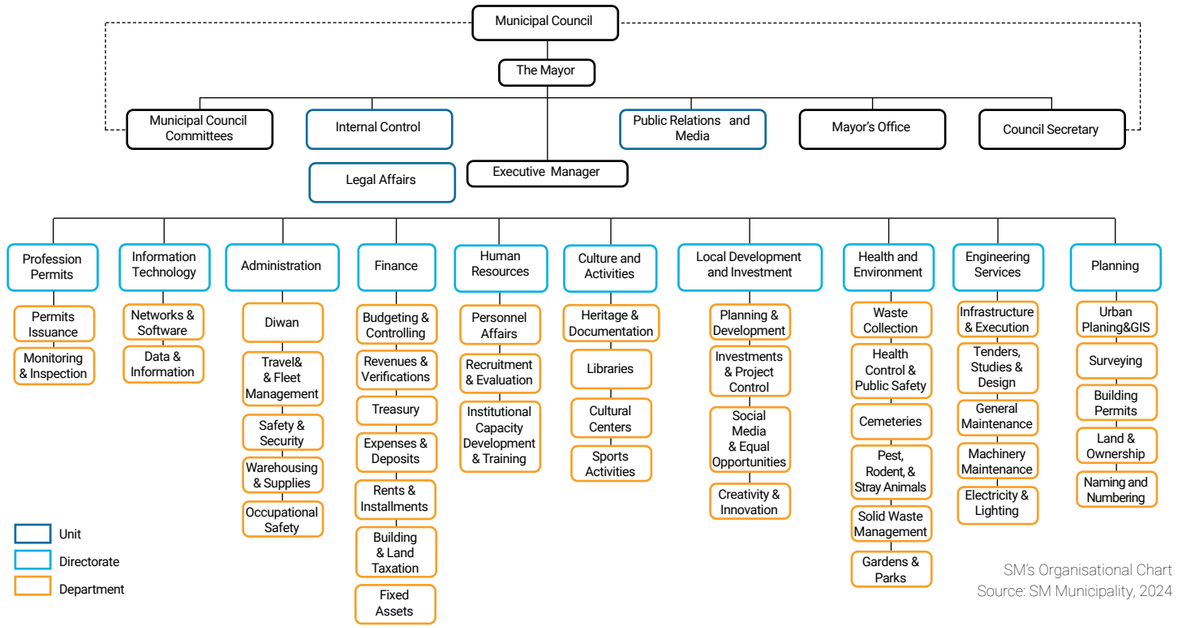
Governance & Administration Structure

Sahab Municipality, a B-category municipality, ccovers a large portion of Sahab Liwa, approximately 2.8% of its total area of 482.7 km², and it is the only municipality within the Liwa. Sahab City is divided into eight main neighbourhoods: Eastern neighbourhood, Northern neighbourhood, Western neighbourhood, Southern neighbourhood, Salboud, Industrial neighbourhood, the downtown and the Hirafyeh Area. Seven human settlements: Sahab, Al-Abdaliyya, Zumlat Al-Ulya, Al-Khashafiyah Al-Janoubiyah, Al-Khashafiyah Al-Shamaliyah, Al-Manakhir, Qa'foor. On the other hand Sahab Municipality is divided into 12 districts: Hanu Raba, Hanu Riya, Abu Rasoom, Bir Al-Adas, Abu Sawan, Abu Sawan Raqim, Muwaris Al-Dar, Muwaris Al-Kibar, Jidar Al-Balad, Hanu Raba Raqim, Salbood, and Sarsakiyah.

Based on available GIS data, The administrative boundaries of Sahab Municipality encompass 13.7 km², with the regulated area covering almost the entire municipality. Sahab Municipality is bordered to the north by Greater Amman Municipality and to the south by Rujm Alshami and Muaqqar Municipality.

One of the major administrative and governance challenges within Sahab Municipality is the organizational separation of the Abdullah II Ibn Al-Hussein Industrial Estate (AIE). The AIE is under the control of the Jordan Industrial Estates Company, not the municipality. The fragmented management structure complicates long-term urban planning and development strategies. The municipality's efforts to create a cohesive urban environment are undermined by the need to work around an independently managed industrial estate. This can hinder initiatives aimed at promoting sustainable development, improving transportation networks, and enhancing the overall quality of life for residents.

The Sahab Municipality Council is headed by the mayor, and consists of 10 members, of which 2 are women. Each member is elected by residents for a four-year term. The council is the main decision-maker that approves the plans and co-formulates it.



SM's Organisational Chart
Source: SM Municipality, 2024

Fig. 8: Administrative Boundaries in Sahab City
Source:

Urban Morphology and Density

Sahab Municipality presents a distinctive urban form characterized by a dense core, with an organic/ irregular urban morphology that reflects a blend of traditional urban design in the downtown and more modern grid-like pattern, planned development in the surrounding neighbourhoods. This structure creates a high-density environment in the city center, which gradually transitions to lower-density zones as one moves outward. However, the municipality faces challenges, such as a lack of sufficient public spaces and the potential for urban sprawl, which need strategic attention. A significant factor shaping Sahab Municipality's urban landscape is the main street that bisects the city, creating three distinct areas with different characteristics. This street not only serves as a physical divider but also influences the functional dynamics within the city, affecting land use patterns, urban density, and the overall development trajectory of each area, while also contributing to certain hazards such as safety hazards and pollution. The central area of Sahab Municipality exhibits a central grid pattern, facilitating easy navigation and supporting a mix of functions. This grid structure is typical of planned urban development, contributing to a well-organized urban core. In contrast, the northern and western parts of the municipality display more irregular patterns, which indicates organic growth and less structured development. These areas host a mix of land uses, reflecting the varied urban fabric of Sahab.

The building shapes, sizes, and materials across the city suggest a diverse mix of residential, commercial, and industrial uses. The dense and uniform grid in the core area serves as a hub of commercial activity, characterized by multi-story buildings, mixed-use developments, and high levels of pedestrian and vehicular traffic. As one moves away from this core, the density decreases, with larger open spaces and more dispersed buildings, indicative of lower-density residential areas and industrial zones. The high-density urban core of Sahab Municipality, marked by tightly packed built structures and a irregular grid layout, plays a crucial role as the city's economic and service hub. This centralization enhances efficiency and economic vitality but also creates potential vulnerabilities. If the core experiences disruptions, such as natural disasters or economic downturns, the impact could be profound due to the concentration of critical infrastructure and services. Therefore, the city's adaptive capacity largely depends on the resilience of these central areas and their ability to absorb and recover from shocks.

The urban morphology and solid-void analysis of Sahab Municipality's neighbourhoods reveal how different urban forms affect their vulnerability to climate risks. For example, densely, compact built areas with like the Downtown and Central Area, which have a high concentration of buildings and minimal open spaces, and unshaded areas are particularly susceptible to floods, poor air circulation heat retention, and heatwaves. The limited permeability in these areas prevents adequate water drainage during heavy rainfalls, increasing flood risks. Additionally, the concentration of infrastructure and lack of green spaces contribute to the urban heat island effect, exacerbating temperatures during heatwaves. In contrast, neighbourhoods like the Western Neighbourhood, Industrial City, and Hirafyeh Area feature larger plots and more open spaces, which affect their vulnerability differently. The presence of more open spaces in these areas can help mitigate flood risks by enhancing water absorption. However, industrial zones, characterized by extensive hard surfaces and minimal vegetation, are prone to significant heat retention, making them susceptible to heatwaves.

With 91% of Sahab Municipality covered by built-up areas, the city is highly vulnerable to environmental and climate hazards, including flooding, heatwaves, droughts, reduced biodiversity, and the urban heat island effect. This extensive development also negatively impacts environmental quality, leading to poor air and water quality and limited green spaces, which further diminishes the overall liveability of the urban environment.

High-Density Urban Core (Downtown)

Irregular Grid (Salboud)

Irregular Grid (Western Neighbourhood)

Grid-like Pattern (Eastern Neighbourhood)

Functional Industrial Grid (Hirafyeh and Industrial City)

Central Grid Pattern (Central Area)

Fig. 9: Urban Morphology of Sahab Municipality.

Fig. 10: Solid-Void Map in Sahab City

04

URBAN DIMENSION

Introduction to Urban Dimension

The urban dimension of the Multi-layered Vulnerability Assessment (MVA) for Sahab City captures a range of indicators that reveal the city's vulnerability to urbanization challenges, socio-economic pressures, and environmental degradation. This dimension reflects the complex interplay of factors such as population density, land use, and access to services, which collectively influence Sahab Municipality's ability to respond to climate change impacts and urban growth pressures.

Several national and local policy frameworks guide this dimension, including the Jordan Vision 2025, which emphasizes sustainable urban development, Jordan's National Urban Policy that aligns with global standards, and the Local Administration Law which governs the decentralization of urban planning and service delivery. One notable challenge in the urban context is balancing industrial development with the need for green and recreational spaces—a priority underscored in Sahab's Strategic and Local Development Plan for 2024–2026. Despite these policy supports, Sahab faces ongoing challenges related to population pressure, lack of infrastructure, and limited open spaces.

Indicator 1: Population Density
This indicator was chosen to assess how population pressure influences urban growth, service delivery, and infrastructure development in Sahab Municipality. High population density can exacerbate challenges such as congestion, insufficient public services, and environmental degradation, all of which contribute to increased vulnerability. Understanding population distribution is key to planning future urban infrastructure and addressing the socio-economic needs of residents.

Indicator 2: Urbanization and Urban Growth
Urbanization and urban growth are critical in understanding how Sahab Municipality has expanded and transformed. This indicator reflects changes in land use, the increasing demand for urban services. Given Sahab Municipality's strategic location near major industrial zones, this indicator helps analyse the pressures from industrial expansion on residential and commercial zones.

Indicator 3: Land Use
Land use patterns influence urban form, environmental quality, and the allocation of resources for housing, infrastructure, and services. Understanding land use allows urban planners to identify areas where better land management practices are necessary to reduce vulnerability.

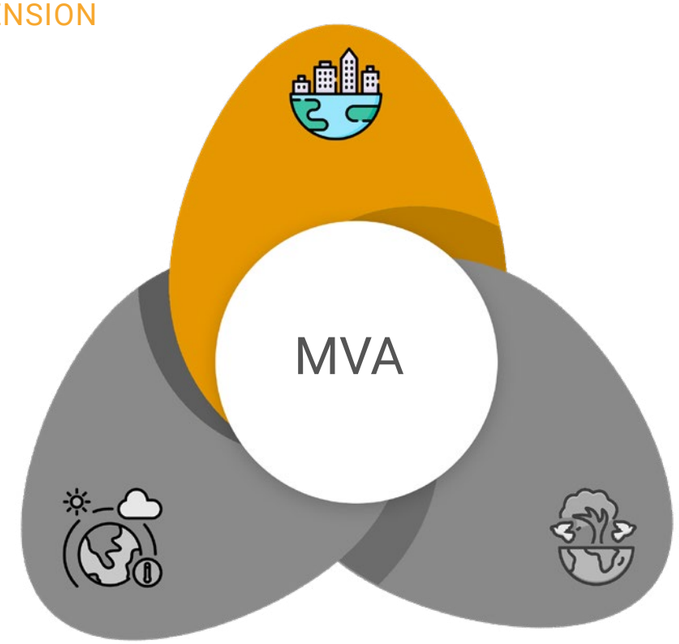
Indicator 4: Socioeconomic Vulnerability
This indicator captures the degree to which different social groups are exposed to economic and environmental risks. It assesses disparities in income, employment, and access to services, which are crucial for understanding how vulnerable populations will fare in urban development scenarios.

Indicator 5: Access to Services
Access to essential services, such as healthcare, education, and transportation, is critical in reducing urban vulnerability. This indicator examines service availability, distribution, and accessibility across different neighbourhoods, providing insight into areas with service gaps.

Indicator 6: Environmental Quality
Environmental quality, including air and water pollution levels, is a critical factor in urban resilience. This indicator was chosen to assess the impact of industrial activity, transportation, and waste management practices on public health and ecosystems in Sahab City.

Indicator 7: Urban Heat Islands
Urban heat islands are areas that experience significantly higher temperatures than their surroundings, often due to dense infrastructure and limited green spaces. This indicator is vital for assessing how urbanization and industrialization affects local climates and exacerbates heat-related vulnerabilities.

URBAN DIMENSION



SELECTED INDICATORS:

- Population Density
- Urbanization and Urban Growth
- Land Use
- Socioeconomic Vulnerability
- Access to Services
- Environmental Quality
- Urban Heat Islands

Fig. 11: Selected Indicators for Urban Dimension

Fig. 12: Urban Policies, Plans , and Strategies

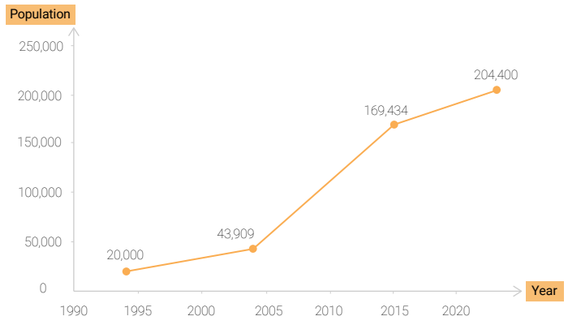
Indicator 1:Population Density & Distribution

Sahab's Liwa demographic landscape is characterized by a diverse mix of populations, including native Jordanians, Syrian refugees, labour migrants from Southeast Asia, Yemeni and Iraqi, and Egyptian expatriates. As of 2015, the city had a population of 128,936, with 51,404 females and 77,532 males. This reflects rapid growth due to both natural increase and migration, with almost 2.2% population growth rate (DOS, 2023), and 5 people/ household size. The Syrian refugee population, which is almost 17% of the total population, driven by regional conflicts, has significantly impacted Sahab's social fabric, contributing to cultural diversity but also posing challenges in terms of social integration and resource allocation. Labour migrants, which is almost 29% of the total population, predominantly employed in the industrial sector, add another layer of complexity.

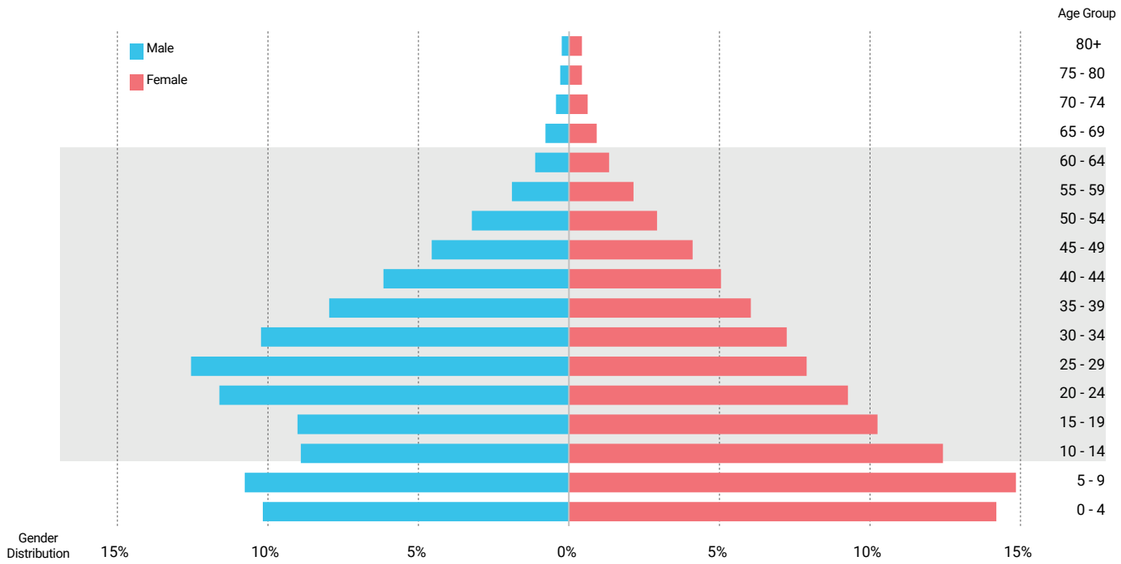
The demographic dependency ratio in the municipality is (57.8%) compared to the dependency rate of the kingdom (61.4%). The population density in the Kingdom reached 71.9 individuals/km², while it reached 598 at the governorate level, while at the Sahab municipality level it reached 9411.4 individuals/km².

How do the population density and distribution studies inform vulnerability assessments?

Mapping population density and its distribution across the city, combined with hazard mapping, enables the precise identification of areas with the **highest exposure**. By overlaying this data, high population density areas that coincide with hazard-prone zones can be identified, amplifying the potential impact, and significantly increasing vulnerability. **This approach highlights the critical areas where targeted interventions are most needed.**



Population Growth over Three Decades in Sahab Liwa (SM, 2024)



The Population Pyramid of Sahab Liwa (DoS, 2017)

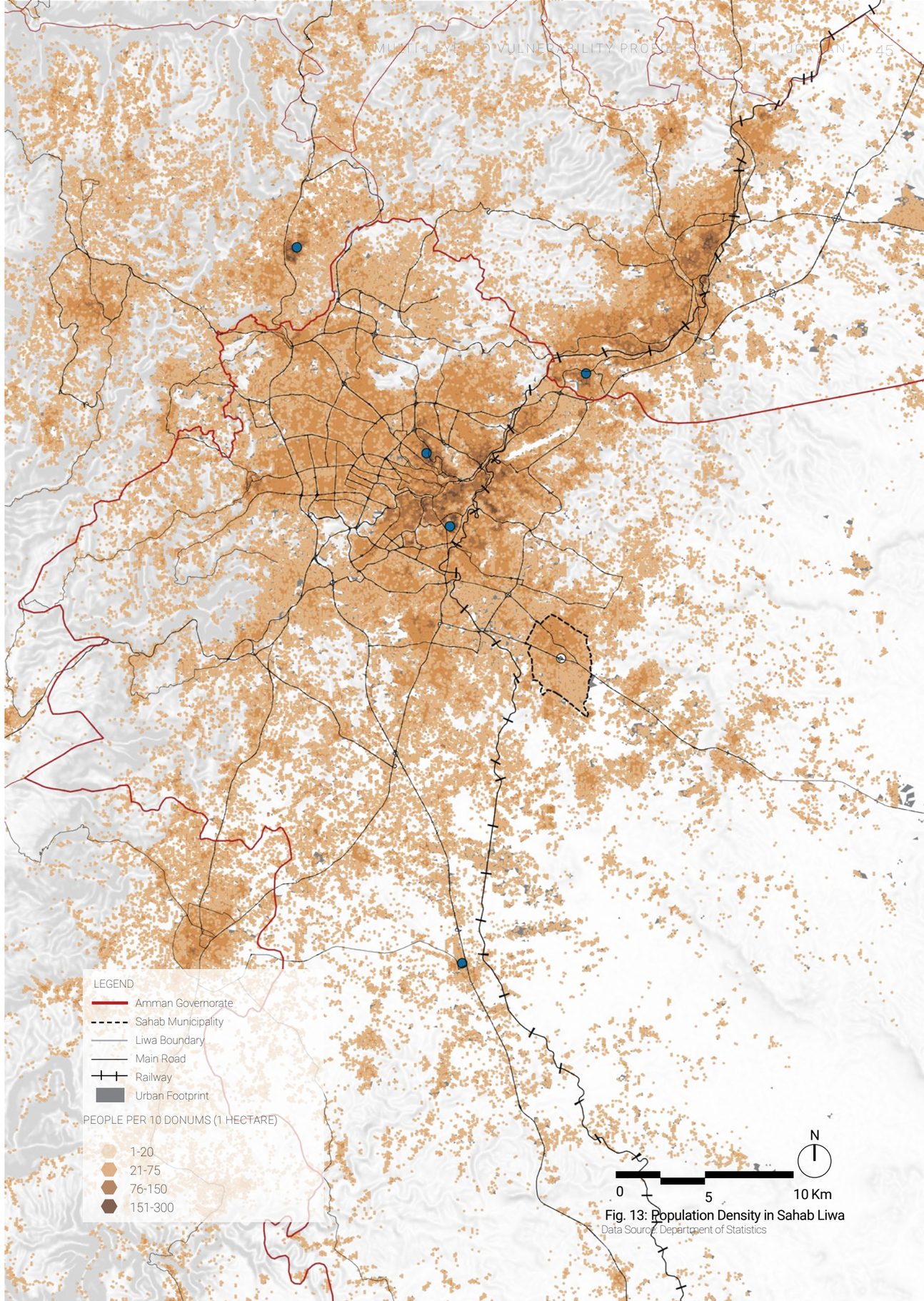
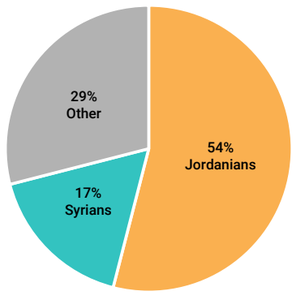


Fig. 13: Population Density in Sahab Liwa
Data Source: Department of Statistics

Indicator 2: Socioeconomic Environment & Urban Poverty

Sahab district's socioeconomic landscape is characterized by a range of factors that contribute to its vulnerability, it is facing significant challenges that have been compounded by rapid urbanization and industrial growth. The district's population includes a substantial number of low-income families and migrant workers who face multidimensional vulnerabilities linked to inadequate housing, job insecurity, poor health and safety conditions, and social exclusion. Many reside in climate-exposed areas where weak housing structures intensify heat stress and flood risks. Additionally, limited financial resources restrict their access to cooling technologies, safe drinking water, and healthcare, exacerbating their vulnerability to climate-induced health risks.

Many migrant workers are employed in industries with high environmental exposure, such as manufacturing and construction, where poor workplace safety, air pollution, and extreme heat present significant hazards. The lack of green spaces in low-income areas further worsens air quality and heat-related health risks. Addressing these challenges requires integrated urban planning, targeted adaptation measures, and inclusive policies to improve both housing resilience and social protection mechanisms.



Population Distribution by Nationality in Sahab Liwa (SM, 2024)

The socioeconomic vulnerability indicator in Sahab includes sub-indicators such as unemployment, income, food security, housing, and safety and security. These factors collectively shape the population's adaptive capacity and resilience to climate, urban, and environmental stressors. Job insecurity and low income restrict access to adequate housing and food, while poor safety conditions heighten exposure to risks such as extreme heat, pollution, and disasters.

Unemployment and Livelihood Systems

According to the statistical report for the third quarter of 2023, the unemployment rate stands at 22.2% in Sahab municipality, which matches the rate in Amman governorate and is slightly higher than the national average of 21.4%. Different types of livelihoods influence and reflect Sahab City's economic and social dynamics, including agricultural, urban, industrial, informal, service sector, self-employment, and migrant/ refugee work. Each type of livelihood provides insights into economic stability, resource allocation, and the overall quality of life in Sahab City. The majority of the workforce in Sahab is employed in industrial, commercial, governmental, military, and artisanal jobs, including stone masonry, carpentry, blacksmithing, and tailoring. The percentage of individuals working in tourism is very low, as Sahab is not a tourist city. (DoS, 2023). Additionally, a significant percentage of children under the age of 18 are working.

Unemployment remains a critical issue in Sahab Liwa, despite its status as home to Jordan's largest industrial city. Contributing factors include the lack of commitment from some employers to hire local staff, the availability of qualified foreign labour for industries such as construction and manufacturing, and the low wages offered in certain sectors, compounded by an insufficient minimum wage. Additionally, many young job seekers are focused on obtaining administrative and office positions, which are less prevalent compared to other employment opportunities, further exacerbating the unemployment problem.

Income Discrepancies

In the Sahab Liwa, the poverty rate is notably high at 36%, compared to the national average of 14.4% and the 15% rate in Amman governorate. The Liwa's spending shortfall for poverty alleviation is estimated at approximately 71 million JOD, which represents the amount needed to raise the spending of the poor to the poverty line, thereby lifting them out of poverty. As one of the poverty pockets in the kingdom, the municipality faces a heightened need for national assistance and social development services (DoS, 2013).

The average household annual income in the Sahab Liwa is 8,331.3 JOD, lower than the average household income in Amman governorate (9,009 JOD) and the national average (9,258 JOD), indicating lower financial resources available to families in Sahab Liwa. Meanwhile the average individual annual income in Sahab is 1,560.6 JOD, compared to 1,741.6 JOD in Amman governorate and 1,857.2 JOD at the national level. Additionally, the average annual household expenditure in Sahab is 9,616.4 JOD, which is less than the national average of 10,254.6 JOD. The average individual annual expenditure in Sahab is 1,939 JOD, lower than the national average of 2,136 JOD (DoS, 2013).

The data indicates a significant discrepancy between average household income and expenditure in Sahab Liwa. This implies that, on average, households in Sahab Liwa are spending more than they earn, and can have potential implications such as debt accumulation, and depletion of savings.

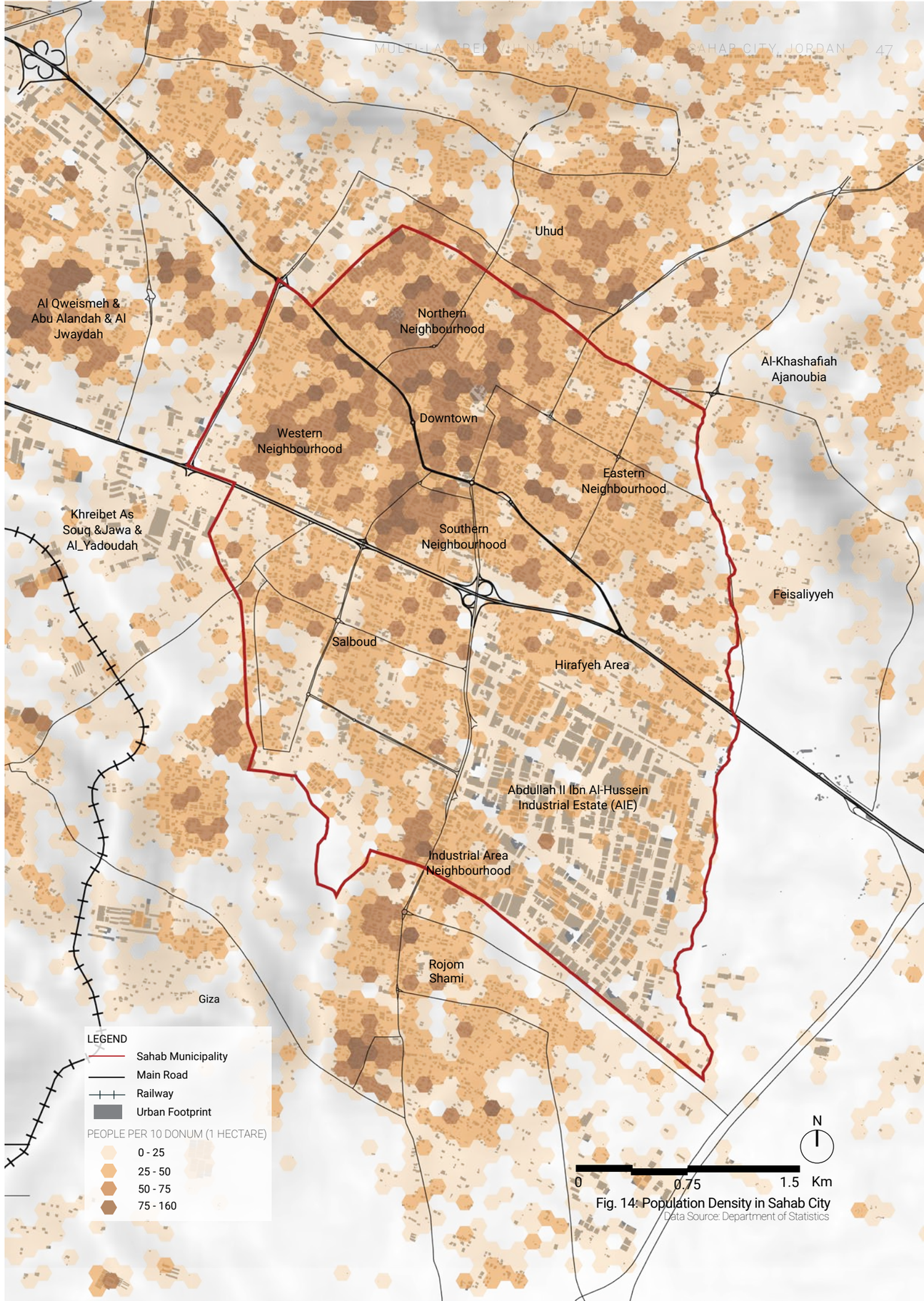


Fig. 14: Population Density in Sahab City
Data Source: Department of Statistics

Additionally, the combination of a 36% poverty rate and an average individual annual income of 1,560.6 JOD in Sahab Liwa paints a stark picture of economic hardship. This data suggests that a significant portion of the population is struggling to meet basic needs, and there is likely a wide gap between the rich and poor within the community.

According to the 2018 statistics from the Directorate of Social Development in Sahab District, approximately 1,500 families benefited from the National Aid Fund. Additionally, 74 families received support through productive family programs offered by the Ministry of Social Development. Furthermore, 180 families received assistance due to disabilities .

Food Security

According to the Jordan Status of Food Security Report in 2010, Sahab ranks among the top ten Qadas in Jordan experiencing food insecurity and vulnerability. Specifically, 3.7% of households in Sahab are classified as food insecure, and 9.9% of households are vulnerable to food insecurity, highlighting significant challenges in the city's food security landscape[2].

Sahab Municipality acknowledges the need to enhance investment in agricultural projects to strengthen food security and local economic development. This recognition is reflected in their strategic plan, where it is highlighted as a key priority. The focus on agricultural investment aims to address food security challenges, improve local food production, and support economic growth within the municipality.

Housing

In Sahab Liwa, 75% of households reside in their own property whereas 25% reside in rental properties, 70% in independent houses, and 30% apartments.

Residential houses in Sahab Liwa and city are predominantly characterized by a stone architectural style. According to population and housing census statistics, the indicators of home ownership, the average number of rooms, and the living area are almost equal to the levels observed in the governorate and at the national level. The average residential property spans approximately 120m² and includes three rooms. In some cases, industrial companies allow their migrant workers to reside on company premises, despite this practice being illegal.

The Housing and Urban Development Corporation (HUDC) has four key affordable housing projects in Sahab. These initiatives are designed to provide economically, socially, and environmentally sustainable housing solutions, with a particular focus on low-income families. By addressing the diverse needs of the community, these projects aim to reduce poverty and enhance the quality of life for the residents of Sahab, ensuring that affordable housing is accessible to all segments of society[3].

Urban Safety and Security

Despite this diverse population, Sahab maintains a high level of security, supported by the presence of the Sahab Police Station and Civil Defence Center. The city's residents are predominantly native to Sahab, with most families being well-known to each other, contributing to a close-knit community atmosphere. The absence of refugee camps or segregated areas within the city further fosters a sense of unity and social cohesion.

The city's safety is bolstered by a constant security presence at key locations, such as the main roundabout, the bus station, and the central commercial street. While there have been occasional issues with drug dealers, local authorities have successfully identified, apprehended, and curtailed their activities, ensuring that these threats remain minimal. Additionally, the education level among Sahab's residents is notably high, with over 90% holding a diploma or higher. This educated populace contributes to the overall stability and safety of the city, reinforcing Sahab's reputation as a secure and well-organized urban center.

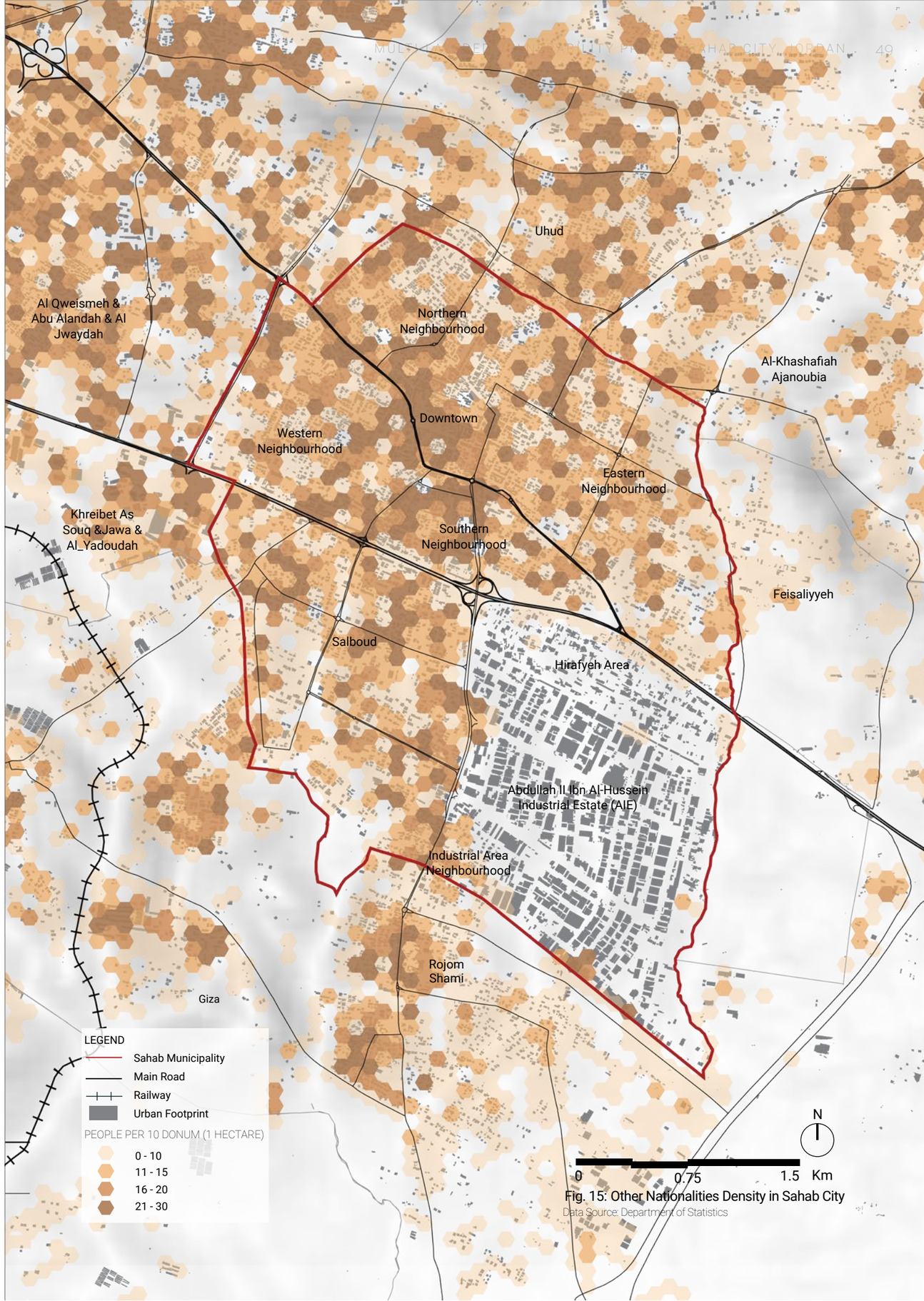


Fig. 15: Other Nationalities Density in Sahab City

Data Source: Department of Statistics

Indicator 3: Urbanization and Urban Growth

Jordan has long been known as an island of stability in a volatile region. Throughout its history, and since the start of the Syrian crisis, it has generously opened its doors to refugees in large numbers. Jordan has the second highest share of refugees per capita in the world, which is 89 refugees per 1,000 inhabitants.[4] It has a population of approximately 11.3 million (2022)[5]. Jordan is one of the 50 most urbanized countries in the world.[6] 90.3% of Jordan's population is living in urban areas.[7] The country is characterized by rapid urbanisation and urban growth, with a current annual population growth rate of 2.3% (2019) and population density of 127.3 persons per square kilometre. Over the last two decades, Jordan's total built-up area has doubled, reaching 1,500 km^2,[8] with the urban built-up area amounting to 909 km^2. The spatial expansion of urban areas is equivalent to 1% per year, or 15 km^2,[9] which poses a risk to agricultural land and the provision of infrastructure and its financing. The trend of urbanization in Jordan is demonstrated by the increase of urban population from 59.9% in 1980 to 78.5% in 2010. The country's biggest city is Amman with 4.0 million inhabitants, which is 42% of the country's total population (DOS, 2016).

Urbanisation Drivers

Within the context of Jordan, various factors have influenced the pace of urbanisation. Urban sprawl and inefficient urban planning have led to inadequate distribution and access to services as well as infrastructure provision. As cities are the main economic drivers of the country's GDP, the majority of jobs are located in urban areas, encouraging rural-to-urban migration. Additionally, the continuous and rapid influx of refugees throughout the years as a result of the region's political instability, is a key factor that led to Jordan's rapid urbanisation.

Sahab City has evolved significantly since its establishment. Initially recognized as a municipality in 1962, Sahab Municipality experienced rapid growth, culminating in its incorporation into the Amman municipality in 2006. By 2013, Sahab Municipality had regained its status as an autonomous city. Key growth phases include the establishment of the King Abdullah II Industrial Estate in 1984, which marked a pivotal shift towards industrialization. The presence of Al Tajamouat Industrial City in 1994 further cemented Sahab's role as an industrial hub. These developments have significantly influenced land use patterns, with industrial, commercial, and residential zones coexisting within the city. Sahab's location has historically served as a vital juncture on ancient trade routes, linking major cities in the region and fostering early economic activity and settlement. The city's early development was driven by its role as a trade hub, particularly along the Amman–Sahab-Azraq Corridor, which connected significant religious and commercial sites, promoting economic activity and settlement. In summary, Sahab's strategic location and industrial capacity have been instrumental in its economic and demographic expansion.

Nearly 90% of Sahab Municipality's population resides in urban areas[10]. Sahab City has the second-highest urban index in Amman Governorate, just behind the Greater Amman Municipality. This urban expansion is characterized by increasing demand for housing, transportation, and social services. However, the existing infrastructure is struggling to keep pace, leading to issues such as traffic congestion, inadequate pedestrian facilities, and insufficient recreational spaces. The city is witnessing changes in land use, with agricultural lands being converted for industrial and residential purposes. Efforts to modernize Sahab include infrastructure expansion projects and potential smart city initiatives aimed at improving urban management and sustainability[11].

The urban nexus focusing on urbanization sub-indicators diagram below illustrates the historical and current relationship between various urbanization and environmental variables in Sahab City, emphasizing the complex interactions and impacts of urbanization on the environment.

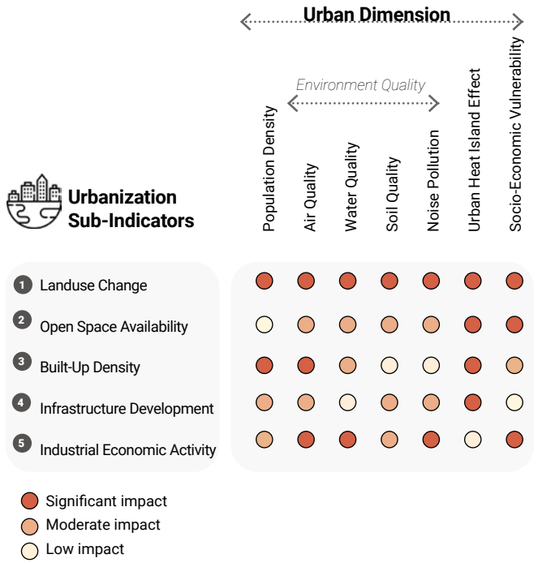


Fig. 17: Urban Nexus focusing on urbanization sub-indicators.

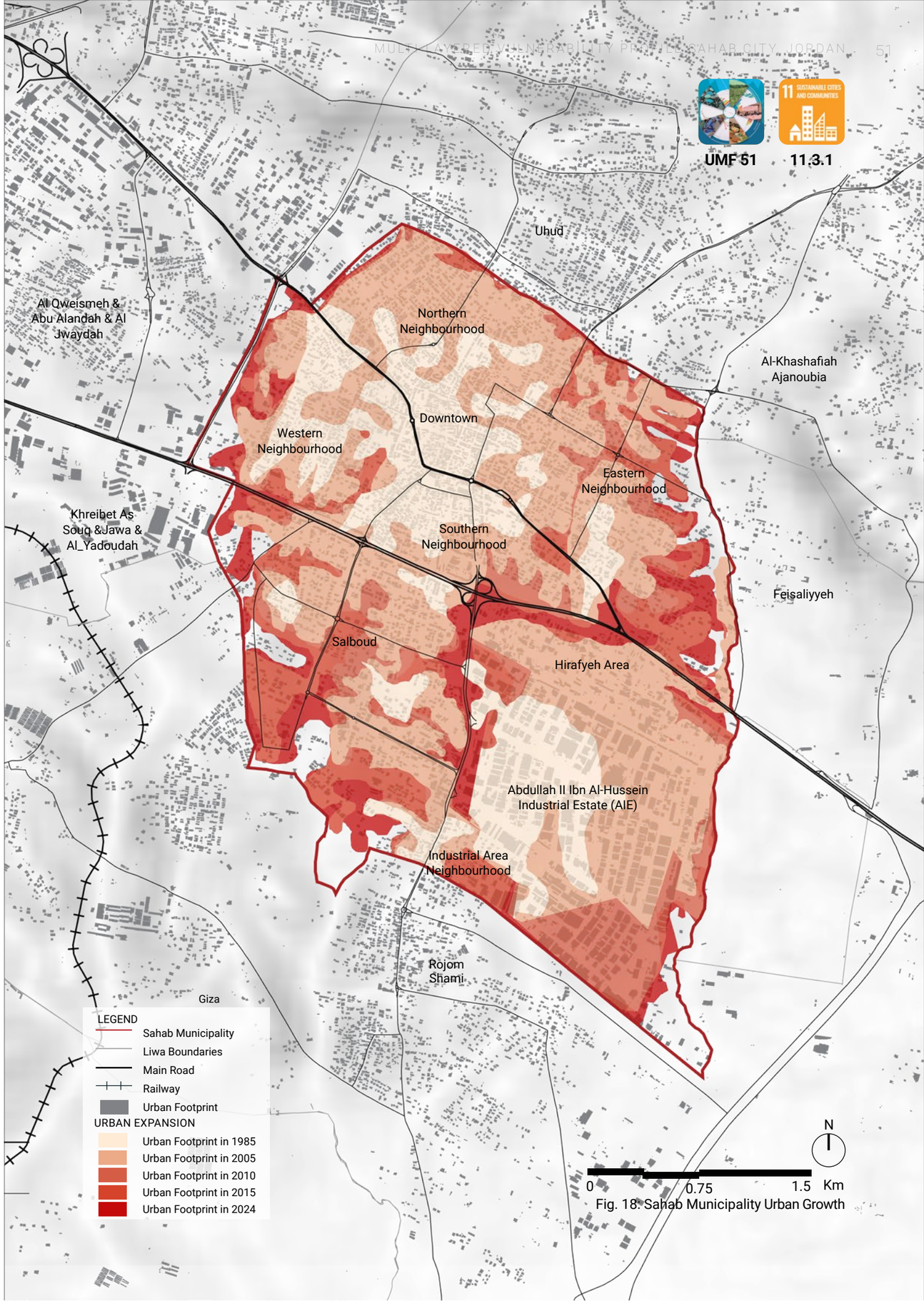


Fig. 18: Sahab Municipality Urban Growth

Indicator 4: Land Use

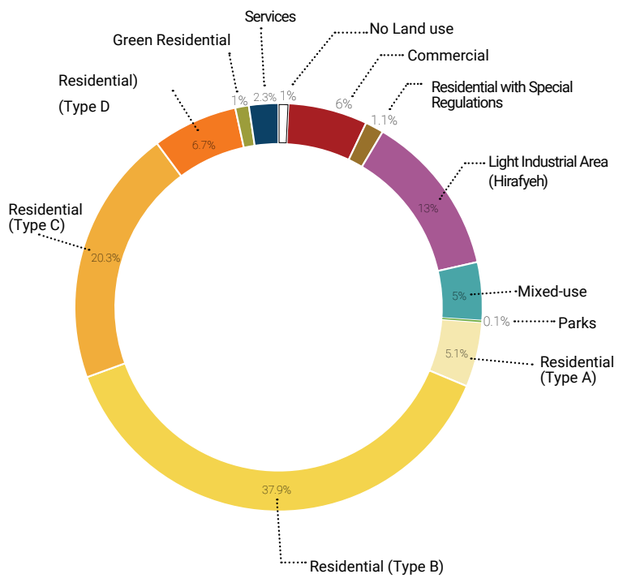
Sahab City's land use distribution reveals an urban structure heavily influenced by residential dominance, concentrated industrial activities, and a pronounced lack of green spaces. Residential areas account for 64.1% of the total land as shown in Fig. 19 , reflecting the city's focus on housing development to accommodate its growing population. Among these, Type B Residential zones dominate, covering 37.9% of the city's land. This indicates a prevalence of low-to-medium density housing, which contributes to urban sprawl and inefficient land use. Type C Residential zones follow, occupying 20.3%, representing higher-density neighbourhoods. Smaller proportions of land are allocated to Type A (5.1%) and Type D (6.7%) residential areas, reflecting diverse socioeconomic patterns. The extensive residential development is accompanied by significant environmental challenges. In the Jordanian context,

Types A, B, and C Residential zones typically allocate larger areas for setbacks compared to Type D zones, as mandated by building regulations. However, these outdoor spaces; such as setbacks, front yards, sidewalks, and gardens; are often paved by homeowners to accommodate private needs, including parking or creating additional usable areas. This practice drastically reduces the permeability of the urban environment, leading to increased stormwater runoff, which overburdens the city's already strained drainage systems. Consequently, flooding risks during heavy rainfall are heightened. The loss of green spaces in residential areas also exacerbates the urban heat island effect, as paved surfaces trap heat, raising temperatures, particularly in densely developed zones. This reduction in vegetation diminishes biodiversity, compromises natural cooling, and limits opportunities for recreation and social interaction, ultimately degrading the environmental and social quality of life in the city.

Industrial activities are another defining feature of Sahab City, occupying 13% of the total land. Key industrial zones include the Abdullah II Ibn Al-Hussein Industrial Estate and Hirafyeh Area, located in the south-eastern part of the city. While these zones play a vital role in the country's economy, their proximity to residential neighbourhoods presents significant challenges. Residents are exposed to air pollution, noise pollution, and potential water contamination, which pose serious public health concerns. The absence of adequate green buffers between industrial and residential areas exacerbates these impacts, further compromising the well-being of nearby communities.

The city's allocation of land for green spaces is critically low, with green residential areas occupying only 2.3% of the total land and parks accounting for just a 0.1%. This significant deficiency has severe environmental and social implications. The lack of vegetation exacerbates heat retention in urban areas, intensifying discomfort during the summer months. Insufficient green infrastructure also reduces natural stormwater absorption, further contributing to urban flooding, a persistent problem in Sahab City due to inadequate drainage systems. Socially, the limited availability of parks and recreational spaces affects the well-being of residents, denying them of spaces for physical activity, relaxation, and social interaction. This shortage of green spaces reduces the city's livability, especially in densely populated neighbourhoods where such spaces are most needed.

Addressing these challenges requires a strategic and integrated approach. Efforts to de-pave unnecessary paved areas and introduce permeable infrastructure can mitigate stormwater runoff and reduce flooding risks. Expanding green spaces, including parks and vegetative buffers, will enhance urban cooling, improve biodiversity, and provide essential recreational opportunities for residents. Strategic urban planning that prioritizes compact development and integrates green infrastructure into both residential and industrial areas is essential to improving Sahab City's resilience to urban and climate-related challenges. By adopting such measures, the city can enhance its environmental health, improve residents' quality of life, and build a sustainable future.



Land use of regulated area within Sahab Municipality Administrative Boundary
Source: MoLA 2007

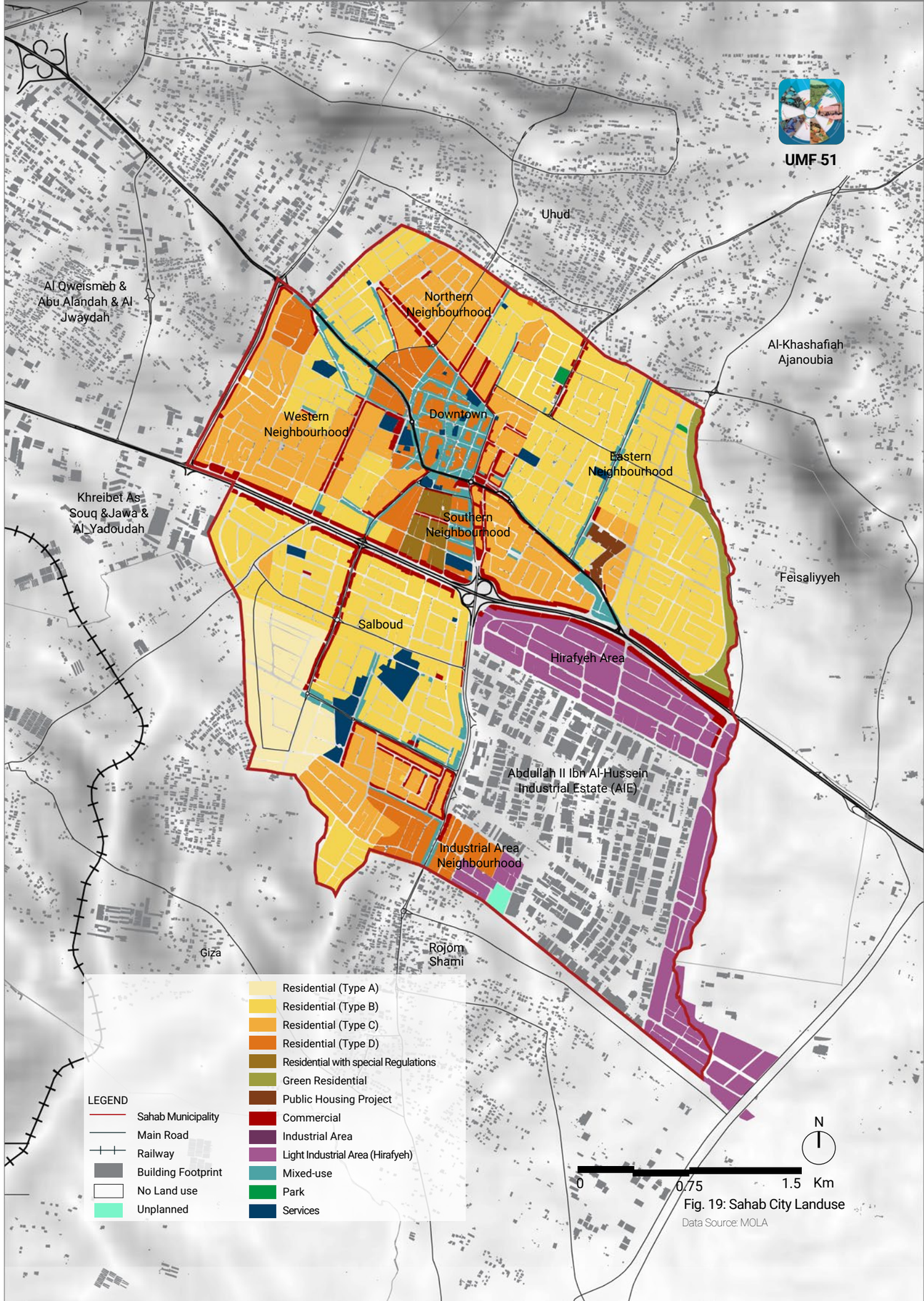


Fig. 19: Sahab City Landuse
Data Source: MOLA

Indicator 5.1: Access to Basic Services

UMF 09 **1.4.1**

This interplay between regional and local levels of governance has created a landscape where access to essential services is both centralized and in some cases is unevenly distributed, reflecting the Sahab Municipality's ongoing struggle to balance its industrial growth with the needs of its residential population. Understanding these dynamics is critical to addressing the challenges of urban growth, ensuring equitable access to services, and fostering sustainable development in Sahab Municipality's.

Access to basic services—such as water, sanitation, healthcare, energy, and transportation—must be considered in the urban vulnerabilities analysis of the Sahab MVA because it directly affects the resilience of people, infrastructure, and ecosystems. Limited or uneven access can exacerbate climate risks, particularly in a dense, industrial, water-scarce, and heat-exposed city like Sahab, where shortages in cooling, water supply, emergency response, and drainage systems can worsen public health, economic stability, and disaster preparedness. Integrating basic service access into the analysis helps identify spatial inequalities and informs targeted interventions to improve urban resilience.

It is worth mentioning that Sahab Liwa hosts key infrastructure related to essential service provision. This includes one of the largest landfills in Jordan, which plays a crucial role in the region's solid waste management. Additionally, Sahab is home to an electricity station that supports the growing energy demands of the city, along with the largest solar power plant in the area, contributing to renewable energy generation and reducing the dependency on conventional energy sources. However, despite hosting these critical facilities, Sahab Liwa does not have direct authority over them. These infrastructures are managed by central or regional authorities, which limits the municipality's ability to control or directly influence their operation, planning, or expansion.

Moreover, Sahab Municipality also relies on infrastructure located outside its municipal boundaries, such as wastewater treatment plants within the Amman Governorate. These facilities, though outside the immediate area, are vital to the Municipality's wastewater management, processing the increasing volume of industrial and residential waste generated by the municipality. This combination of local and regional infrastructure highlights Sahab Municipality's integral role within the broader framework of service provision for the Greater Amman area and emphasizes the interconnected nature of its development with the surrounding region.

Access to Energy and Electricity

The National Electricity Company is the main and only provider of electric power in Sahab Liwa. The total number of household subscribers 23,800 in Sahab Liwa and Sahab Municipality reached 13,300 subscribers in 2019. Approximately, 95% of the population in Sahab Liwa and 98% of the population in Sahab Municipality is now connected to the electricity network. The total number of household subscribers 23,800 in Sahab Liwa and Sahab Municipality reached 13,300 subscribers in 2019. Approximately, 95% of the population in Sahab Liwa and 98% of the population in Sahab Municipality is now connected to the electricity network.

The existing power network consists of 400 V overhead lines (OHL) installed on steel poles and distribution power transformers. The network, which is owned by the Jordanian Electric Power Company (JEPCO), supplies power to commercial and residential consumers, as well as street lighting[12].

Nevertheless, the challenges faced by the energy and electricity sector in Sahab Liwa include:

- Frequent power outages in winter due to increased pressure on electrical generators.
- Multiple subscriptions on a single meter.
- Lack of alternative resources of electrical energy.
- Limited availability of new power stations to reduce the load on aging transformers.

As part of a project implemented by the Ministry of Energy and the Ministry of Local Administration, 3,000 old street lighting units in Sahab Municipality have been replaced with energy-efficient LED units. Work is also underway to add more units through a change order (MEMER, 2024). Within the Sahab Liwa, the largest solar power plant "The Baynouna" was established through a power purchase agreement between Masdar and the Jordanian National Electric Power Company. This plant produces over 560 GWh of energy annually, enough to power 160,000 homes. Additionally, it prevents the emission of 360,000 tons of CO^2 per year, which is equivalent to removing approximately 80,000 cars from the roads (Baynouna, 2024).

Telecommunications, Post and Information Technology

The 2015 Population and Housing Census data for Sahab Liwa shows that Sahab has relatively higher levels of telecommunications and postal sector services compared to the governorate and national averages. Specifically, 38.9% of households in Sahab own a laptop, surpassing Amman governorate average of 21.6% and the national average of 25.8%. Additionally, 98.2% of households have a mobile phone, compared to Amman governorate average of 60.2% and the national average of 63.2%. The percentage of households owning a land-line phone is 6.2%, while 27.7% have internet access. Moreover, Sahab Liwa's infrastructure is supported by 7 post offices and 3 knowledge stations.

Access to telecommunications, internet, mobile phones, and IT enhances climate resilience in cities like Sahab by enabling early warning systems, real-time weather updates, and emergency alerts for extreme heat, flash floods, and water shortages. Digital connectivity also supports disaster coordination, and access to vital services, reducing disruptions during climate shocks. Additionally, it empowers residents with climate adaptation knowledge, mobile banking for financial stability, and digital platforms for community support and resource sharing in times of crisis.

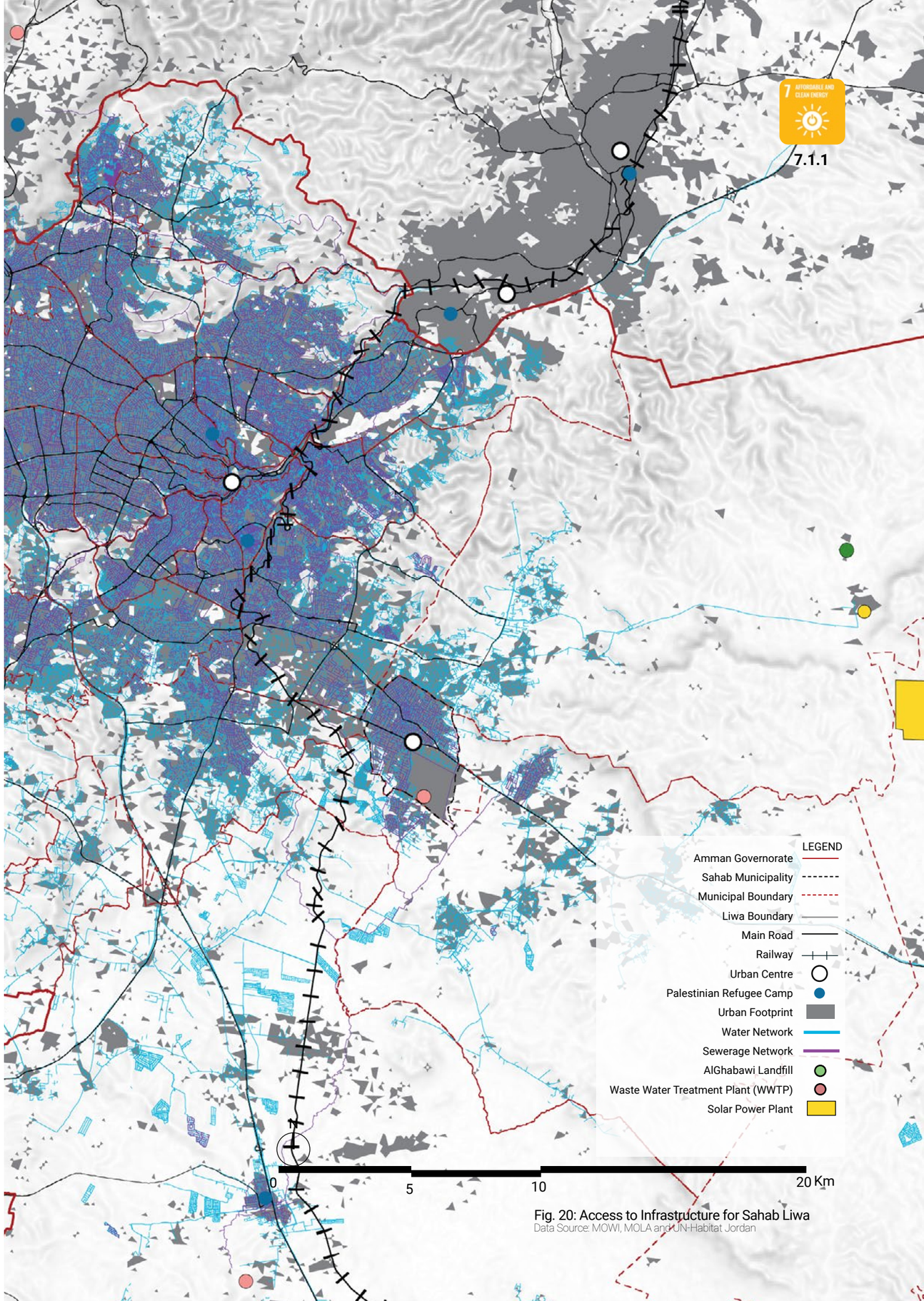


Fig. 20: Access to Infrastructure for Sahab Liwa
Data Source: MOWI, MOLA and UN-Habitat Jordan

Access to Water

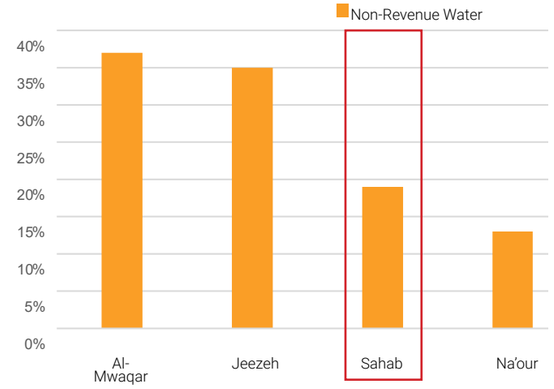
Jordan currently is the fifth-highest ranking country in terms of water stress. Water availability is already highly insufficient, and when accounting for population growth, per capita water availability will decline to very low levels. Renewable water supplies only meet around half of the total water consumption. By 2080, annual per capita water availability is projected to range between 22 m³ and 230 m³. For reference, the threshold for absolute water scarcity is below 500 m³ per person per year. Additionally, Jordan's per capita share of annual renewable water resources is anticipated to decrease from 61 m³ meters to 35 m³ by 2040 [13].

Miyahuna Company, with its branch located in Sahab Municipality, provides delivery services to Sahab Municipality residents. Approximately 92% of households relying on the public drinking water network, and almost 81.27% of households are connected to the drinking water network. The average daily water consumption ranges from 47 to 70 litres per person (approximately from 17 to 26 m^3 per person annually). This contrasts with Jordan's per-capita water consumption of 61m^3 in 2022, equivalent to 167 litres per person per day. This discrepancy underscores the city's water scarcity and demand-supply challenges, particularly in the context of its growing population, industrial activities, and extreme climate conditions.

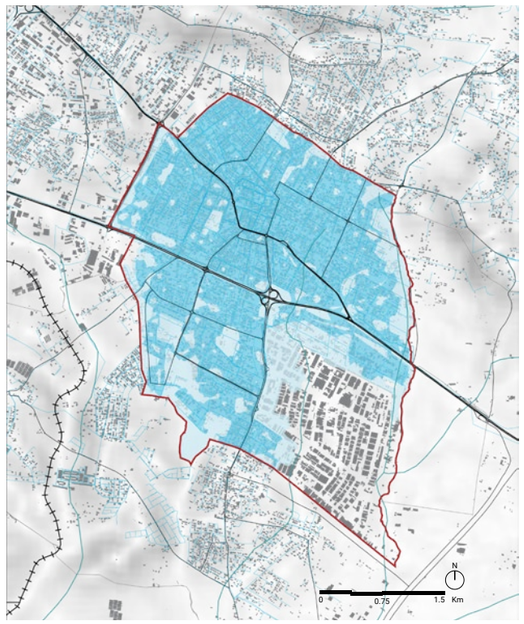
Non-revenue water in Sahab City is the third highest in Amman, accounting for 19%. Non-Revenue Water (NRW) - refers to both tangible losses from breaks or leaks in water distribution infrastructure (like pipes and reservoirs) and intangible losses in the commercial domain, including meter reading inaccuracies, data management complexities, and illegal water usage. Almost 50 litres per capita per day—half of the daily per capita water supply (100 litres)—is lost due to infrastructure deficiencies, indicating severe inefficiencies that require urgent intervention. To address these challenges, Sahab City was included in the Water Loss Project, which was launched in 2015 with support from the United States Agency for International Development (USAID) and is implemented by Miyahuna Company. This ongoing project aims to improve water services across Amman by enhancing water networks and implementing more effective maintenance and operational management programs. While this initiative aims to strengthen infrastructure, enhance maintenance, and improve operational efficiency, additional measures may be necessary, such as leak detection technologies, stricter enforcement against illegal water usage, and community engagement programs to promote conservation.

The capacity assessment tool measured the demand on the existing water network, indicating the sufficiency of the existing water network (whereby high demand means low network sufficiency) by factoring in the pipes' diameter and length, as well as the number of people served. The results designate areas of high and low demand on the tested infrastructure network. Overall, the water capacity assessment revealed that there is a relatively high demand on water network in most areas which represents almost 56.52% at the northern and western part of the city. High demand typically correlates with lower sufficiency, meaning that these areas might experience issues such as lower water pressure or inadequate supply during peak usage times. This could indicate a need for infrastructure upgrades, such as increasing pipe diameters, improving water distribution networks, or even expanding the capacity of the water supply in these high-demand areas.

The data used in the map can support the municipality in reporting on the SDG 6.1.1 indicator. This also facilitates stakeholders, policymakers, and residents in developing targeted solutions tailored to the distinct characteristics and needs of various areas within the city.



Non-Revenue in Sahab and near by Liwas
Source: Geographic Multidimensional Vulnerability Analysis (UNICEF, 2020)



Water Demand in Sahab Municipality

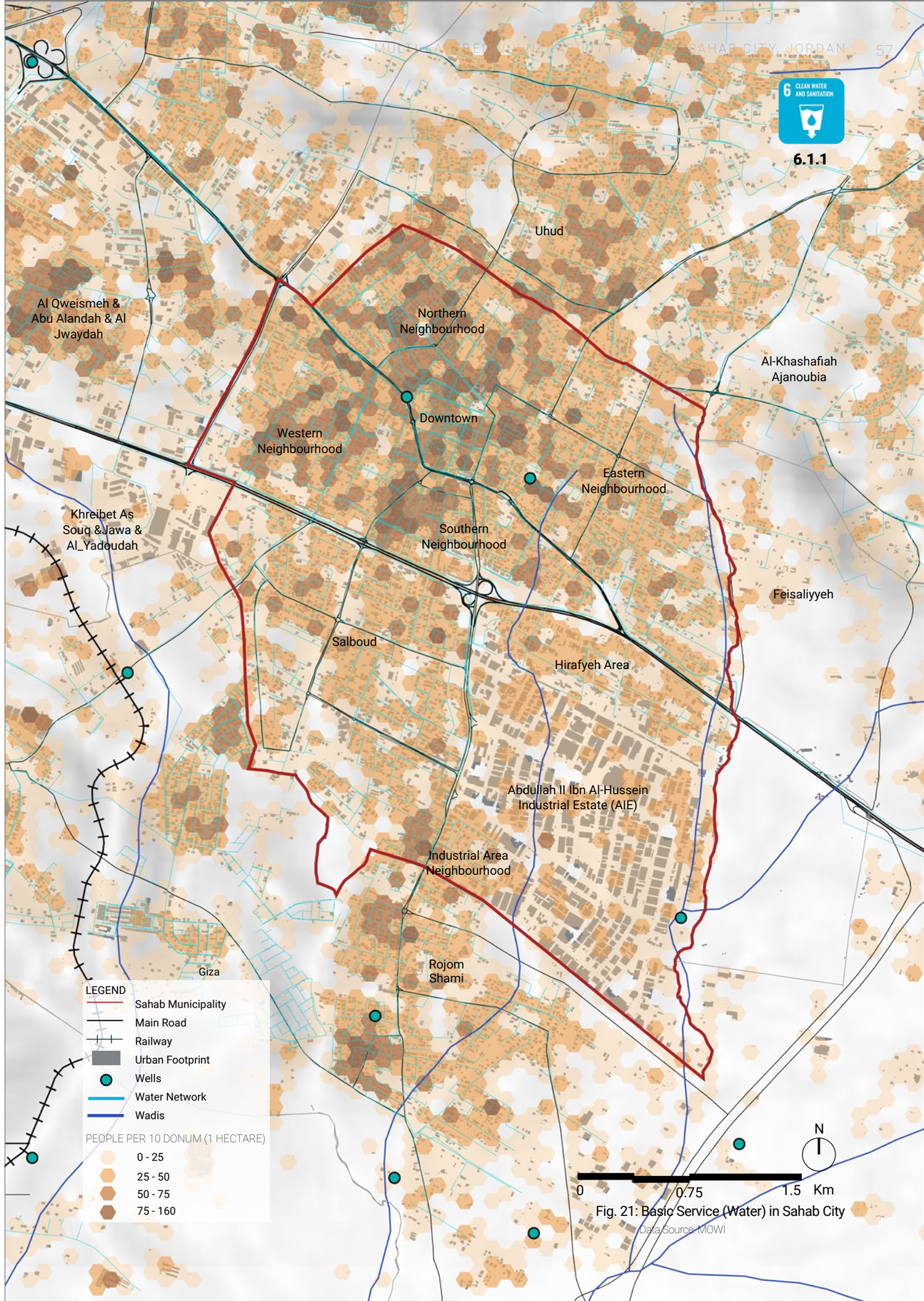


Fig. 21: Basic Service (Water) in Sahab City
Data Source: MOWI

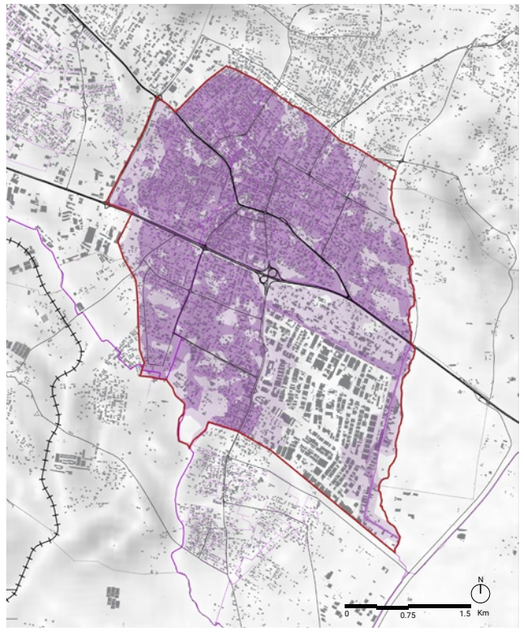
Access to Sewerage Network
Based on the available GIS data, 72.8% of Sahab Municipality's total households are connected to sewerage network. While a significant portion of Sahab Municipality's households are connected to the sewerage network, there remain areas where wastewater management is inadequate, In particular, the old town sees residents disposing of wastewater in caves due to high demand, which highlights the urgent need for infrastructure upgrades and improved wastewater management solutions. The contamination risks to groundwater and public health in these areas are critical concerns that demand immediate attention. The wastewater generated within Sahab Municipality is transferred to two wastewater treatment plants (WWTPs) located outside its boundaries.

The data used in the map can support the municipality in reporting on the SDG 6.2.1a indicator. This also facilitates stakeholders, policymakers, and residents in developing targeted solutions tailored to the distinct characteristics and needs of various areas within the city.

Stormwater Drainage Network
The lack of an adequate stormwater drainage in Sahab Municipality, despite the addition of culverts, highlights the need for a more comprehensive stormwater management system. Currently, stormwater accumulates and is directed through culverts into two main wadis. The primary wadi, Salboud, flows towards the Rojom Shami and Zizya areas, while the second wadi lies between the industrial city and the Hirafyeh area.

Rain Water Harvesting Initiatives
The areas within Sahab Liwa, including Sahab Municipality, have benefited from initiatives by the Ministry of Agriculture in regions receiving an annual rainfall of 200 mm or more. A total of 28 projects were implemented to construct rainwater harvesting wells in the last three years, with each well designed to hold a capacity of 30m³ per beneficiary[14].

Industrial Waste Water
Managing industrial wastewater in Sahab City presents significant challenges due to the high water consumption by its extensive industrial base. The Industrial Wastewater Treatment Plant (IWTP) in the King Abdullah II Industrial Estate is designed to handle wastewater from approximately 435 factories, including sectors such as engineering, chemicals, pharmaceuticals, and food processing. Although the plant's capacity is set at 2,000 m³/day with an organic load limit of 900 mg/L, it currently receives an organic load of about 2,700 mg/L per day, exceeding its capacity. This challenge is compounded by the non-compliance of many factories with wastewater discharge regulations, leading to the release of effluents containing pollutant levels exceeding allowable limits. As a result, the IWTP struggles to provide adequate treatment within its 72-hour detention time, causing the discharge of partially treated wastewater. This not only contributes to groundwater pollution, threatening local water resources, but also poses serious public health risks. The use of inadequately treated waste water for irrigation on nearby farms risks contaminating crops and animal fodder, potentially jeopardizing food safety.[15].



Sewerage Demand in Sahab Municipality

Fig. 22: Urban Nexus focusing water and sewerage sub-indicators.

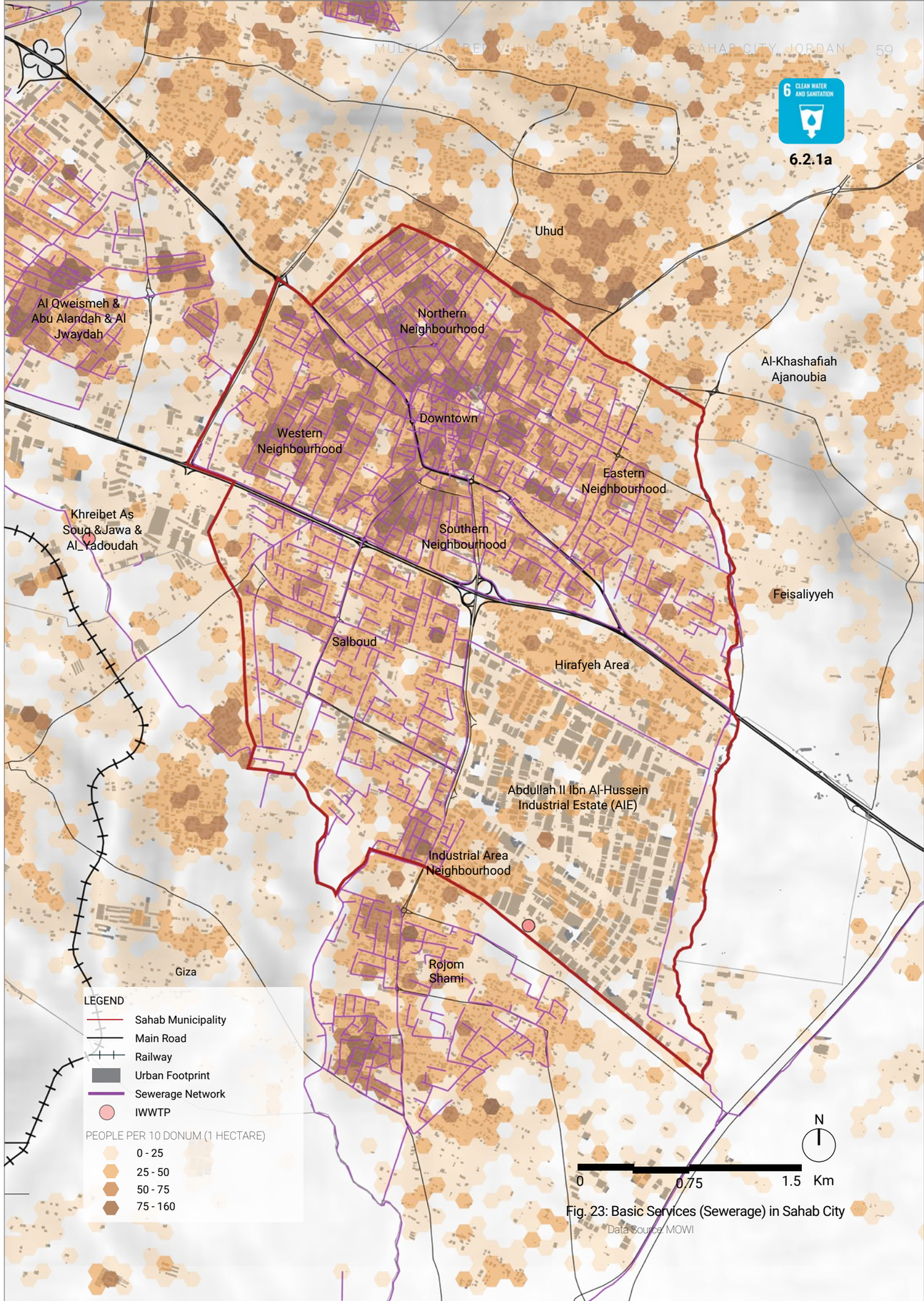


Fig. 23: Basic Services (Sewerage) in Sahab City
Data Source: MOWI

In addition to the IWTP in the King Abdullah II Industrial Estate, Sahab Municipality is also impacted by a second industrial wastewater treatment plant (IWWTP) located in Tajamouat Industrial City, on the periphery of Sahab City. As a result, untreated or partially treated wastewater is frequently released into the surrounding environment, contributing to environmental degradation and public health risks in nearby areas. This discharge leads to the contamination of local soil and water sources, further endangering the groundwater that is vital for both domestic use and agricultural irrigation. Additionally, the improper handling of industrial wastewater has the potential to introduce harmful substances into the local ecosystem, threatening biodiversity and agricultural productivity.

Solid Waste Management

Sahab Municipality plays a pivotal role in managing solid waste within Sahab City, with the exception of Abdullah II Ibn Al-Hussein Industrial Estate (AIE), where industrial waste is managed by a private company under contract with Jordan Industrial Estate Company. Although the general cleanliness of the industrial areas within Sahab City is outside the municipality's authority, the presence of local and foreign labourers residing in Sahab City has an indirect impact on the city's overall cleanliness. This is evident from the random disposal of solid waste, particularly in the areas surrounding these industrial zones.

The municipality's solid waste management operations encompass urban cleanliness, street maintenance, solid waste collection, and transportation to final disposal sites. On a daily basis, Sahab Municipality manages the disposal of around 100 tons of solid waste. This waste is transported to two primary disposal sites: the Ghabawi landfill, located 24 kilometres from the city, and the East Amman Transfer Station, situated 9 kilometres away. By utilizing these facilities, the municipality ensures that solid waste is appropriately managed and disposed of, supporting environmental health and community well-being.

Moreover, the influx of Syrian refugees in Sahab City has significantly increased solid waste generation, placing a heavy burden on the municipality and straining its resources and infrastructure. Currently, the municipality covers only 87% of the required waste collection, and with waste levels projected to double by 2025 according to the Local Solid Waste Management Plan for Sahab municipality, there is an urgent need for enhanced waste management strategies and increased support to effectively address these growing demands. The composition of waste in Sahab City includes municipal solid waste, commercial waste, and industrial waste. Municipal solid waste, which consists of waste generated from households or any other waste with a similar composition and nature to household waste, forms the largest portion. Almost 50% of the municipal solid waste generated is organic, while 34.5% comprises dry recyclables, including paper, cardboard, and plastics.

The SWM Adaptive Capacity Matrix for Sahab City is designed to evaluate the city's solid waste management (SWM) system. It focuses on various factors that influence the system's efficiency and adaptability, helping to identify areas for improvement and ensure that the system can respond effectively to changes, hazards, and risks.

Variable	Indicator	Current Status	Target Status	Assess-ment
Waste Generation Rates	Amount of waste generated per -capita	0.99 Kg/ person/ day		
Collection Efficiency	Frequency and coverage of waste collection	Daily 87% coverage	Daily 100% coverage	
Waste Containers	Number of waste con-tainers	2217	4432	
Fleet Size	Number of waste collec-tion vehicles	10 vehicles		
Fleet Techni-cal Condition	Vehicle main-tenance and reliability	Very good to excellent condition	Maintain very good condition	
Routing System	Efficiency of waste collec-tion routes	Basic routing system	Optimized routing system	
Financial Re-sources and Reporting	Quality of financial man-agement and cost recovery	Inadequate tracking and reporting of costs	Compre-hensive tracking and reporting of costs	
Human Resources	Staff to pop-ulation ratio and training levels	1 to 1621 Resident	1 to 850 Resident	
Regulatory Framework	Compliance with waste management regulations	Partial compliance; some gaps	Full compli-ance	
Risk Management	Quality of risk management and contin-gency plans	Basic plans with limited details	Comprehen-sive, detailed plans and regular updates	
Institutional Capacity	Organizational structure and effectiveness	Clear policies Weak proce-dures and Active plans	Strong procedures Effective manage-ment	
Sustainable Behavior	Public aware-ness and responsibility	Low aware-ness and weak civic responsibility	High aware-ness and strong civic responsibility	
Occupational Health and Safety	Quality of health and safety measures for staff	Comprehen-sive safety protocols and regular training	Comprehen-sive safety protocols and regular training	

SWM Adaptive Capacity Assessment Matrix

High
Moderate
Low

Source: IWTP in the King Abdullah II Industrial Estate Sahab City, Jordan, (c) UN-Habitat /Ledia Nimri

Indicator 5.2: Access to Public Facilities

Sahab Municipality provides its services to everyone living within its boundaries. The municipality provides physical services including street cleaning and environmental-related aspects, building permits, markets, health inspection, and maintenance of the urban infrastructure. All services provided by the municipality and activities targeting the community are available to locals, refugees, and migrant labour.

The map shown in Fig. 24 shows the spatial distribution of the public facilities within Sahab Municipality's administrative boundary including educational, healthcare, religious, commercial, and recreational facilities. It is important to note that Sahab houses the largest cemetery in Amman, catering to both the local community and residents of Amman.

Through spatial analysis and research, access to and quality of each of the identified public facility is further investigated in the pages to follow. The left side of the city hosts the majority of public facilities, while their frequency diminishes towards the right side, which is predominantly occupied by industrial activities.

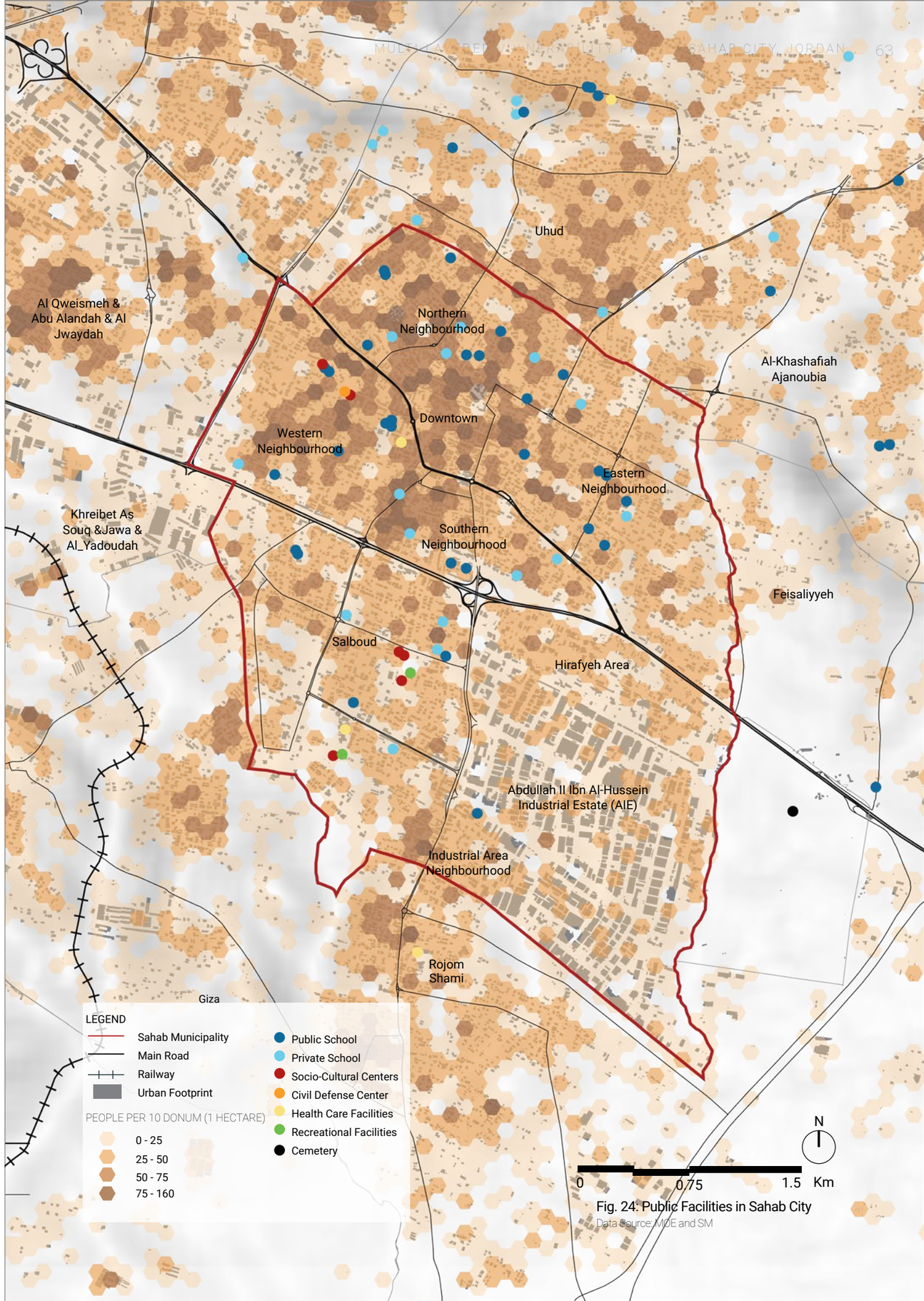


Fig. 24: Public Facilities in Sahab City

Data Source: MOE and SM

Access to Public Transport

Sahab Municipality is the strategic centre of the Sahab Liwa due to its administrative centre and strategic location as a crossroads with bordering countries, and it is also significant as an industrial hub.

Sahab Liwa's road network has primary, secondary, and rural roads. The road network is 231.6km in length. The road network in Sahab Liwa faces several pressing challenges, including: frequent excavations due to sewage works, encroachments on sidewalks and roads, deterioration of pavement conditions, and poorly planned road designs, (SM, 2024).

Sahab City accommodates approximately 60,000 daily workers in addition to its residents, which has significant influence on the urban dynamics and infrastructure. This substantial workforce impacts transportation and mobility throughout the area, underscoring the need for efficient transportation solutions to support the daily movement of both residents and workers. Sahab bus station emerges as a critical component of the area's transit network. By providing service to nearly 47,720 passengers daily through approximately 65 trips, using a fleet of 106 public transport vehicles, the station plays a pivotal role in accommodating the city's transportation demands from Sahab City to different locations and universities outside the area. While serving a significant number of passengers, it primarily focuses on intercity travel rather than intra-city mobility.

Sahab City faces significant challenges in the mobility sector. The lack of a reliable public transit system within the city's boundaries has forced residents to heavily rely on private vehicles. This over-dependence on personal transportation, combined with the daily influx of approximately 60,000 workers and the significant amount of vehicular traffic including heavy vehicles and trucks has led to severe traffic congestion, increased air and soil pollution, and heightened safety concerns. The lack of taxis within the municipality further complicates the situation, forcing residents to use unsuitable private vehicles for public transportation. This not only compromises passenger safety but also exacerbates traffic congestion and contributes to environmental degradation (SM, 2024)[16]. The high volume of heavy vehicles and trucks, combined with limited designated parking areas, has led to trucks being parked along main streets and in residential areas. This exacerbates traffic congestion, obstructs roadways, and increases the risk of accidents. The lack of proper truck parking facilities further contributes to environmental degradation, as idling trucks emit pollutants, worsening air quality. Additionally, the presence of heavy trucks in unsuitable locations poses safety concerns for pedestrians and other road users, further complicating the city's mobility challenges.

The map shown in Fig. 26 clearly shows that the public transport network mainly serves the north of Sahab Municipality. Within a 5-minute walking distance, 7.64% of individuals have access to the public transport route, whereas 45.07% and 75.32% of Sahab Municipality residents can reach bus stops within 15 and 30 minutes, respectively. There are two types of bus stops identified on the map. The bus stops marked in blue are developed and managed by the LTRC, while those marked in red are developed and managed collaboratively by the governorate council and the LTRC.

The data used to develop this map can provide support to the municipality in reporting on key indicators associated with UMF 10 and SDG 11.2.1. This also facilitates stakeholders, policymakers, and residents in developing targeted solutions tailored to the distinct characteristics and needs of various areas within the city.

The diagram below illustrates the relationship between various transport and mobility sub-indicators and environmental variables in Sahab City, emphasizing the complex interactions and impacts of transportation infrastructure on both the environmental quality and socio-economic factors.

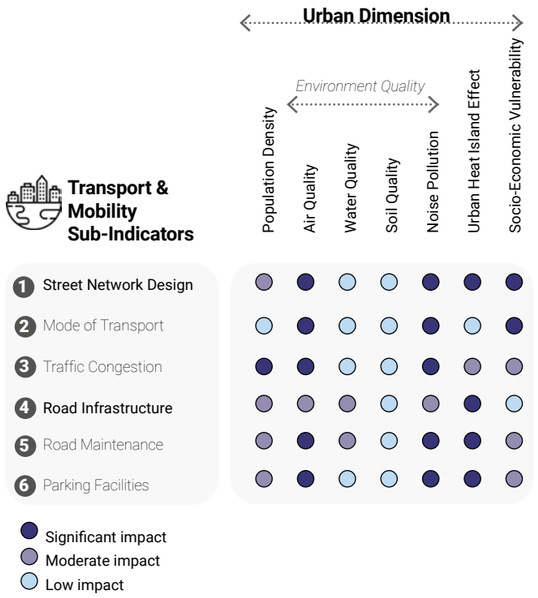


Fig. 25: Urban Nexus focusing transport and mobility sub-indicators.

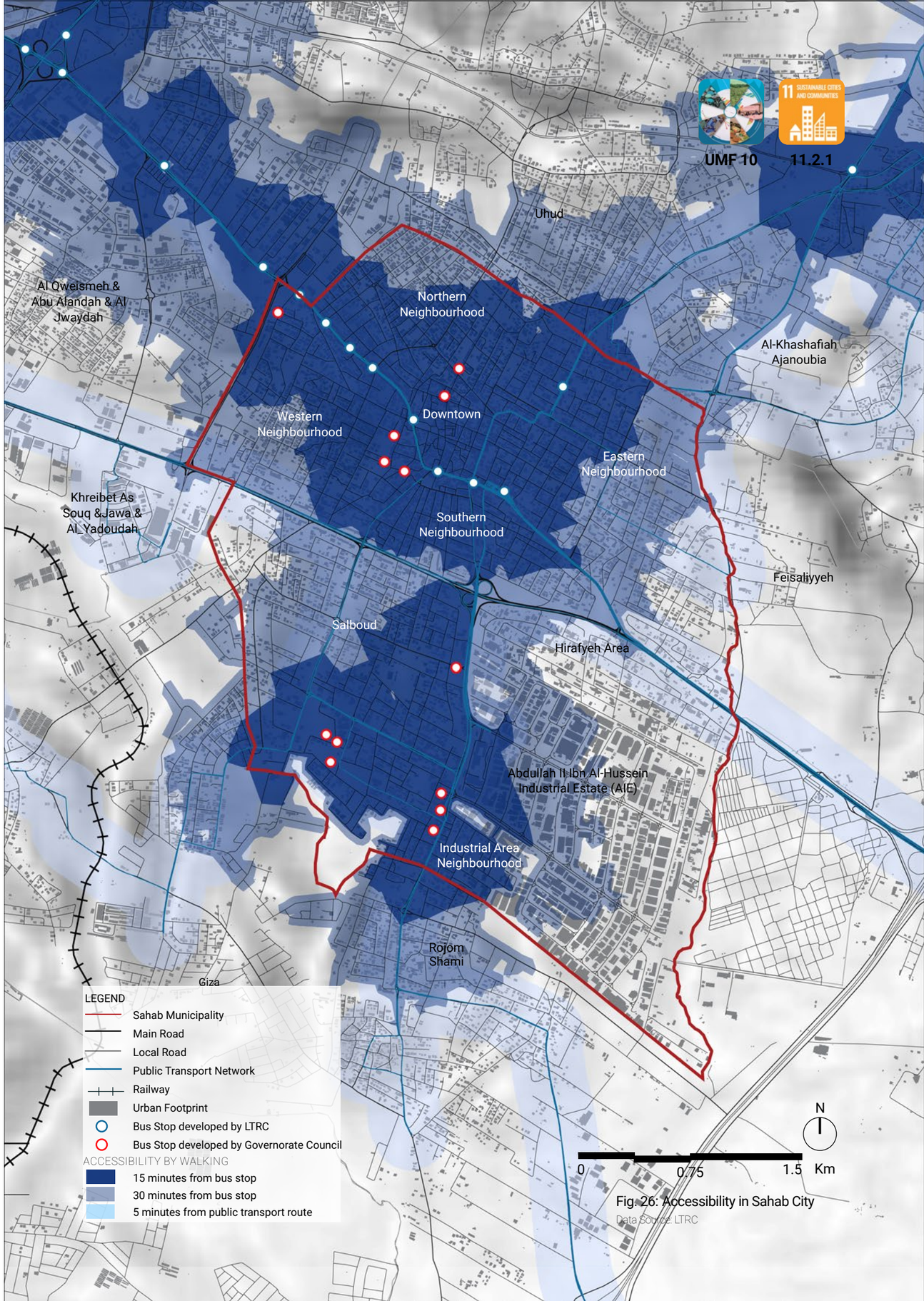


Fig. 26: Accessibility in Sahab City

Data Source: LTRC

Access to Commercial Activities

The commercial sector in Sahab Municipality is a crucial pillar of the local economy, heavily relied upon due to the large number of workers commuting from across Jordan. This sector is diverse, encompassing a wide range of professional services, retail and trade businesses, industrial and manufacturing activities, as well as agriculture and food-related enterprises. [17]

The map shown in Fig. 27 illustrates the commercial morphology of Sahab Municipality, characterized by a classic core-periphery pattern, which accounts for 6.11% of the total regulated area. The city center serves as the primary commercial hub, where the majority of commercial activities are concentrated. Beyond this central area, several clusters of commercial activities are found along major roads, forming commercial corridors that cater to local neighbourhoods and the industrial sector. The commercial corridors in Sahab City, highlighted by the concentration of commercial activities along specific roads, underscore their importance to the city's economic vitality. These corridors serve as key areas where businesses are densely clustered, attracting both local residents and visitors.

Beyond these commercial corridors, the urban landscape transitions into mixed-use zones, which represent 4.53% of the regulated area. Here, residential and commercial functions coexist, particularly along local roads, illustrating a flexible urban form that accommodates neighbourhood needs alongside broader economic activities. The presence of commercial activities within these mixed-use zones reflects the gradual spread of economic functions from the core to the periphery, adapting to the city's growing population.

As of the end of 2023, a total of 899 building permits for commercial use have been issued, representing approximately 19% of the total building permits granted by Sahab since records began in 2007. These permits are issued on land regulated under either commercial zoning or mixed-use zoning, which includes both commercial and residential elements, highlighting a significant focus on commercial development within the city's permitting activities over the years (SM, 2024)[18].

Based on the SDG indicator analysis of public services within a 15 and 30 minute walking distance 90.7% of Sahab Municipality population has access to commercial activities within a 15-minute walking distance and 96.6% has access within a 30-minute walking distance.

Prince Hassan Road, a key commercial corridor in Sahab Municipality, plays a vital role in supporting the city's economic vitality. As a major shopping destination for the local community, the road serves as a central hub where businesses are densely concentrated, attracting both local residents and visitors. The recent completion of its rehabilitation marks a substantial advancement in enhancing the safety, functionality, and climate resilience of this key corridor. The project has successfully transformed Prince Hassan Road into a more pedestrian-friendly space, with widened sidewalks to accommodate foot traffic and reduce vehicle congestion, improving overall traffic flow. These upgrades not only stimulate local commerce but also create a safer and more accessible environment for the community.

Beyond improving traffic and pedestrian safety, the project integrated climate-resilient features to address the growing risks posed by heat waves, rising temperatures, and storm water flooding. The addition of tree-lined streets and shaded walkways helps mitigate the urban heat island effect, providing much-needed relief during extreme heat events and encouraging outdoor activities even in warmer weather. Moreover, the implementation of permeable pavements and green infrastructure, such as bioswales and rain gardens, has significantly enhanced storm water management. With the installation of an upgraded storm water drainage system, Prince Hassan Road is now better equipped to manage higher volumes of rainwater, ensuring that businesses along the road can continue to operate without disruption during periods of intense rainfall [19].

However, despite these advancements, the commercial sector faces several challenges. In mixed-use zones, commercial activities sometimes dominate in an informal and disorganized manner, creating noise, visual and other types of pollution and a lack of structure. Additionally, along Alsteen Road, the commercial activities mainly cater to the industrial sector, such as vehicle maintenance services, further reflecting the heavy industrial influence on the city's commercial dynamics. These challenges highlight the need for better regulation and urban planning to harmonize commercial and residential functions in mixed-use zones and manage the dominance of industrial-related commercial activities.

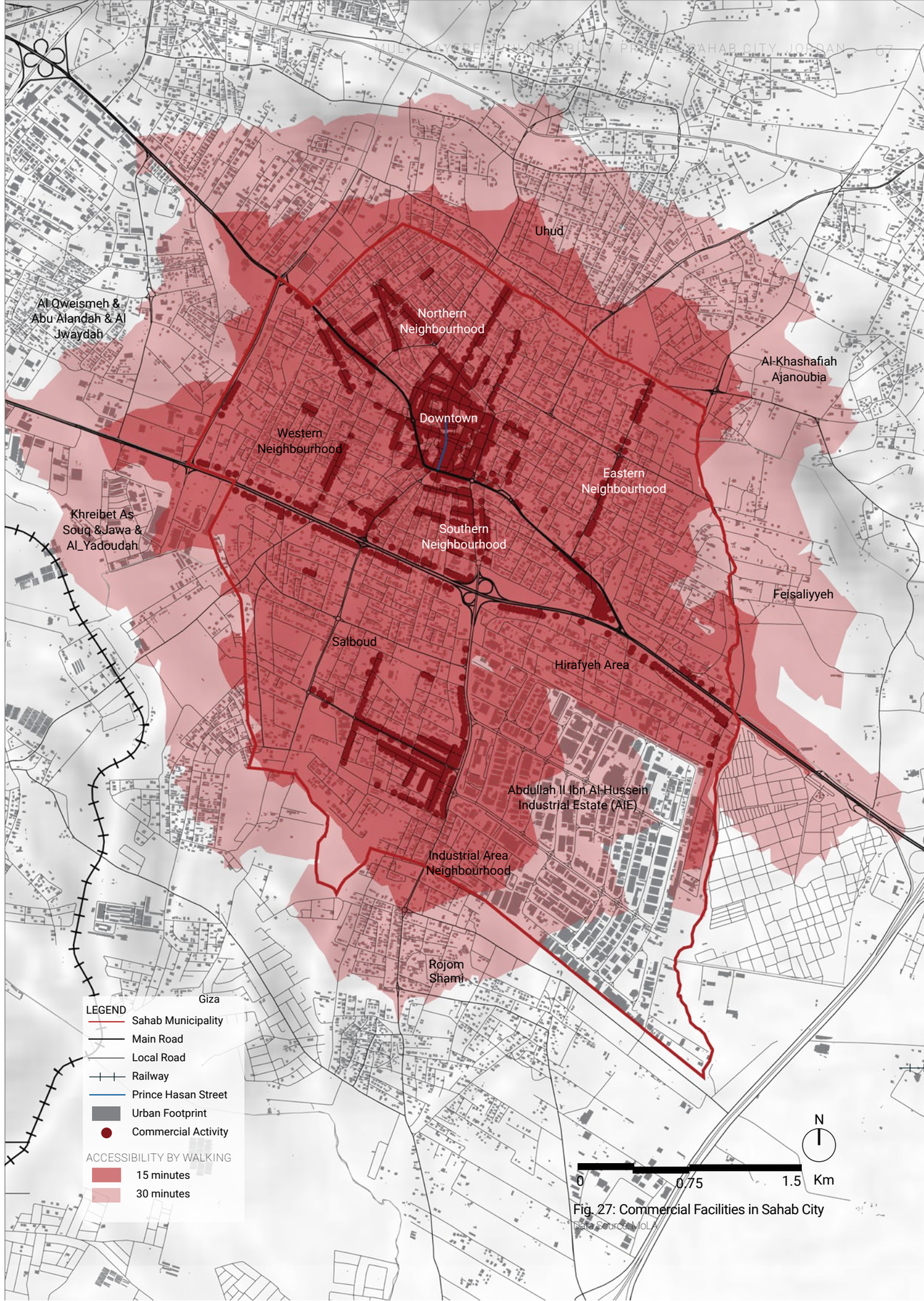


Fig. 27: Commercial Facilities in Sahab City

Data Source: MoLA

Access to Healthcare Facilities

As a country, Jordan has quite an advanced healthcare system and is considered a regional leader for the provision of medical services. In 2020, 9% of Jordan's GDP was devoted to healthcare services, which is high compared to other countries. Jordan has long stood as one of the most desirable locations in the region for medical tourism, prior to COVID-19, Jordan received as many as 250,000 foreign patients with over $1 billion in revenues annually.

A steadily growing domestic population, and continuous influx of refugees has led to a significant increase in the demand for hospitals as well as demands for suitable, sustained healthcare infrastructure and services overall. The country's healthcare system is mainly divided between public, private, and military institutions. The public sector provides 37% of all hospital beds in the country while the military's Royal Medical Services provides 24% of beds, and the private sector provides 36% of beds. Currently, there are 117 hospitals in Jordan of which 69 are private hospitals, 31 governmental hospitals, 15 hospitals for the royal medical services, and 2 university hospitals.

In addition to the public and private sectors, a significant portion of healthcare in Jordan, specifically for refugees, is provided through programmes led by the United Nations and non-governmental humanitarian agencies. UNRWA is the dominant provider of primary healthcare for Palestinian refugees. Furthermore, UNHCR, together with health partners, continues to support access to primary, secondary, and tertiary healthcare services for all other refugees in the camps and urban areas, through the referral system and the cash-for-health programme. UNHCR supported health services are available for free for all vulnerable refugees excluding Palestinians.

Additionally, until late 2014, the Jordanian Ministry of Health provided healthcare free of charge to all Syrian refugees registered with the UNHCR. This caused a large burden on the healthcare system. In response, the GoJ announced a new health access policy in early 2018, reducing the level of access to all refugees outside camps, where refugees were required to pay 80% of the full foreigner's rate at MoH facilities (this represented a two- to five-fold increase in service rates)., The new policy and huge inflation in the cost of health services caused considerable hardship for all refugees living outside camps. This affected the access to healthcare facilities and utilization behaviours among urban refugees. The impact on vulnerable Syrian refugees was the most significant, whereby 69% of households experienced reduced access to healthcare, 9% reported that medicine was unaffordable, 17% of households have reportedly increased their level of debt, and more than 53% of Syrians spent more than 10% of their expenditure on health items. In 2019, the Government of Jordan reinstated subsidized access to public healthcare for Syrian refugees. This was extended in 2020 to all non-Syrian asylum seekers and refugees across Jordan. Accordingly, primary, secondary, and some tertiary healthcare services are available to all registered refugees from all nationalities at the non-insured Jordanian rate at public health centres and Governmental hospitals. The non-insured Jordanian rate is normally considered affordable for non-vulnerable individuals especially at secondary and tertiary levels of care. Based on the latest population census, about 56% of the Kingdom's overall population are insured. The majority of Jordanians have insurance with the public sector, while the remainder have coverage through private, university, or military sources.

At city level, health care services in Sahab Municipality include 1 public hospital, and 1 health centre that are located within the boundaries of Sahab Municipality, Additionally, residents of Sahab Municipality also utilize three other health centres located outside the municipality's boundaries. Sahab Liwa has a low hospital bed to inhabitant ratio at 8 beds per 10,000 citizens, compared to 15 at the governorate level, and 14 at the national level (MoH,2016). In dental care, Sahab Municipality has 14 clinics, whereas Sahab Liwa, which includes the municipality, has a total of 18 clinics. Regarding pharmacies, Sahab Municipality has 14, while Sahab Liwa has 30. Additionally, Sahab Municipality is home to 6 mother and child centres, in contrast to 8 in Sahab Liwa.

The map shown in Fig. 28 displays the spatial distribution the existing hospital, and health centres in Sahab Municipality, there is a clear disparity between neighbourhoods around the ease of access to health centres, where only 18.76% of Sahab Municipality's population is within 15-minute walking distance, and 64.02% within 30-minute walking distance.

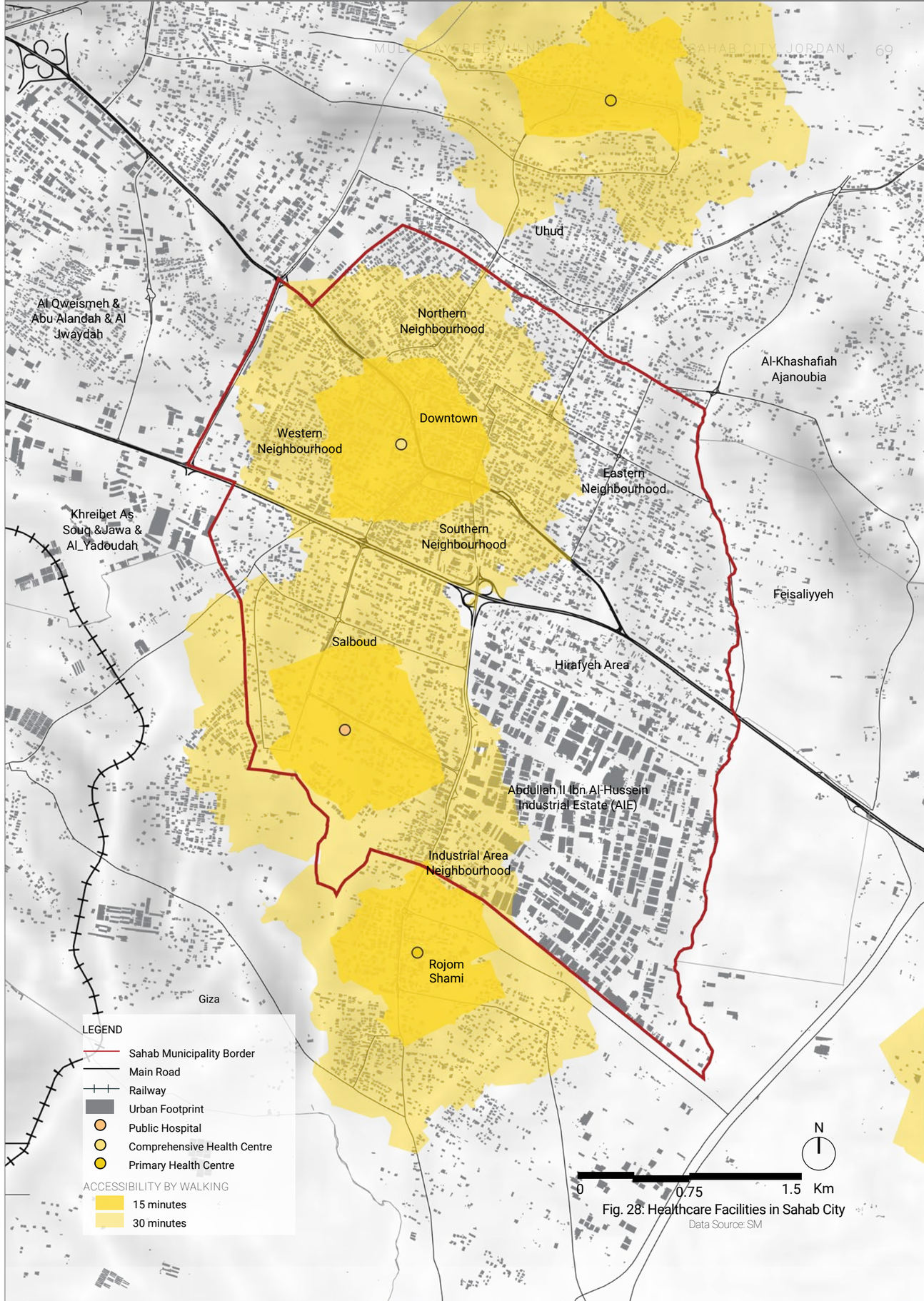


Fig. 28: Healthcare Facilities in Sahab City
Data Source: SM

Access to Education Facilities

Basic education in Jordan consists of 10 years of mandatory schooling for students aged 6 to 16 years. This education is free for students in public schools and is regulated by the Ministry of Education. Overall, the Jordanian educational system consists of 2 years of preschool education, 10 years of compulsory basic education, and 2 years of secondary academic or vocational education. Furthermore, schools in Jordan are mainly categorised into private, public, and military schools.

According to the Sahab Strategic Plan, most education-related indicators align with or exceed those at the governorate and national levels. However, there are concerns with some indicators, including an increase in the number of rented schools by 40%, a rise in the student-to-teacher ratio to 50:1, compared to 20:1 at the governorate level and approximately 15.7:1 at the national level. Regarding higher education, there are no higher education institutions in Sahab Municipality, unlike Amman Governorate, which hosts the University of Jordan, 10 private universities, 7 private community colleges, and four military colleges. The municipality hosts one vocational training center, and several institutions that provide other services for young people. The plan also highlights the importance of developing a specialized technical college or a specialized technical center and youth spaces for creativity and innovation. There is a vocational training center in the municipality.

There is a total of 87 schools in Sahab Liwa, 45 of which are public schools (32 primary and 13 secondary), and 42 private schools, 62 mixed schools, 18 for males, and only 7 for females.

The street network analysis conducted for public schools in Sahab Municipality indicates that 76.8% of the population have access to public schools within a 15-minute walking distance, while 94.7% have access within a 30-minute walking distance. Spatially, educational facilities are concentrated in the districts to the north of the city.

Based on the local standards, the service catchment radius for primary and secondary public schools, which is 3 and 5km respectively, is well served within Sahab Municipality urban areas as shown in Fig. 30.

Fig. 29: Educational Facilities Catchment Area in Sahab City

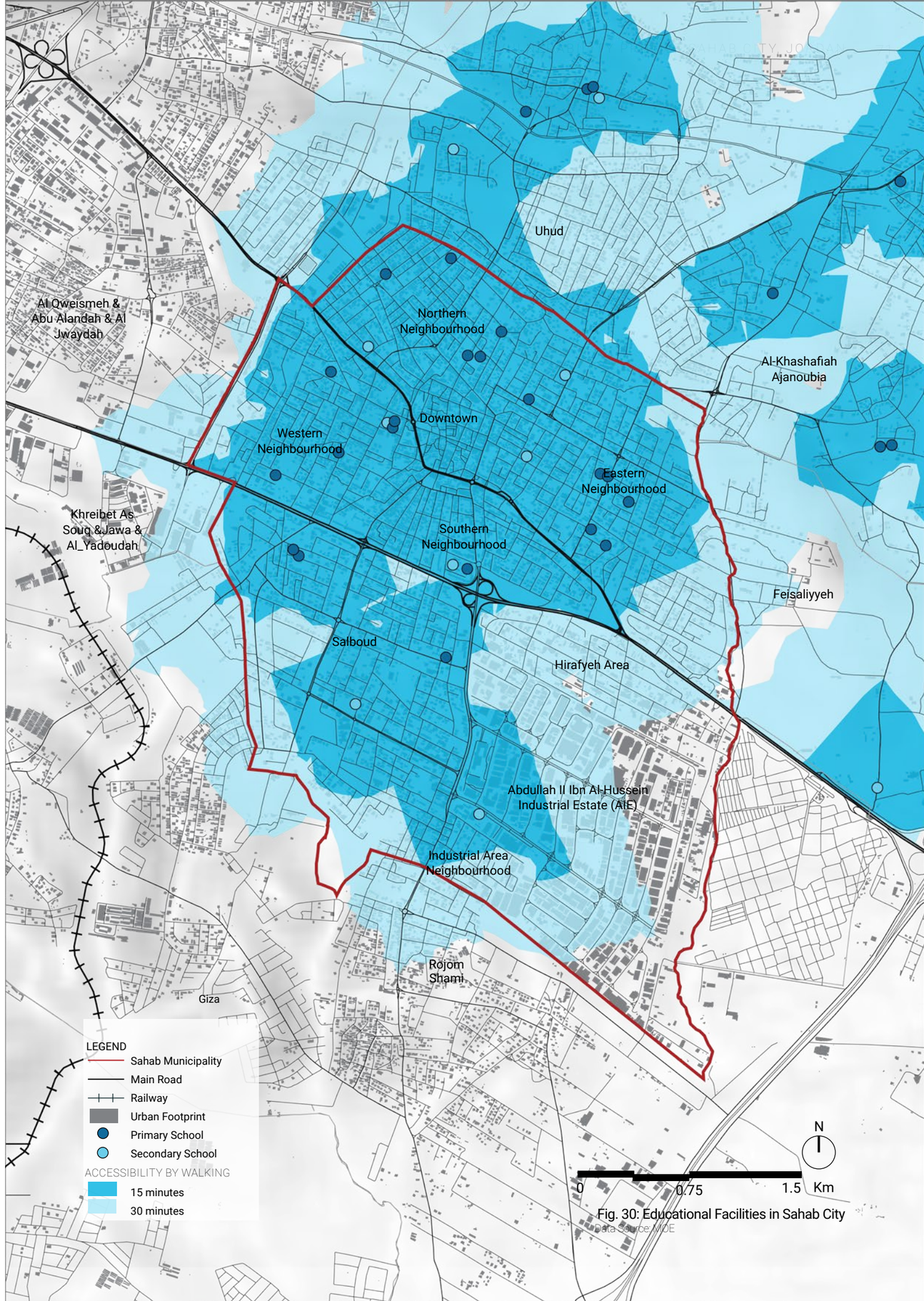


Fig. 30: Educational Facilities in Sahab City

Data Source: MOE

Access to Recreational Facilities

The scarcity of public parks is a prevalent challenge across many Jordanian municipalities and cities, with Sahab Municipality being no exception. The scarcity of green and recreational spaces can be attributed to the municipality's prioritization of industrial, residential, and commercial development over the creation of public amenities. This focus on economic growth has overshadowed the need for open spaces, adversely impacting the quality of life and well-being of Sahab Municipality's residents. Notably, only 0.16% of the total regulated area in Sahab municipality is designated for parks, a figure that is strikingly low given the city's growing population and economic expansion.

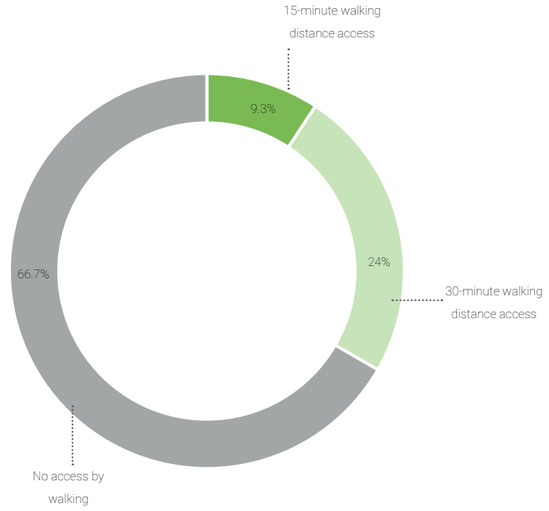
Adding to these challenges, Sahab Municipality has only one park and one stadium, both located in distant areas. As shown on the map in Fig. 31 and through the analysis of SDG indicator 11.7.1 regarding access to public services, only 9.3% of Sahab Municipality's population has access to recreational facilities within a 15-minute walking distance, while 24% can access these spaces within a 30-minute walking distance. The map also highlights empty lands designated for parks, which were excluded from access to recreational facilities analysis due to the absence of provided services. This starkly highlights the spatial imbalance and the critical shortage of recreational facilities. The only one open public park available faces challenges related to maintenance, especially as they serve a large number of people.

The minimal allocation of land for parks and open spaces not only diminishes Sahab municipality's livability but also undermines its climate resilience. The lack of green spaces increases the city's vulnerability to the urban heat island effect, as parks and open spaces play a crucial role in mitigating extreme temperatures. Without adequate parks, Sahab municipality's risk of flooding also rises, since fewer permeable surfaces exist to absorb stormwater, thus exacerbating flooding in built-up areas. Moreover, the absence of green spaces limits the municipality's ability to support biodiversity and provide essential ecosystem services such as air purification and carbon sequestration.

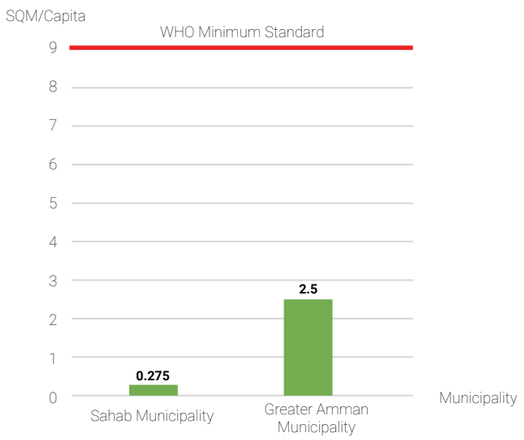
One of the most pressing indicators of this issue is the green area per capita in Sahab Municipality, which is just 0.275 m². In comparison, the green area per capita in Amman is 2.5 m², and international standards recommend a minimum of 9 m² per capita. This significant gap highlights the severity of the issue and the urgent need for intervention.

Beyond environmental concerns, the lack of parks and recreational spaces directly affects the social and psychological well-being of Sahab's residents. Access to green areas is essential for physical activity, relaxation, and community cohesion, all of which are crucial for fostering a healthy and vibrant society. The distance between residential areas and existing parks further alienates residents from these vital resources, depriving them of opportunities for recreation and social interaction.

Addressing these challenges is critical for Sahab's future. The integration of more parks and open spaces into urban development plans is essential to enhance the city's climate resilience, environmental health, and overall quality of life. The data presented here also supports the municipality in reporting on key indicators related to UMF 44 and SDG 11.7.1, helping policymakers, stakeholders, and residents to develop targeted solutions that address the unique needs of different areas within the city.



Access to Recreational Facilities by Walking in Sahab City



Green Area Per Capita in Sahab City (SQM/Capita)

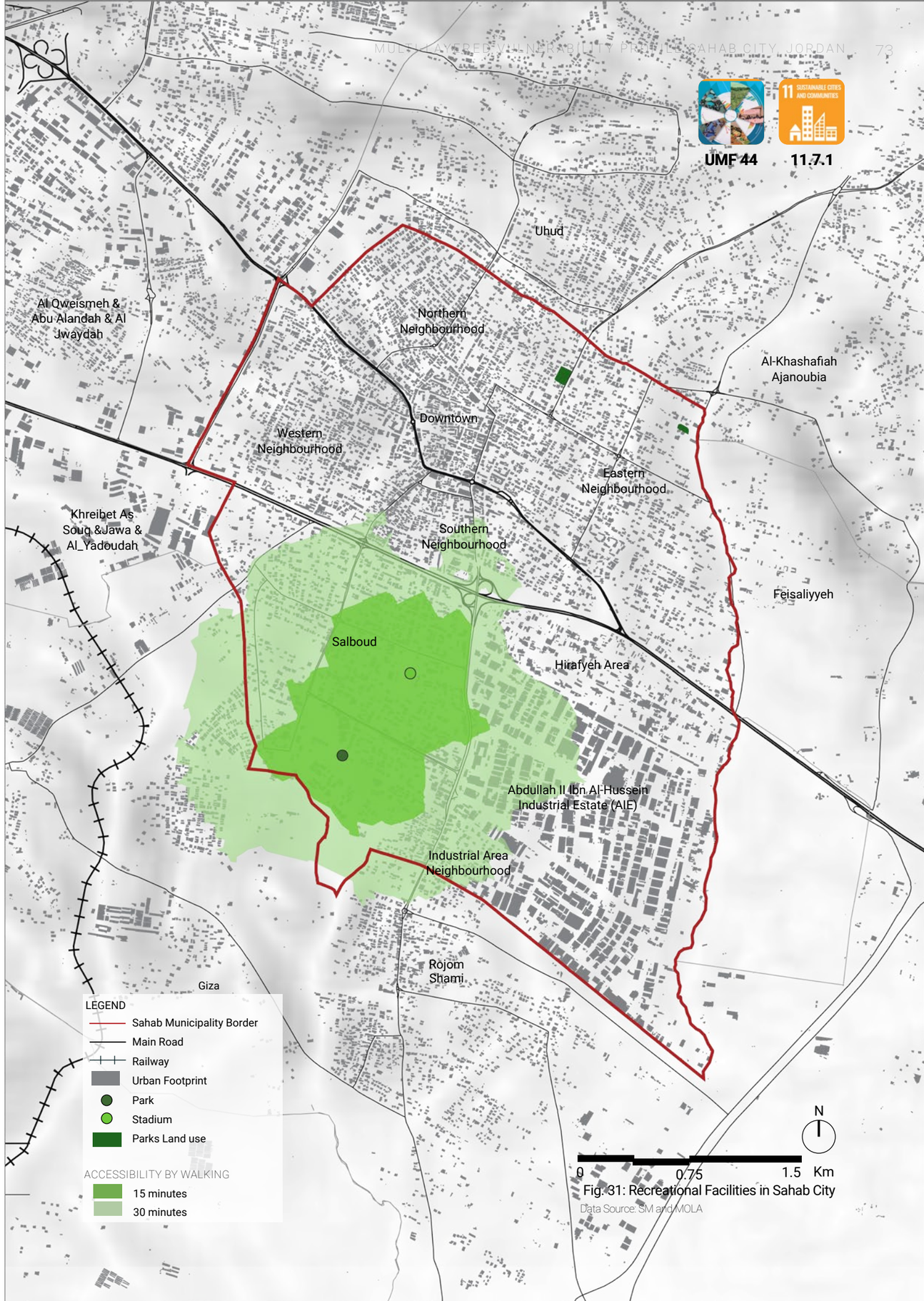


Fig. 31: Recreational Facilities in Sahab City

Data Source: SM and MOLA

Access to Socio-Cultural Facilities

Socio-cultural activities in cities like Sahab play a crucial role in building community cohesion, fostering local knowledge, and promoting collective action for climate resilience. These activities can enhance public awareness of climate risks, support community-based adaptation strategies, and strengthen social networks, which are vital for emergency response and recovering from climate-induced events like floods or heatwaves.

The GIS analysis shows significant disparities in access to socio-cultural centres across Sahab Municipality. It highlights that only 21.35% of the population is within a 15-minute walking distance of these facilities, indicating limited convenience for the majority of residents. This issue is particularly acute in central and peripheral areas, where these centres are sparse. The analysis suggests that many residents, especially vulnerable groups such as the elderly and persons with disabilities, are forced to travel longer distances to reach essential services. Additionally, the analysis reveals that 59.61% of the population is within a 30-minute walking distance, leaving nearly 40% of residents relying on private transportation.

The GIS analysis also emphasizes the risk of overburdening the existing socio-cultural facilities. Since many residents rely on a limited number of centres, these facilities may face overcrowding, reducing the quality of services and stretching resources thin as the population grows.

Finally, the analysis points to a broader concern of social inequity, with nearly 40% of residents living beyond the 30-minute walking zone for socio-cultural services. This uneven distribution calls for focused urban planning efforts to expand service reach, enhance public transportation, and create a more equitable and inclusive urban environment across Sahab Municipality.

Charitable associations, which number 37 in Sahab Liwa, provide crucial support to address these socio-economic challenges. These organizations deliver essential services such as aid for people with special needs, poverty alleviation, and support for the elderly and disabled. They also play a significant role in empowering women and fostering social and cultural activities. Given the unequal distribution of socio-cultural centres, these associations are pivotal in filling service gaps and supporting the broader community.

These associations face several significant challenges. Firstly, many rely heavily on volunteer work, which can be unreliable and limits the associations' ability to sustain long-term services. Additionally, there is a lack of clear strategic planning, meaning that many associations operate without defined action plans or goals, which reduces their effectiveness in addressing the root causes of socio-economic problems. Another challenge is the inefficient use of available grants. Many associations struggle to capitalize on available funding to establish meaningful projects that can address key issues such as poverty and unemployment. Additionally, some associations are hampered by a lack of proper facilities and resources, which limits their capacity to implement their programs effectively[20].

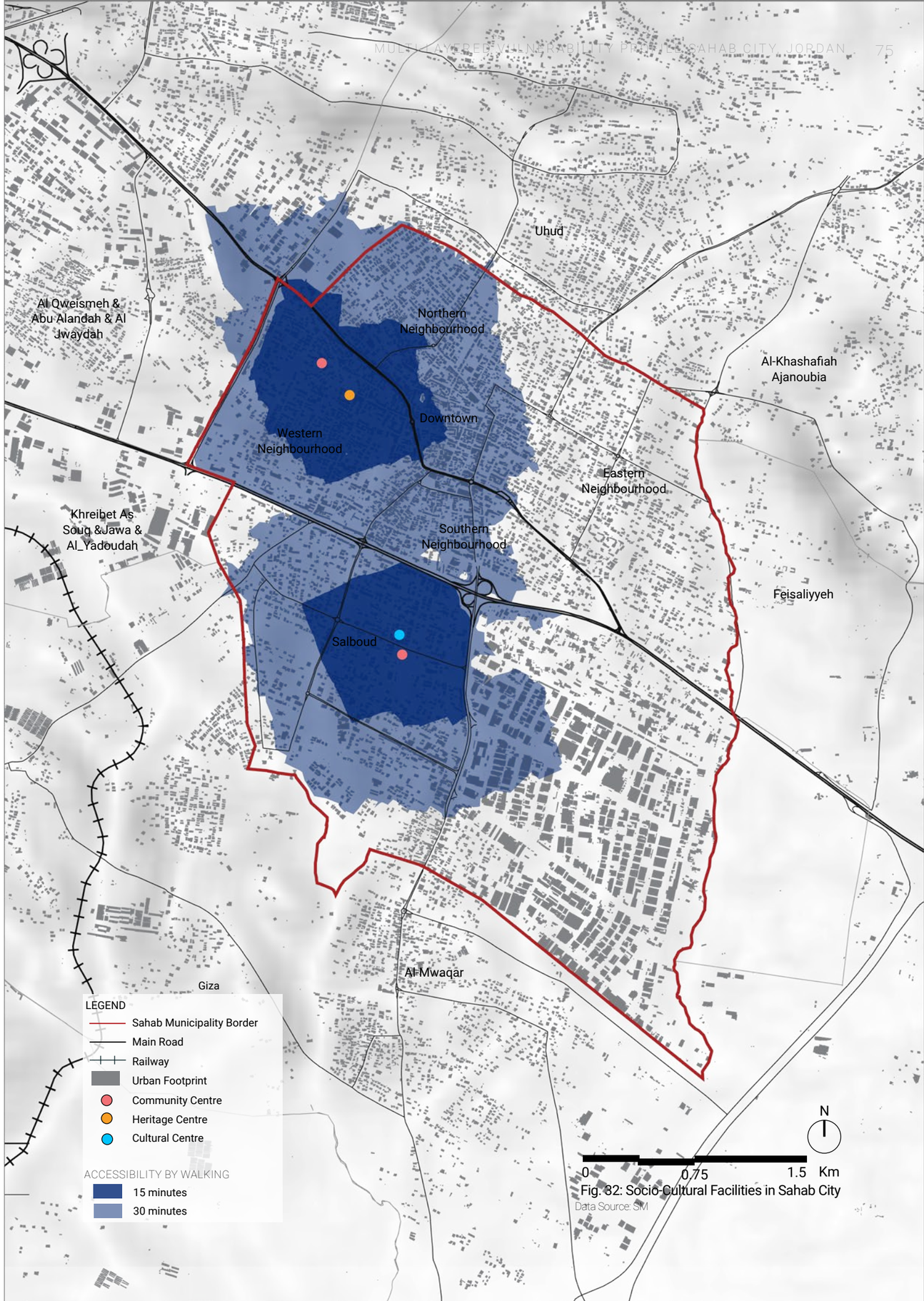


Fig. 82: Socio-Cultural Facilities in Sahab City

Data Source: SM

Indicator 6: Environmental Quality

The environmental quality of Sahab Municipality is under significant pressure from various industrial and urban activities, which are clearly mapped out across key locations. These include major industrial hubs like the King Abdullah II Industrial Estate and Al Tajamouat City (highlighted in purple in Fig. 33), extensive stone cutting workshops (marked in yellow), truck parking areas (shown in red), and the heavy traffic main road (marked in blue) that runs through the municipality. Each of these zones contributes significantly to the deterioration of Sahab Municipality's environmental quality, impacting air, water, and soil, as well as the health and well-being of its residents. A closer look at sub-indicators—air quality, water quality, soil quality, and noise pollution—reveals a concerning trend. Rapid industrialization, poor waste management, and unregulated activities are negatively affecting the health of the environment and the local population.

Soil pollution is a particularly pressing issue, primarily driven by the discharge of industrial effluents, urban expansion, stone cutting activities, and poor management of truck parking areas. Industrial zones like the King Abdullah II Industrial Estate release untreated or partially treated wastewater containing hazardous substances, including heavy metals, nitrates, ammonia, and organic pollutants. These pollutants seep into the soil, reducing its fertility and accumulating over time, exacerbated by high levels of Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Chemical Oxygen Demand (COD), and Biological Oxygen Demand (BOD). The rapid urbanization of Sahab has also led to soil sealing, where impermeable surfaces prevent the natural absorption of water and nutrients, further degrading soil quality. Additionally, urban construction introduces pollutants like debris, oils, and chemicals into the soil. The stone cutting workshops produce large amounts of gypsum-like residue, known locally as "Kamkha," which mixes with wastewater and spreads over large areas, creating a chalk-like crust that alters the soil's chemical composition, reduces its fertility, and obstructs water infiltration. Furthermore, the improper disposal of motor oils and petroleum products from truck parking areas leads to hydrocarbon contamination, further degrading soil quality and impacting its ability to support agricultural activities and plant life.

These soil pollution hazards also have serious implications for water quality in Sahab Municipality. Industrial effluents, urban runoff, and contaminants from stone cutting and truck parking areas may infiltrate groundwater or can be carried into surface water bodies, leading to the degradation of water quality. This pollution poses a threat to both drinking water supplies and agricultural irrigation, increasing risks to public health and the local ecosystem. Without effective soil and water management strategies, these environmental challenges will continue to compromise the quality of life for Sahab Municipality's residents.

In addition to soil and water pollution, noise pollution is a growing concern in Sahab, especially near industrial cities, stone cutting workshops, and along the main road. The constant operation of heavy machinery in factories and workshops generates significant noise, which affects both workers and nearby communities. Traffic congestion caused by trucks along the main road and in parking areas further contributes to high noise levels. Prolonged exposure to this noise can lead to serious health problems, including hearing impairment, stress, and sleep disturbances for both residents and workers. Beyond health impacts, the persistent noise pollution diminishes the quality of life in Sahab Municipality and makes the area less attractive for future development or residential expansion.

A key measure for mitigating the environmental impacts of industrial activities in Sahab Municipality is the establishment of buffer and transitional zones. These zones serve as protective barriers between industrial areas and residential or environmentally sensitive regions, reducing the harmful effects of pollutants on nearby communities and ecosystems. For example, a 200-meter buffer zone is mandated around stone cutting workshops and other medium industrial sites, similar to the green buffer suggested on the map, to limit the spread of air pollution, water contamination, noise, and dust to surrounding human settlements. However, in many cases, this regulation is not enforced, with industrial facilities and workshops often operating much closer to residential areas than permitted. The failure to adhere to buffer zone requirements significantly exacerbates environmental degradation, exposing residents to harmful pollutants and further deteriorating air, water, and soil quality. Enforcing these buffer and transitional zones is essential for safeguarding public health, improving environmental conditions, and ensuring sustainable urban growth in Sahab Municipality.

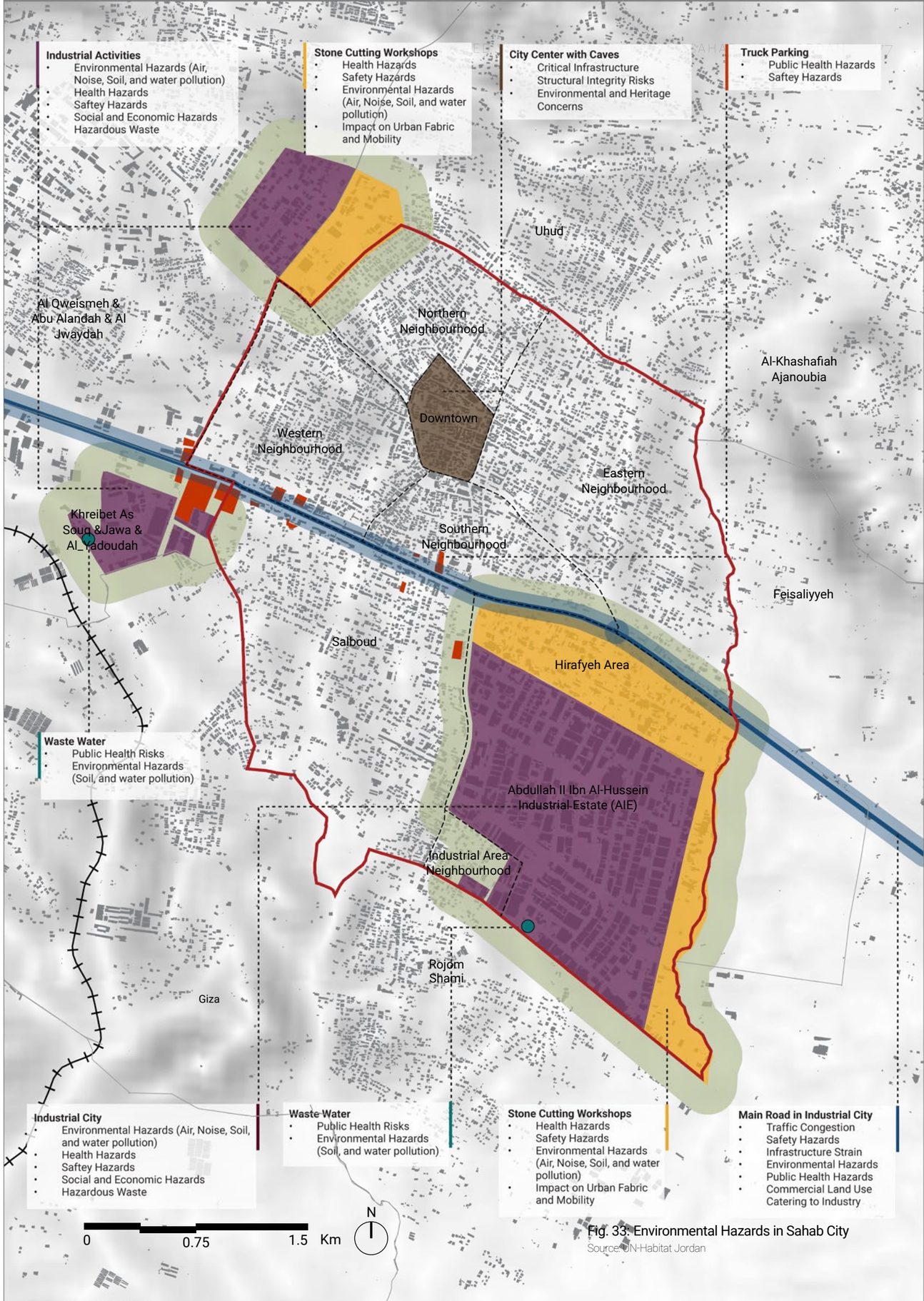


Fig. 33: Environmental Hazards in Sahab City
Source: UN-Habitat Jordan

Air Quality

The air quality in Sahab Municipality presents a multifaceted challenge that stems from a combination of industrial activities, urban traffic, stone cutting operations, and natural sources like desert dust. According to the 2023 data from electronic monitoring stations in King Abdullah II Industrial City (Sahab)[21], NO_2 level stands at 11.70 ppb, which falls within the Jordanian Standard (50 ppb) but exceeds the more stringent WHO guideline (5 ppb) by more than two times. This highlights a potential health risk, particularly for vulnerable populations such as children, the elderly, and individuals with respiratory conditions. In addition to NO_2, the monitoring of particulate matter (PM2.5) reveals further concerns about air quality in Sahab Municipality. The PM2.5 level for 2023 is 35.00 µg/m³, which is below the Jordanian Standard of 40 µg/m³ but significantly exceeds the WHO guideline of 5 µg/m³ by seven times. Meanwhile, the PM10 level for 2022 is 48.80 µg/m³ , which is below the Jordanian Standard of 70 µg/m³ but exceeds the WHO guideline of 15 µg/m³by around three times.

Pollutant	Sahab 2022 Values	Sahab 2023 Values	JS 1140/2006	WHO Standard
PM10	48.80 µg/m³	-	70 µg/m³	15 µg/m³
PM2.5	30.1 µg/m³	35.00 µg/m³	40 µg/m³	5 µg/m³
NO2	17.5 ppb	11.70 ppb	50 ppb	5 ppb

Comparison of Air Quality Levels in Sahab City and Annual Standards

As part of the MVA air quality for Sahab Municipality and its surrounding areas was assessed, offering a comprehensive view of pollution levels. By analysing a total of 166 daily satellite images for 2023, while excluding cloudy days and noise, the assessment provided valuable insights into the spatial distribution of pollutants, and in specific NO_2 and Aerosols. The maps of nitrogen dioxide (NO_2) and aerosol concentrations, measured in mol/m², illustrate how air pollution is distributed across the municipality and adjacent areas to identify vulnerability hotspots. These maps helped in identifying areas most vulnerable to air pollution and will be used to inform targeted interventions for air quality improvement.

The regional NO_2 concentration map Fig. 35 shows a spatial gradient of NO_2 concentrations across Amman Governorate and adjacent areas. This map indicates that areas closer to the urban core of Amman, including Sahab Municipality, experience higher concentrations of NO_2. Being comprehensive, Sahab Municipality, as part of the regional map, is located in an area characterized by high to very high NO_2 levels, primarily due to its proximity to industrial activities and major road networks. This map also shows that when one moves away from these hotspots toward more rural and less industrialized areas the NO_2 concentration decreases.

When zooming in on NO_2 concentrations within Sahab Municipality, the map Fig. 34 shows that all of Sahab Municipality falls above the medium level for NO_2 concentrations, with varying shades of yellow and orange indicating different intensities of NO_2 pollution. The Downtown, Northern, and Eastern Neighbourhoods are marked by darker orange zones, representing higher NO_2 concentrations. These areas are impacted by a combination of industrial activity, plastic recycling and processing activities, traffic congestion, and dense population, contributing to elevated levels of NO_2.

In contrast, while some regions such as the Southern Neighbourhood and parts of the Industrial City show lighter shades, indicating somehow lower NO_2 concentrations, they still fall above the medium threshold. Interestingly, despite being a major source of emissions, the Industrial City does not appear in the darkest zones on the map. This could be due to factors such as effective pollution control measures or wind patterns that disperse NO_2 emissions, preventing local accumulation and pushing pollutants toward the northern and central areas of Sahab Municipality. Specifically, during the winter, south-eastern winds may push pollutants away from the Industrial City toward other areas, while in the summer, north-western winds could similarly disperse emissions, directing them toward the northern and central parts of Sahab Municipality.

The elevated NO_2 levels in Sahab Municipality pose a significant health risk to its residents. Long-term exposure to NO_2, primarily from vehicle emissions and industrial processes, can lead to respiratory and cardiovascular issues, such as airway inflammation and asthma. This may require targeted health interventions. Research also shows a link between long-term exposure to nitrogen dioxide (NO_2) and increased mortality [22].

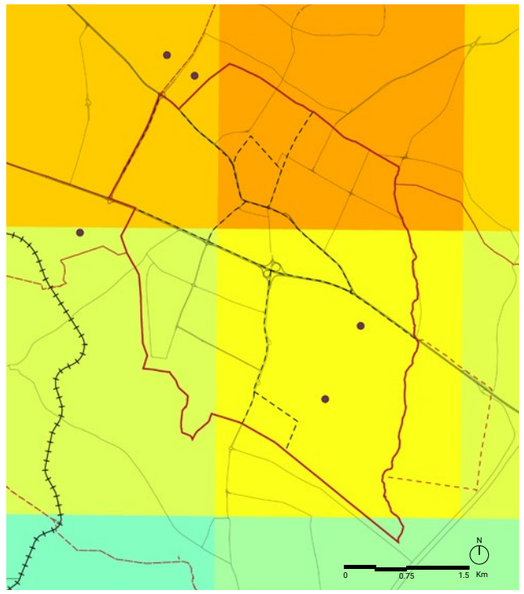


Fig. 34: NO_2 Concentrations in Sahab City

LEGEND
- Sahab Municipality
- Neighbourhood Boundary
- Main Road
- Railway
- Industrial Activities

VALUE
High
Low

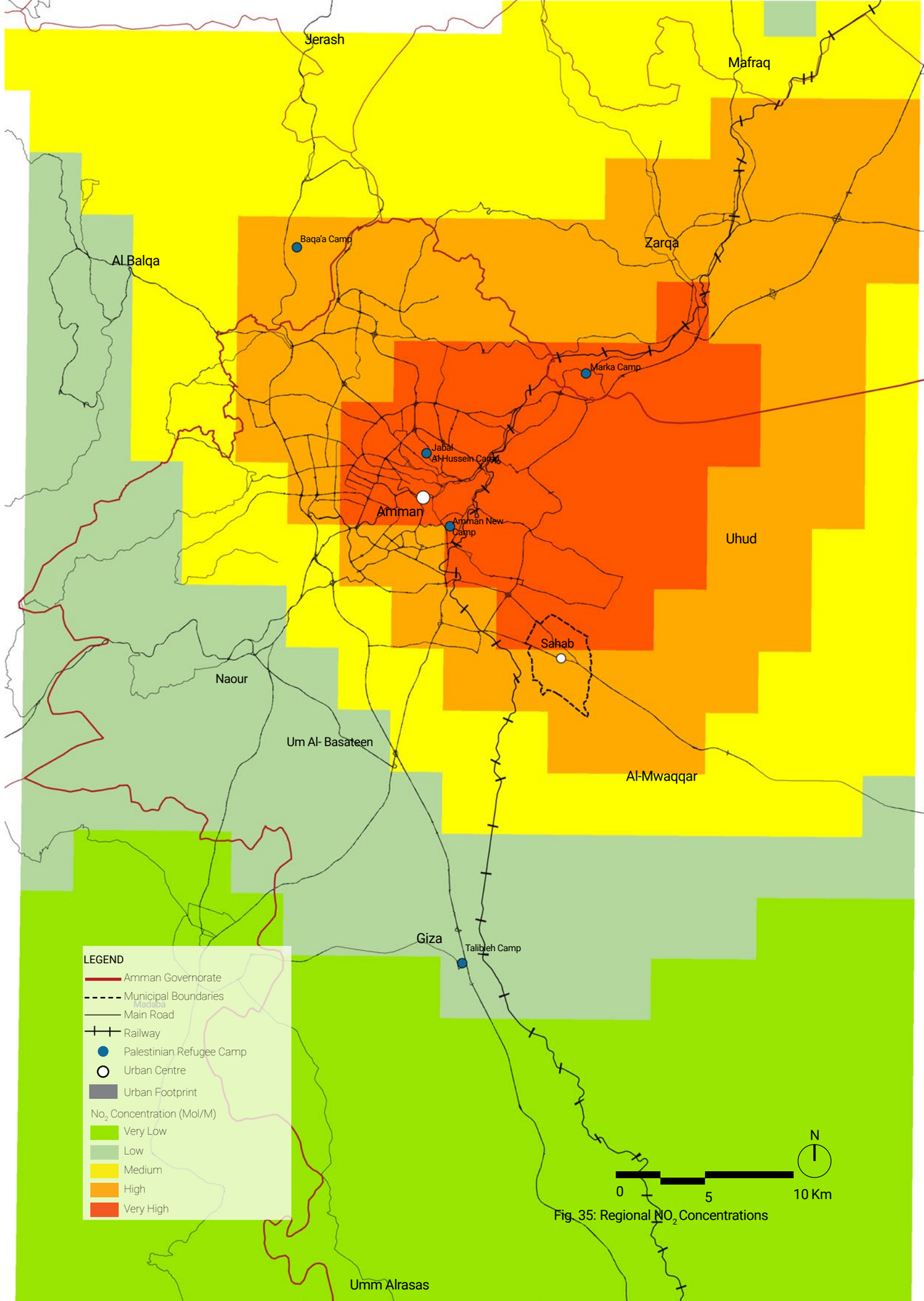


Fig. 35: Regional NO_2 Concentrations

The Aerosol Index (AI) maps provide valuable insights into the distribution of fine particulate matter (PM), such as dust and other suspended particles, across Amman Governorate and Sahab Municipality. On the regional level, the darker shades of red on the map Fig. 37 indicate locations where aerosol concentrations are the highest, primarily due to stone cutting, industrial emissions, and traffic-related dust. These areas face worse air quality because of the combined effect of human activities and natural dust from the surrounding desert regions. On the other hand, areas shaded in blue represent lower aerosol index, and areas shaded in yellow suggests moderate aerosoles levels. Meanwhile, the AI map at Sahab City level shown in Fig. 36 provides a city scale view of AI, with a focus on the distribution of aerosols across the different neighbourhoods. The darker shades indicate higher concentrations and mainly can be seen in the Downtown, western, northern, southern, and salboud neighbourhoods.

The impact of aerosols, including PM2.5 and PM10, on public health is a major concern, especially in urban areas. areas. Studies have found that long term exposure to these particles, largely generated by industrial activities, stone cutting, and traffic-related emissions can cause a range of health problems, such as lung damage, lung cancer, and heart issues. These fine particulate matters exacerbates heart disease and increases the risk of strokes and heart attacks[32]. The combination of industrial emissions, traffic pollution, desert dust, and lack of green areas in Sahab Municipality not only degrades air quality but also poses long-term health risks, particularly for vulnerable populations such as children, the elderly, and those with pre-existing conditions, highlighting the urgent need for targeted air quality management and pollution reduction measures.

The following table provides a comparison between aerosols and nitrogen dioxide (NO_2), focusing on their characteristics and impacts. While aerosols contribute to respiratory and cardiovascular issues and can alter climate conditions, NO_2 is closely linked to respiratory inflammation and chronic health problems. Their shared sources, including vehicle emissions and industrial activities, highlight the need for effective pollution control measures to mitigate their impact on human health and the environment. Addressing these pollutants is essential for improving air quality and safeguarding public health.

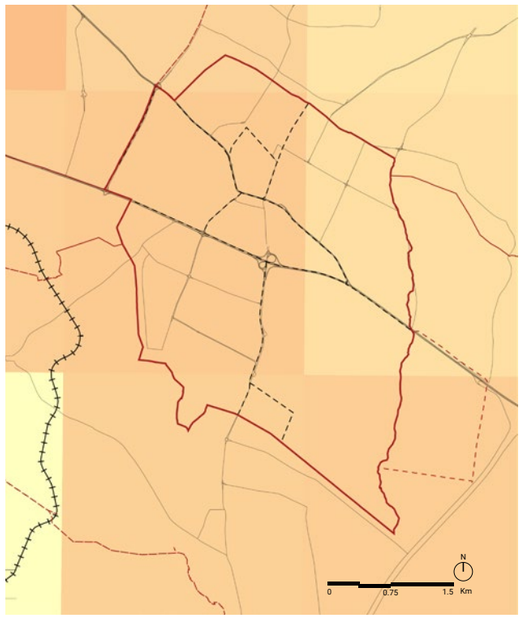


Fig. 36: Aerosol Index in Sahab City

Aspect	Aerosols	Nitrogen Dioxide (NO_2)
Nature	Solid or liquid particles suspended in the air (PM2.5, PM10).	A gaseous pollutant formed during combustion.
Size and Penetration	PM2.5 can reach deep into the lungs and bloodstream; PM10 affects upper airways.	Primarily affects the upper airways and lungs through inhalation
Sources	Combustion processes, vehicle emissions, industrial activities, construction, stone-cutting workshop, dust storms.	Vehicle emissions, power plants, industrial combustion processes.
Short-term Health Impacts	Worsens asthma and respiratory diseases, eye and throat irritation.	Causes airway inflammation, exacerbates asthma, increases respiratory symptoms.
Long-term Health Impacts	Linked to cardiovascular diseases, lung cancer, and premature mortality.	Associated with the development of asthma, chronic respiratory conditions, and increased mortality.
Vulnerable Populations	Children, elderly, people with heart or lung conditions, outdoor workers	Children, elderly, people with asthma or other respiratory conditions
Environmental Role	Reduces visibility (haze), affects climate by reflecting/absorbing sunlight.	Contributes to the formation of ground-level ozone and particulate matter.

Comparison between Aerosols and Nitrogen Dioxide (NO_2) Impact [23 24 25 26 27 28 29 30 31]

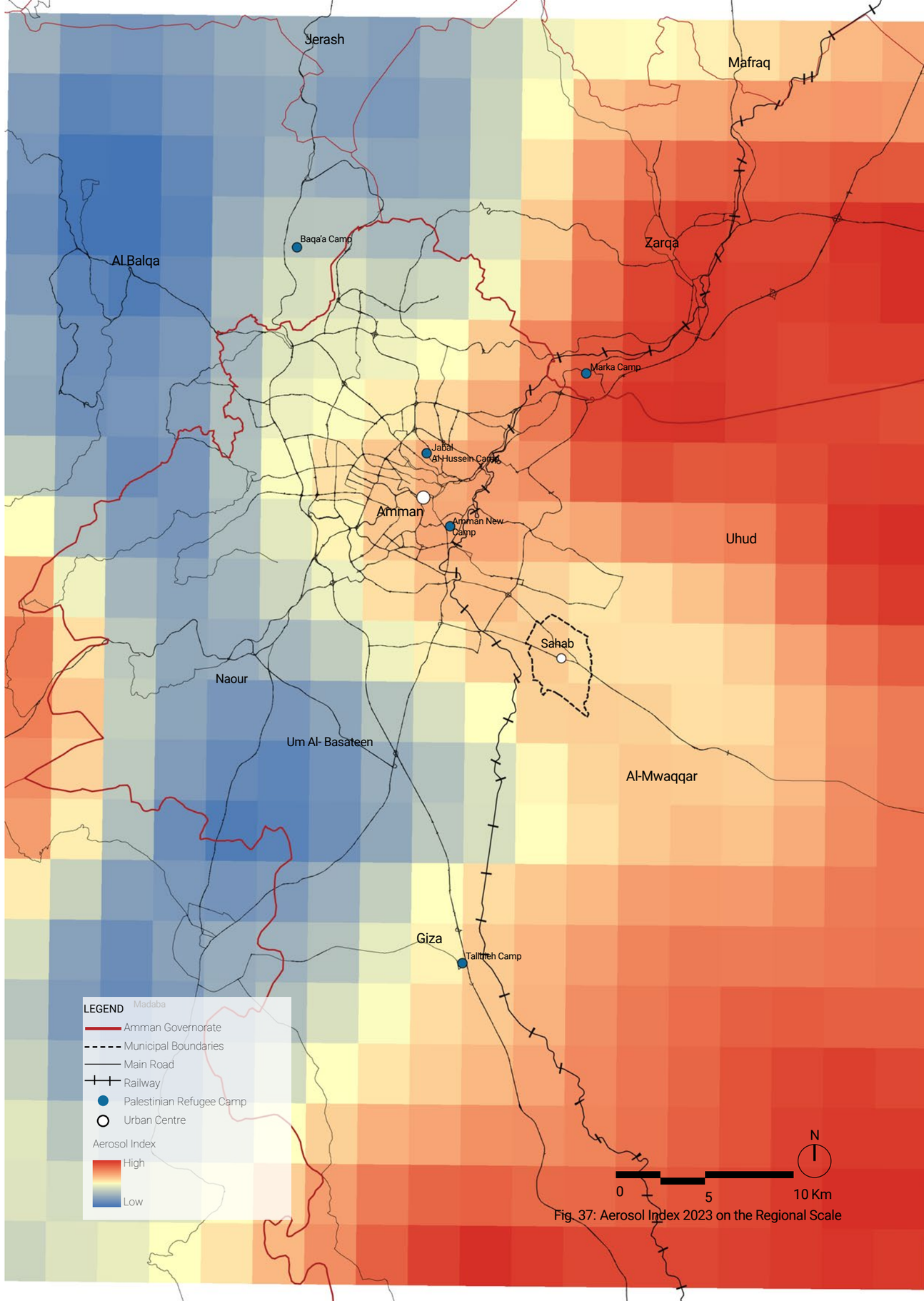


Fig. 37: Aerosol Index 2023 on the Regional Scale

Indicator 7: Urban Heat Island Effect

The Urban Heat Island (UHI) effect in Sahab Municipality is a direct result of the city's rapid expansion and industrialization, which have reshaped the local environment. Traditionally, the UHI effect occurs when urban areas are significantly warmer than their rural counterparts due to human activities, and Sahab Municipality is a prime example of this phenomenon.

Over the years, Sahab Municipality has transitioned from a small town to a highly urbanized industrial hub, where factories, residential buildings, and commercial zones dominate the landscape. This growth has led to a dense concentration of heat-absorbing materials such as asphalt, concrete, and steel, which are prevalent in both buildings and infrastructure. These materials absorb heat during the day and release it slowly at night, preventing the city from cooling down effectively. As a result, the UHI effect in Sahab becomes more pronounced, with consistently higher temperatures compared to surrounding rural areas, which are further exacerbated during heatwaves.

In a typical Urban Heat Island (UHI) scenario, the densest urban and industrial areas are the hottest. However, in Sahab Municipality, aerosols from industrial activities scatter sunlight, leading to cooler land surface temperatures (LST) in some zones. While land surface temperature (LST) maps may show these areas as cooler, they still experience poor air quality due to high levels of airborne pollutants. Essentially, these regions trade heat for pollution, which poses a more dangerous and long-term health risk for residents and labour workers [33].

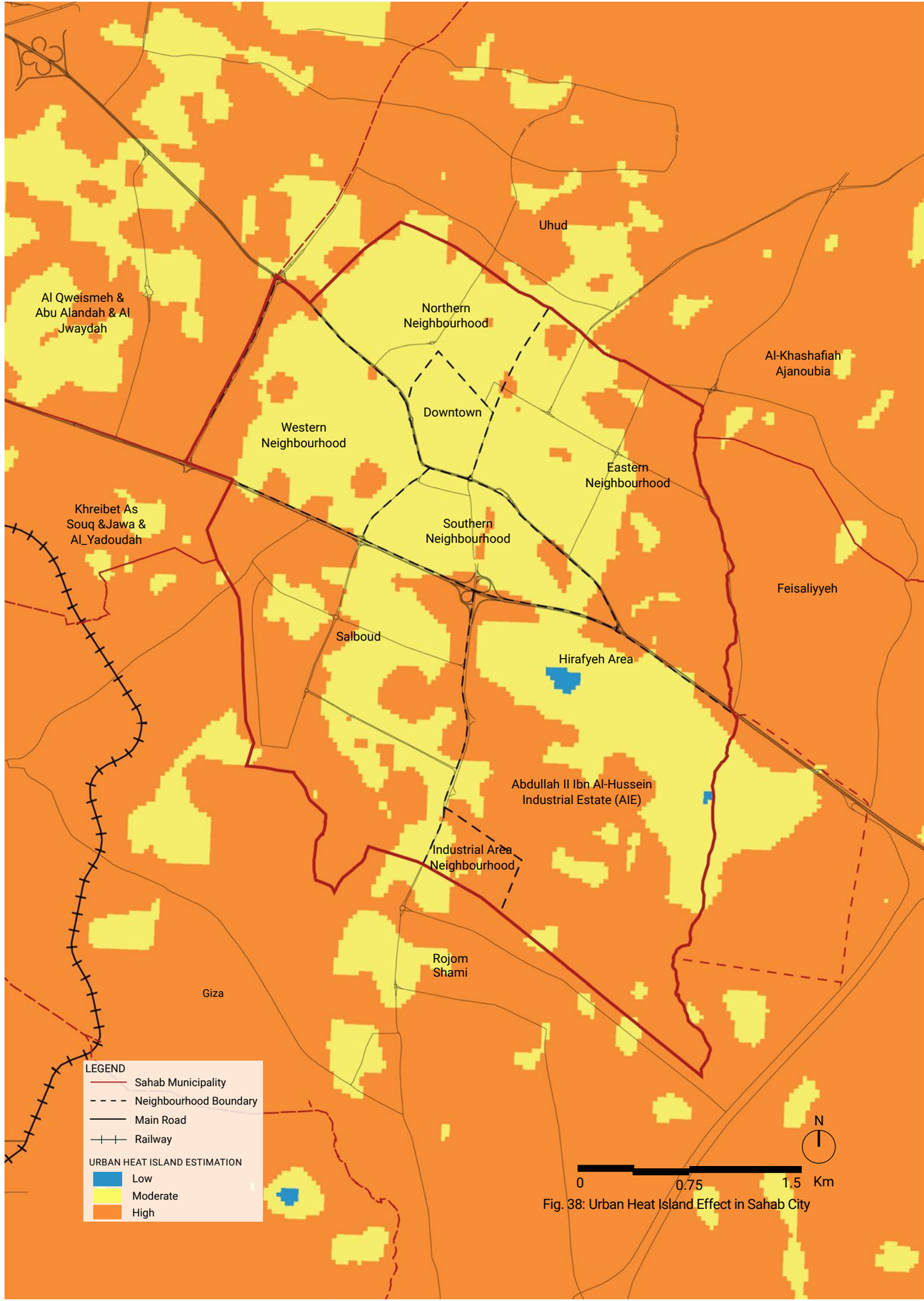


Fig. 38: Urban Heat Island Effect in Sahab City

Urban Current Vulnerabilities Hotspots

To better understand the urban vulnerability hotspots we have conducted a GIS analysis that incorporates several layers with equal weighting to assess urban vulnerability comprehensively. The analysis combined several critical indicators that were studied earlier in the urban dimension, such as population density, building density, access to infrastructure services, access to public facilities, access to transportation, air pollution, the urban heat island effect, the efficiency of infrastructure networks, and environmental hazards. By analysing these factors together we were able to highlight areas with higher or lower levels of vulnerability, giving us a clearer understanding of where the municipality faces its greatest challenges. The study provides a holistic view of how various socio-economic, environmental, and infrastructural elements contribute to the vulnerability of different urban areas. This method supports in better understanding the greatest challenges of the municipality and in prioritizing areas for planning and action.

Accordingly below are the key highlights of the map:

- **High Vulnerability Areas:** The Downtown, Southern Neighbourhood, Industrial Area Neighbourhood, and parts of the Western, Eastern, Southern Neighbourhoods, as well as the main road between Salboud and the industrial estate, have been identified as areas of high vulnerability due to a combination of high population density, rapid urbanization, and inadequate infrastructure. These areas also suffer from air pollution and the urban heat island (UHI) effect, exacerbating environmental stress and reducing quality of life for residents. Furthermore, these districts experience significant gaps in essential services such as healthcare, transportation, and public facilities, with limited green spaces contributing to poor air quality and reduced resilience to climate impacts. These deficiencies not only heighten the city's environmental vulnerabilities but also magnify socio-economic challenges, such as the lack of access to basic services and green areas disproportionately impact vulnerable groups, such as low-income families, migrant workers, and the elderly.

  Moreover, the industrial nature of these areas, coupled with rapid infrastructure growth, often leads to unsustainable land use and limited investment in resilience-building measures, such as stormwater management and heat mitigation. The cumulative pressure from these environmental, infrastructural, and social factors makes these areas especially susceptible to the compounding effects of climate change, including flooding, heat stress, and poor public health outcomes.

- **Medium Vulnerability Areas:** Parts of the Western, Eastern, and Southern Neighbourhoods, along with most of Salboud, fall into the medium vulnerability category. While these areas may have better access to services or experience less population pressure compared to the high vulnerability zones, they still face moderate challenges due to their proximity to industrial zones, which negatively impact environmental quality. These industrial zones contribute to air and water pollution, the urban heat island (UHI) effect, and increased traffic congestion, all of which undermine the overall environmental resilience of these areas. Additionally, the proximity to industrial activities can lead to increased health risks for residents, particularly in terms of respiratory illnesses, due to poor air quality. While there may be improvements in infrastructure and access to some essential services, these areas still face vulnerabilities in terms of environmental degradation and socio-economic disparities that can limit their ability to withstand climate-related shocks. Strengthening regulations on industrial emissions, enhancing green infrastructure, and improving access to public health services are essential strategies for reducing these vulnerabilities and improving resilience.

- **Lower Vulnerability Areas:** The Abdullah II Ibn Al-Hussein Industrial Estate (AIE), Hirafyeh Area, and the Industrial Area Neighbourhood exhibit lower levels of vulnerability due to their predominantly industrial character, which results in fewer residential pressures and lower population density. This contributes to better access to services and infrastructure in comparison to more densely populated areas. However, these zones are still considered environmental hazard zones, as the concentration of industrial activities creates significant risks for air and water pollution, hazardous waste, and potential accidents that could impact the surrounding communities. While these areas may not experience the same degree of socio-economic vulnerability, they require careful management to address the spillover effects of industrial operations, particularly in terms of environmental health risks for neighboring residential and agricultural areas. Mitigating the impacts of industrial pollution through better environmental regulations, regular monitoring, and safety measures is essential to reduce the broader vulnerabilities posed by industrial activity and protect surrounding communities from the adverse consequences of industrialization.

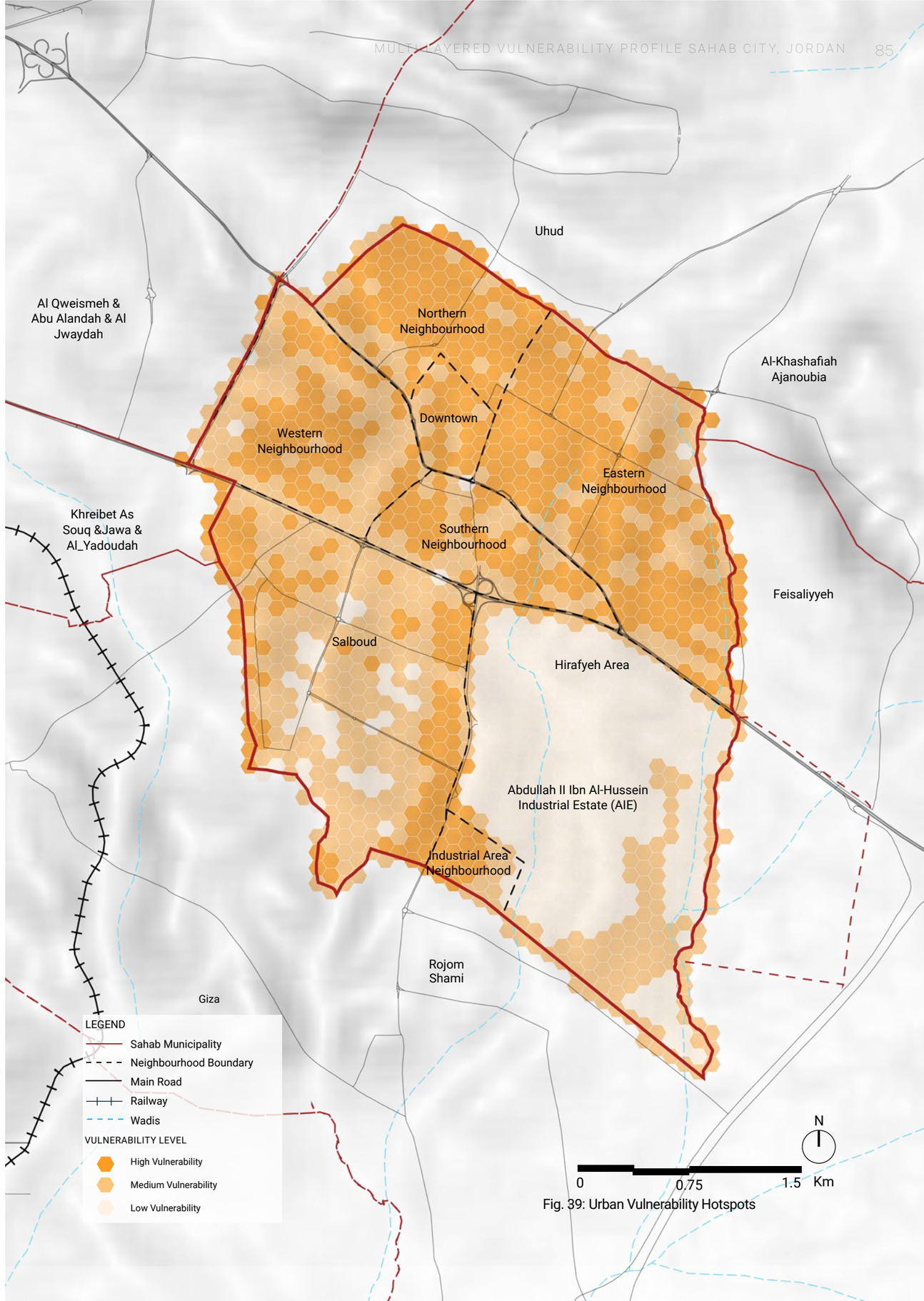
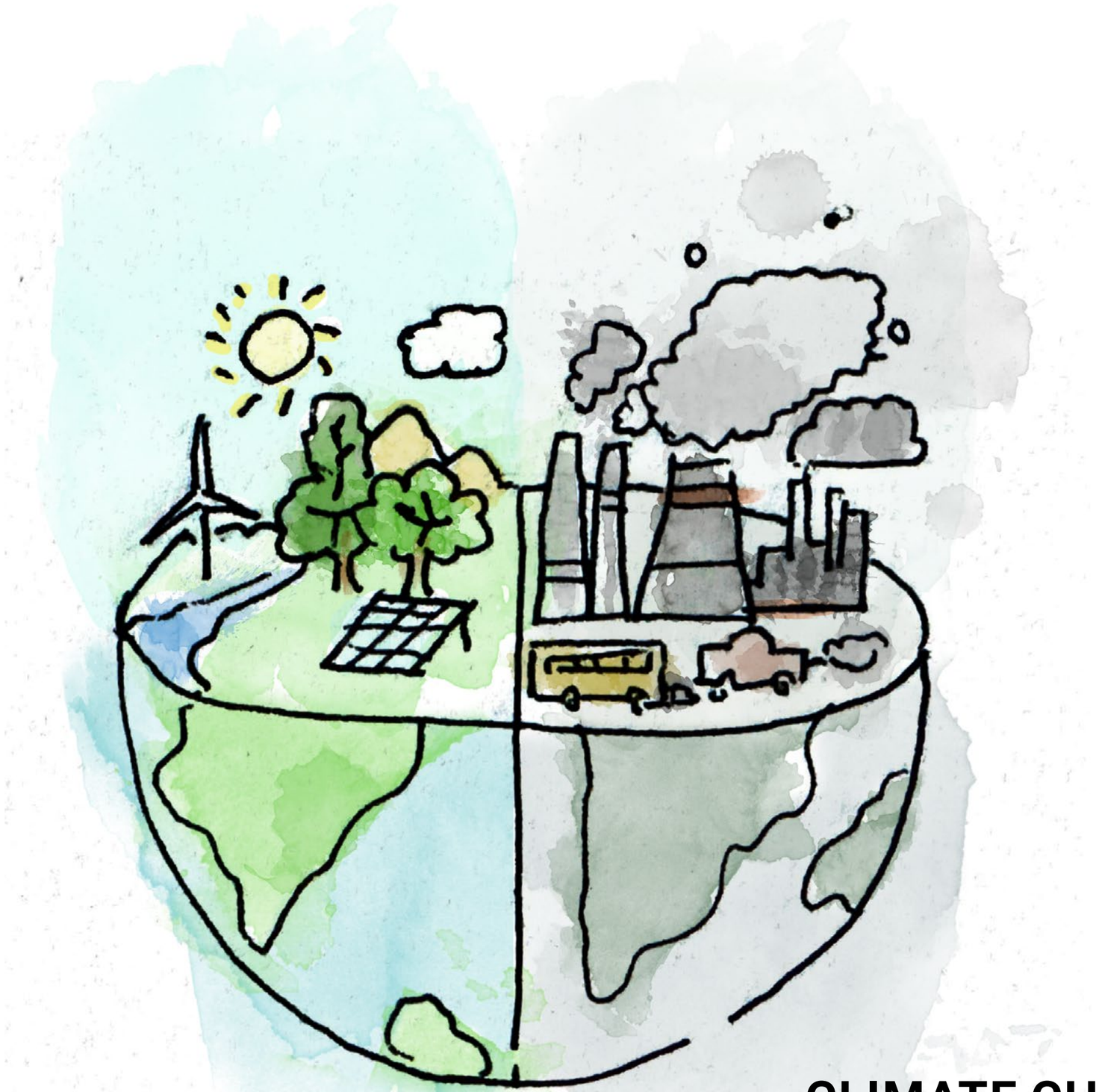


Fig. 39: Urban Vulnerability Hotspots



05

CLIMATE CHANGE DIMENSION

Introduction to Climate Change Dimension

Jordan is highly vulnerable to the effects of climate change due to its location in a semi-arid region with limited water resources. The country already faces significant environmental challenges, including water scarcity, droughts, and desertification. Climate change exacerbates these existing stresses, increasing the frequency and intensity of extreme weather events such as heatwaves, droughts, floods, and hydrometeorological hazards. As global temperatures rise, Jordan's already fragile ecosystems, agricultural productivity, and water availability are under growing pressure. The impacts are not only environmental, but also social and economic, affecting livelihoods, food security, and public health.

Jordan's National Climate Change Policy (2022-2050) outlines the country's strategy for adapting to these growing challenges, emphasizing the need for resilient infrastructure, improved water management, and climate-responsive urban planning. The policy highlights Jordan's focus on reducing the risks associated with climate change through adaptation strategies that address key vulnerabilities. These include enhancing early warning systems, improving drainage infrastructure, and promoting sustainable agricultural practices to mitigate the effects of drought and temperature rise. Furthermore, the policy stresses the importance of building climate resilience at the local level, with a focus on vulnerable communities and regions like Sahab City, which faces multiple climate-related risks.

In line with these national priorities and growing challenges, assessing climate-related vulnerabilities at the city level is crucial for planning adaptive and mitigation strategies.

In Sahab City, which faces a combination of rapid urbanization and climatic stresses, the Climate Change Dimension of this Multi-layered Vulnerability Assessment (MVA) focuses on key indicators such as flooding, drought, and extreme heat. This assessment provides a clearer understanding of how climate change is impacting the city's population, infrastructure, and resources. These insights will help guide targeted interventions to enhance the city's resilience to future climate challenges.

Indicator 1: Flooding
Flooding was selected as a key indicator for the climate change dimension in the MVA of Sahab City due to its far-reaching and unpredictable impacts. Floods can overwhelm extensive areas, causing loss of life and injury, displacing communities, and severely damaging property, infrastructure, and urban services. In a city like Sahab, where certain areas may be more vulnerable to flooding, the risk extends to the disruption of local economies and damage to vital agricultural land, which is a critical source of livelihood for many residents. Assessing flooding as part of the vulnerability analysis is essential not only to understand its immediate impacts but also to plan for future urban infrastructure that can mitigate these risks.

Indicator 2: Drought
Drought was selected as a crucial indicator due to its profound and long-term impacts on water resources, agriculture, and socio-economic conditions. As a country that relies heavily on rain-fed agricultural systems, Sahab is particularly vulnerable to the adverse effects of prolonged droughts. Drought can lead to severe water shortages, affecting not only the availability of drinking water but also the livelihoods of farmers and the overall food security of the community. Addressing drought is key to ensuring the long-term sustainability of Sahab's resources and improving the adaptive capacity of its residents to cope with prolonged periods of low water availability.

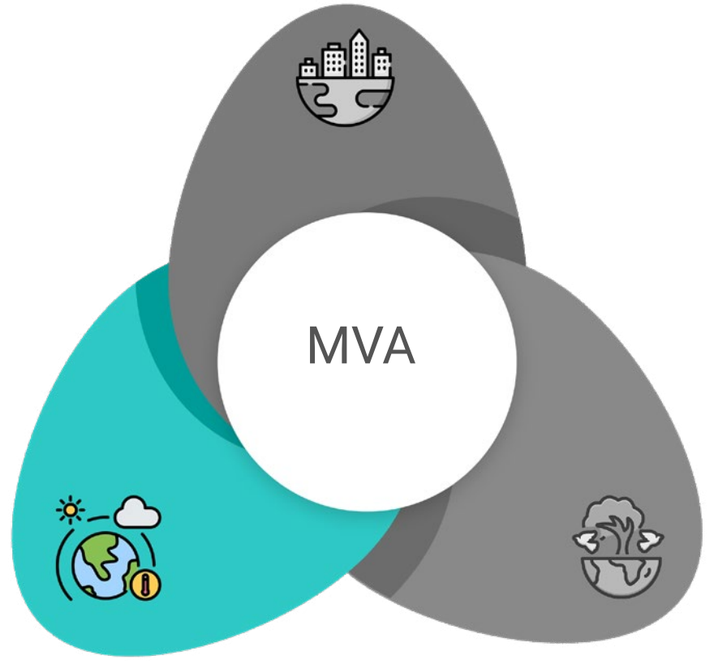
Indicator 3: Extreme Heat
Extreme heat was chosen as a key indicator due to its direct impacts on both public health and urban infrastructure. Vulnerable populations, including children, the elderly, persons with disabilities, and those living in inadequate housing, are particularly at risk. Increased exposure to frequent and intense heatwaves can lead to health issues such as heat exhaustion, heatstroke, and dehydration. In addition to health risks, urban infrastructure is also vulnerable to the stresses caused by heatwaves. Higher energy demands can strain electricity systems, while the heat itself can disrupt essential services like transportation and water supply, further increasing the vulnerability of communities. Understanding the effects of extreme heat is essential for planning future infrastructure that can withstand rising temperatures and for protecting the most at-risk populations in Sahab City.

Geospatial analysis using GIS data was utilized to assess the impact of each of these indicators. By observing how these factors interact and aggregate over time, a comprehensive assessment of climate change hazard sin Sahab was developed.

The following pages will provide a detailed analysis of the city's exposure to droughts, floods, heat-waves, and rising temperatures, elucidating the ways in which these phenomena affect Sahab's path toward resilience.

It should be noted here that the climate projections for Jordan presented in this section are based on two greenhouse gas concentration scenarios, known as Representative Concentration Pathways (RCPs), as adopted by the Intergovernmental Panel on Climate Change (IPCC). These scenarios, included in Jordan's 4th National Communication to the UNFCCC, are the medium-change scenario (RCP 4.5), with radiative forcing increasing by 4.5 Watts/m², and the high-change scenario (RCP 8.5), with radiative forcing increasing by 8.5 Watts/m². Projections were developed using statistically downscaled Regional Climate Models (RCMs) that were de-biased and validated against climatic records from the Jordan Meteorological Department (MoEnv, 2023). Future climate maps were produced using co-kriging techniques, and statistical summaries were generated to provide detailed insights.

CLIMATE CHANGE DIMENSION



SELECTED INDICATORS:

Fig. 40: Selected Indicators for Climate Change Dimension

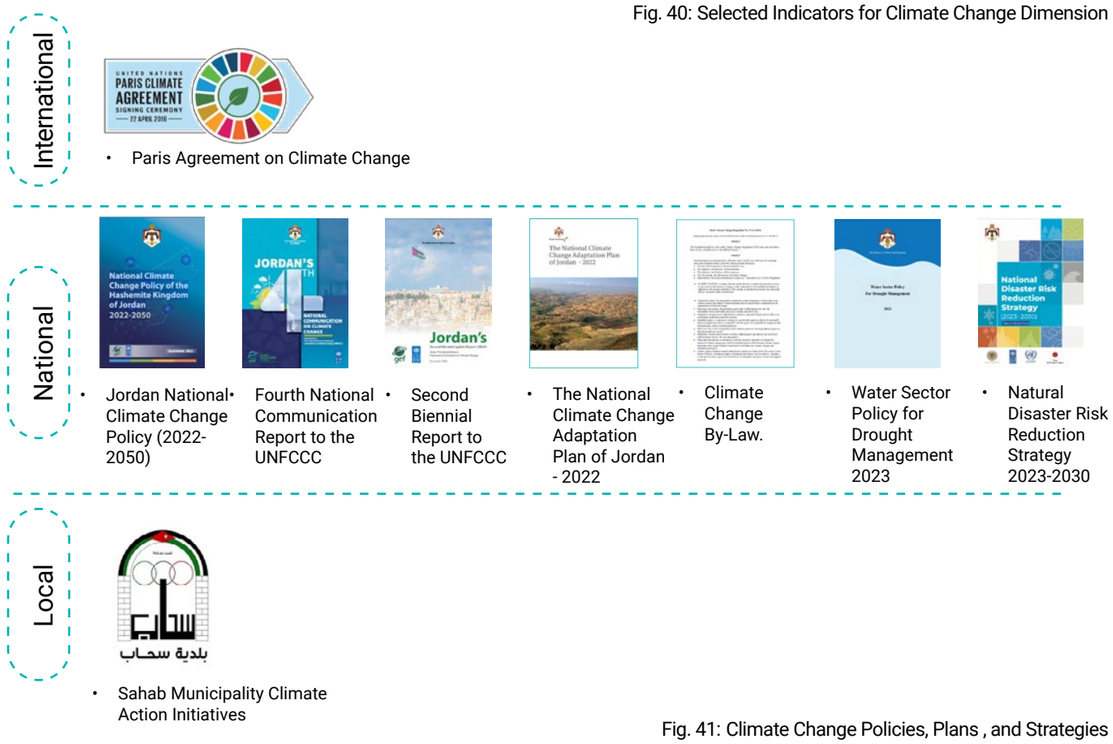


Fig. 41: Climate Change Policies, Plans , and Strategies

Flood Vulnerability in Jordan

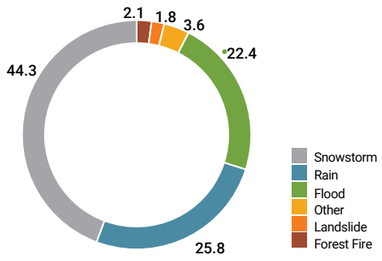
Floods in Jordan primarily fall into two categories: pluvial and flash floods. Pluvial floods result from heavy rainfall overwhelming drainage systems or saturating the ground. Flash floods, a subset of pluvial flooding, are sudden and intense, often impacting Jordan's wadis and arid regions. For clarity, 'flood' in this report refers to pluvial flooding, while 'flash flood' is specified separately due to its unique characteristics and rapid onset.

Jordan, a country located in a semi-arid to arid region, experiences variable rainfall patterns, often concentrated in short periods, which makes the nation highly susceptible to flash floods. The rainy season extends from October to May, with peak precipitation typically occurring in January and February. These months mark the height of the wet season, as most weather stations record their highest rainfall levels during this period. Despite its generally dry and desert-like climate, certain areas, especially valleys (wadis), are prone to sudden, heavy rainfall, which can lead to rapid flooding due to the terrain and limited vegetation.[34] The country's diverse topography, including mountain ranges in the west and the Jordan Rift Valley, creates natural drainage systems that can exacerbate flooding. When rain does fall, it often results in flash floods, particularly in low-lying areas such as the Dead Sea region, Petra, and the capital city, Amman. Wadi systems in these areas can quickly become overwhelmed during heavy rainfall, posing risks to both infrastructure and human lives. Climate change further complicates this issue, as shifting weather patterns have made rainfall increasingly unpredictable and intense, leading to more frequent and severe flooding events. Additionally, rapid urbanization, coupled with inadequate drainage infrastructure, exacerbates the impact of flash floods, leaving densely populated areas particularly vulnerable.

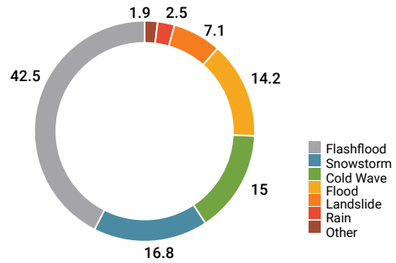
Several significant flood events have caused widespread damage in Jordan. In 2018, flash floods near the Dead Sea resulted in tragic casualties, including the deaths of schoolchildren on a field trip, underscoring the urgent need for improved flood risk management and early warning systems. Another major event occurred on February 28, 2019, when a heavy rainstorm, with an estimated intensity of 8–12 mm/h, triggered flash floods in downtown Amman. The storm, which lasted two days, produced a peak discharge of approximately 658 m³/s. The flood caused extensive damage to vehicles and properties in the affected areas, highlighting vulnerabilities in urban infrastructure.[35] Flash floods pose numerous challenges, including loss of life, displacement of communities, and extensive damage to infrastructure such as roads, bridges, and water systems. In addition, floods threaten Jordan's archaeological sites, such as Petra, where flash floods have previously forced the evacuation of tourists. Economic costs related to these disasters are rising, putting additional pressure on national resources.[36]

The Jordanian government, along with international organizations, has been working on flood mitigation strategies. This includes improving early warning systems, upgrading drainage infrastructure, and promoting sustainable urban planning to minimize flood risks. Additionally, Jordan's climate resilience efforts emphasize water management, public awareness campaigns, and the construction of retention dams to control flood waters. It is worth mentioning here, that UN-Habitat has conducted a flood risk assessment for the GAM, identifying 120 flood-prone hotspots for targeted mitigation interventions. This assessment is helping guide infrastructure upgrades and improve the city's flood preparedness.

Flash floods and general floods together account for 31% of total disaster-related mortality in Jordan from 1990 to 2014. This significant proportion highlights that floods, in all their forms, are the leading cause of disaster-related deaths in the country, underscoring their significant threat to human life. Additionally, floods contribute to 22.4% of the total economic losses from disasters, underscoring the extensive financial impact of these events. The data emphasizes the need for stronger flood mitigation strategies to safeguard both lives and livelihoods.[37]



Nationally Reported Losses 1990-2014 in terms of combined Economic Losses



Nationally Reported Losses 1990-2014 in terms of combined Mortality

With floods (including flash floods) responsible for more than half of disaster-related deaths and a large portion of economic losses, Jordan must prioritize flood preparedness, improve drainage systems, and invest in climate-resilient infrastructure to mitigate these risks. The National Climate Change Policy of the Hashemite Kingdom of Jordan 2022-2050 policy highlights the importance of building resilient infrastructure to withstand extreme weather events, particularly floods. This includes upgrading drainage systems and constructing flood barriers to safeguard both urban and rural areas. Additionally, strengthening early warning systems and emergency response protocols is vital to reducing the human and economic impact of flooding. The policy also advocates for improved water resource management, ensuring that flood waters are effectively channelled and stored for future use, enhancing both flood mitigation and water security.[38]

Projected precipitation intensities indicate that heavy rain days (exceeding 20 mm in Jordan) will remain rare, with no significant trends suggesting an increase in such events. Future scenarios, particularly under RCP 8.5, show a decreased likelihood of intense precipitation by the end of the century. The severity of these events will vary by location and is expected to be more pronounced in the mid-21st century compared to the end of the century. Despite the anticipated decline in rainfall intensities, poor soil conditions in Jordan, especially in low-rainfall areas, are likely to exacerbate flood risks.[39]

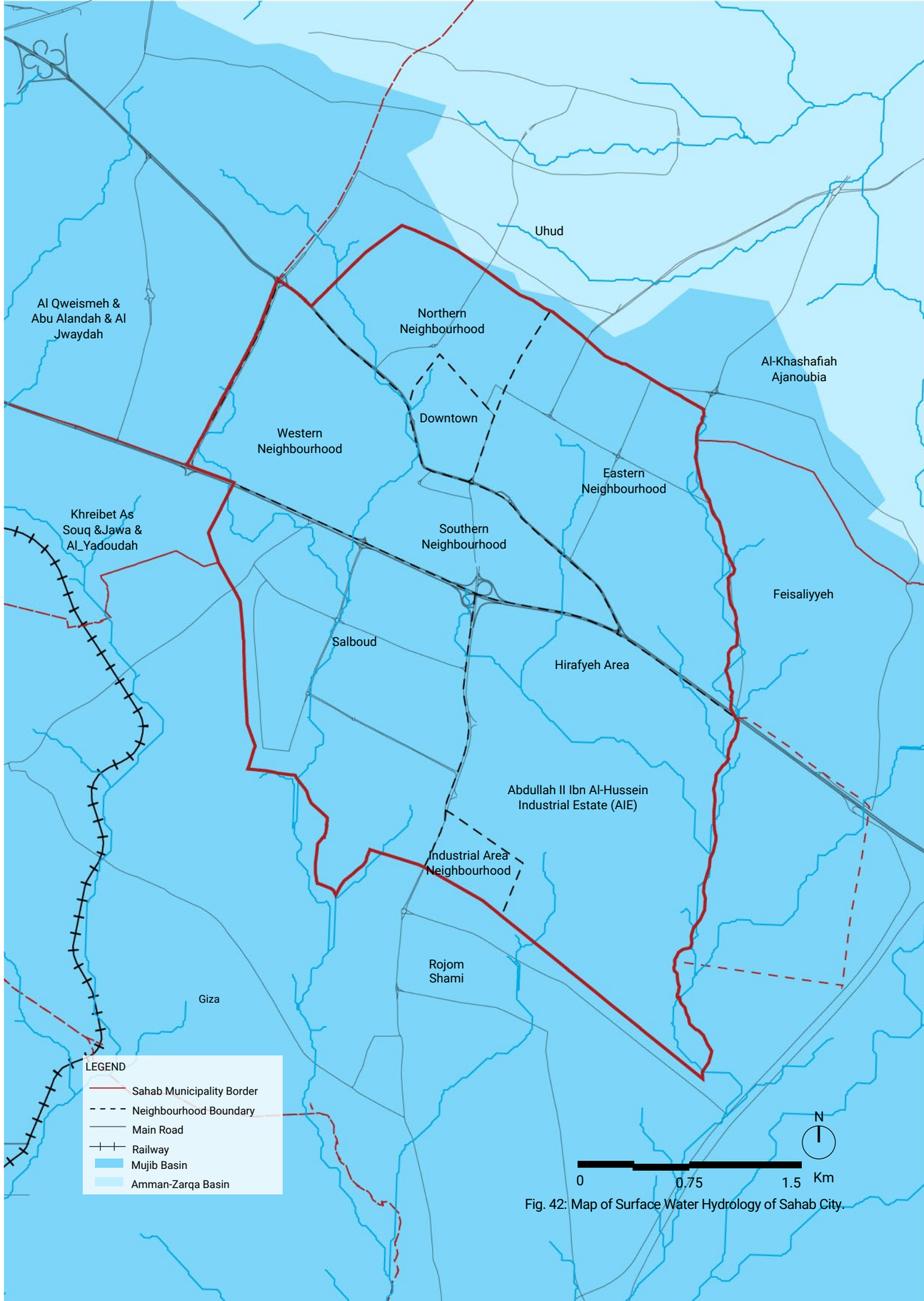


Fig. 42: Map of Surface Water Hydrology of Sahab City.

Indicator 1: Flood Hazard Assessment in Sahab City

In Sahab City, flash floods and floods present a significant risk due to a combination of climatic and urban factors.The most impacted communities, infrastructure, and ecosystems are primarily those located in flood-prone areas such as the Salboud Neighbourhood, which is particularly vulnerable due to the presence of a wadi stream running through the area. This vulnerability has also been consistently highlighted by key stakeholders and local community representatives during the consultation sessions. These communities experience significant disruption from flash floods, which pose serious risks to residential areas, public infrastructure, and livelihoods.

The rapid urbanization of Sahab has exacerbated the situation, leading to increased surface runoff and overburdened drainage systems, leaving residential and industrial zones vulnerable to flood damage. The low-lying topography of the city, coupled with inadequate drainage, significantly impacts infrastructure like roads, utilities, and buildings, with flooding often causing extensive damage to public services, transportation networks, and private property. Additionally, local ecosystems, including wadi habitats and surrounding green spaces, are also at risk from erosion and waterlogging during heavy rains.

Efforts such as the installation of culverts by the Sahab Municipality are steps toward improving flood resilience, but continued investments in flood management infrastructure and sustainable urban planning are essential to better protect these vulnerable communities and their environment from future flood events

The criteria used to determine flood hazards included several key layers: land cover, proximity to streams, drainage density, rainfall, elevation, and slope. The land cover layer identifies different types of surface features, such as urban areas, vegetation, and bare soil, which influence water absorption and runoff patterns. The distance to streams layer helps evaluate proximity to water bodies and channels, indicating areas at higher risk of flooding due to overflow. Drainage density measures the total length of streams and rivers in a given area, helping to understand how well the landscape drains water. The rainfall layer identifies regions prone to heavy precipitation, contributing to surface water accumulation. The elevation layer highlights the height of the land relative to sea level, indicating potential flow paths for water. Lastly, the slope layer illustrates how the gradient of the land affects water flow and accumulation, identifying regions where water is likely to collect and lead to potential flooding. Flood hazard mapping was conducted using a DEM with a resolution of 12.5 meters, sourced from the ALOS PALSAR corrected terrain data.

Based on the flood hazards map, the neighbourhoods shaded in dark blue; such as parts of the Northern, Eastern, and Salboud neighbourhoods; are identified as the highest flood hazard areas along the wadi streams. These areas are particularly prone to significant water accumulation due to their topography, making them highly susceptible to flooding during heavy rainfall. Roads and infrastructure within these flood hazard zones are at greater risk of damage, potentially causing transportation disruptions and impacting buildings and essential facilities.

Given the increased flood hazard in these areas, they should be prioritized for flood mitigation efforts. This includes improving drainage systems, constructing flood barriers, and ensuring robust emergency response plans are in place to minimize the impact of potential flooding.

Additionally, special attention should be given to residents in these areas when planning for urban resilience.

Tailored flood hazard reduction strategies, such as community awareness initiatives and well-developed evacuation routes, are essential to protect the safety of those living in these flood hazard zones.

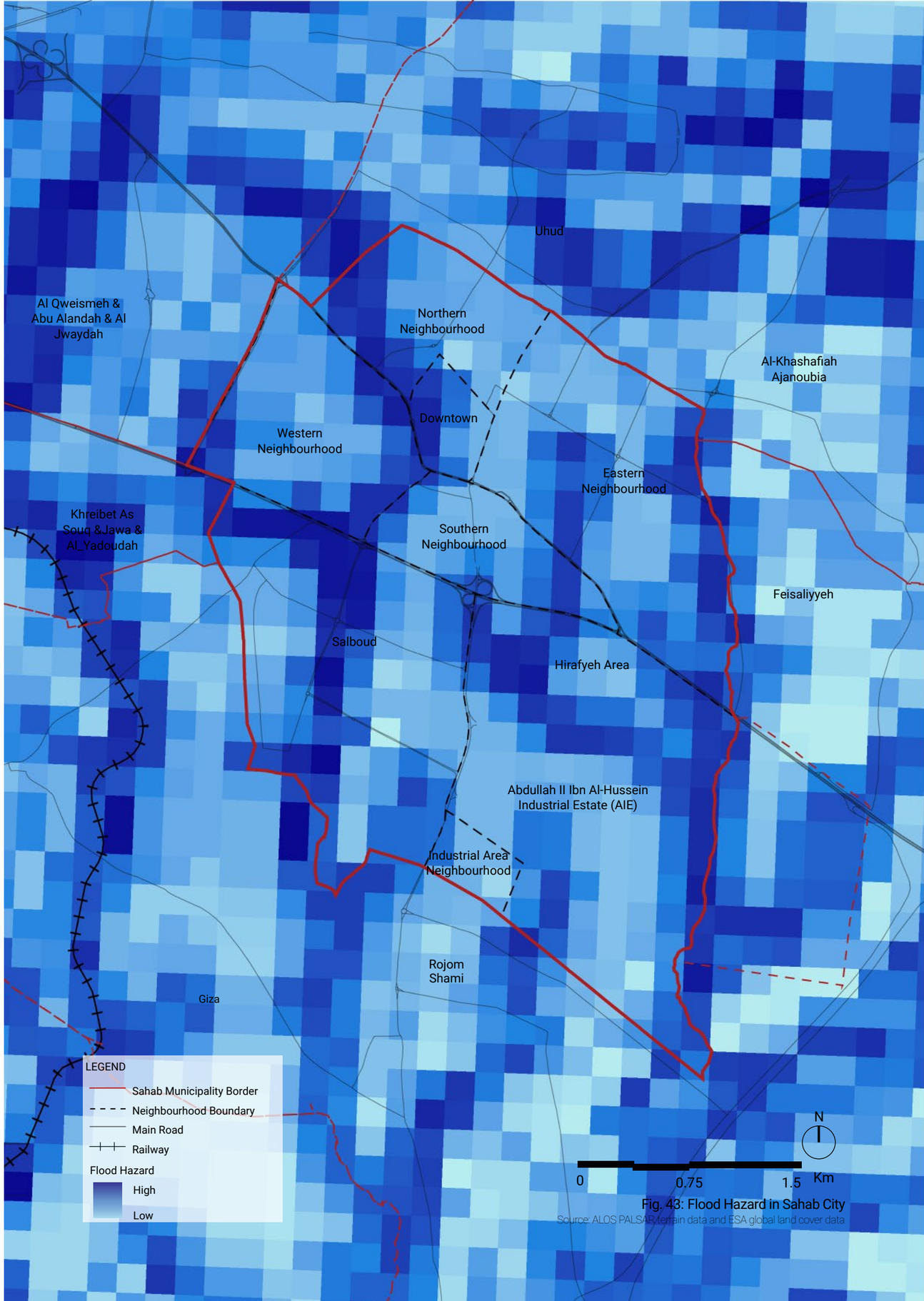


Fig. 43: Flood Hazard in Sahab City

Source: ALOS PALSAR terrain data and ESA global land cover data

Heat-waves in Jordan

As defined in Jordan's Fourth National Communication (4NC) to the UNFCCC, a heatwave refers to a period of three consecutive days during which the maximum temperature exceeds the long-term average by 5°C or more. In recent years, Jordan has experienced increasingly frequent and intense heat-waves, a direct consequence of global climate change. Located in a semi-arid region, the country is characterized by hot, dry summers and mild winters. However, the rise in average temperatures, coupled with prolonged periods of extreme heat, has intensified the severity and frequency of heat-waves across the country.

Jordan's urban areas are particularly vulnerable to heat-waves due to the urban heat island (UHI) effect, where densely built environments with limited vegetation absorb and retain heat, causing temperatures to rise even higher than in rural areas. This phenomenon, exacerbated by poor urban planning and a lack of green spaces, poses significant health risks, especially for vulnerable populations such as the elderly, children, and individuals with pre-existing health conditions.

Heat-waves in Jordan not only affect public health but also place stress on critical infrastructure, including energy and water systems. With increasing demand for electricity for cooling and water resources already under significant pressure due to the country's arid climate, the impact of heat-waves is multi-dimensional, affecting both economic stability and environmental sustainability.

The mapping of heat-waves was carried out by interpolating maximum daily air temperature data from the Jordan Meteorological Department (JMD) and analysing trends from 1990 to 2020. At the national level, the analysis revealed a significant increase in the frequency of heatwave events, with an average rise of 0.15 events per year. The occurrence of heat-waves varies across time and location, ranging from once per year to as many as 15 events annually.

To understand the local impact, the heat-wave data was examined at a regional level, focusing on specific areas, including Sahab. Fig. 44 illustrates the heat-wave estimations at the regional level, reflecting the number of heat-waves recorded between 1990 and 2020 with darker areas representing regions that experienced the highest temperatures and most frequent heat events.

Sahab, along with other areas, is identified as a zone that experiences a high number of heat-waves, highlighting its vulnerability to extreme heat impacts.

Future projections suggest that heat-waves will become more frequent, especially between 2070 and 2100. These future heat-waves are expected to be more severe in terms of their length and intensity. Compared to the past, the number of heat-waves could increase by 120% under moderate climate change (RCP 4.5) and by up to 800% under more extreme conditions (RCP 8.5). This suggests that areas like Sahab, already identified as prone to heat-waves, will face even greater risks in terms of heatwave frequency, intensity, and duration towards the end of the century.[40]

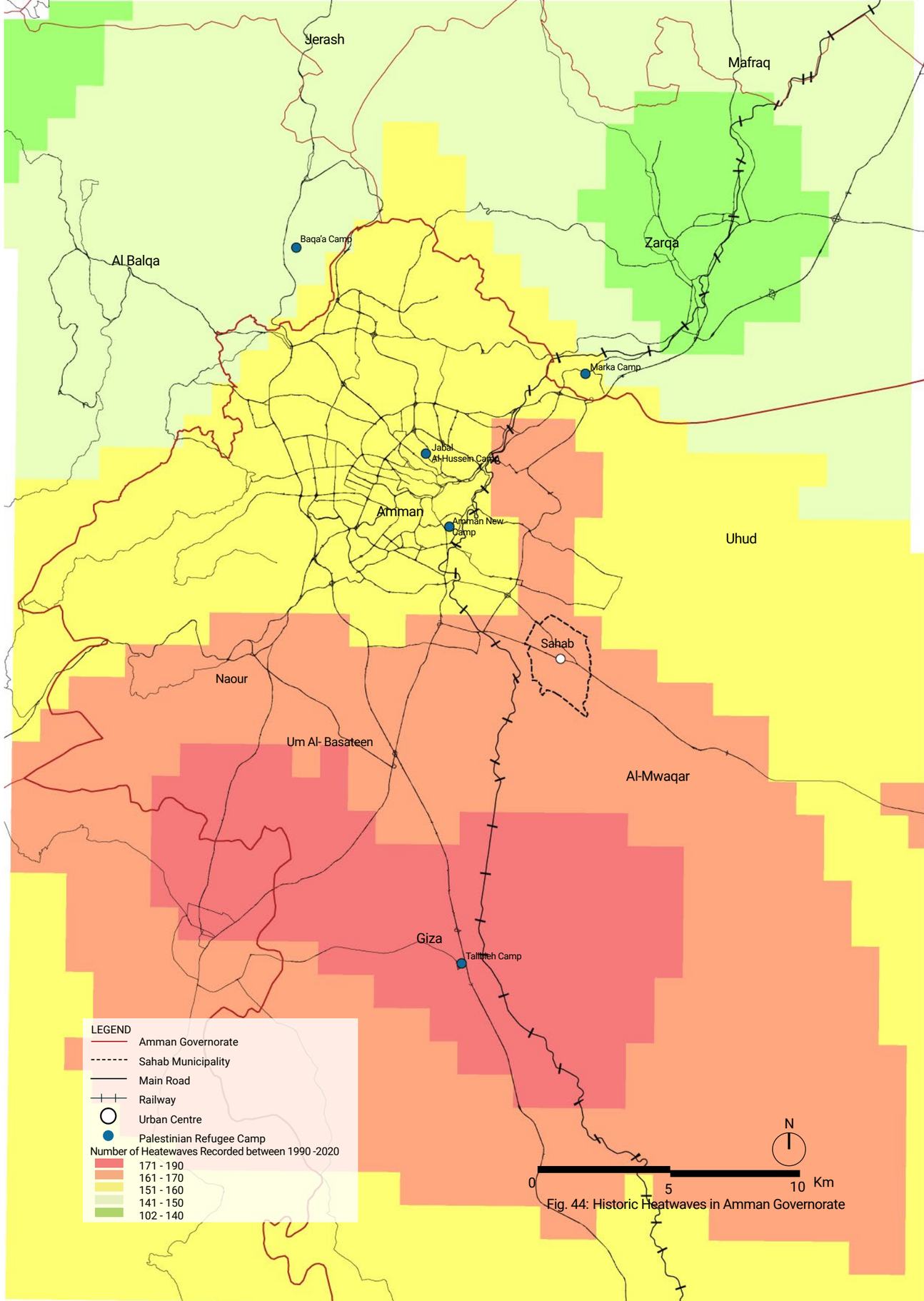


Fig. 44: Historic Heatwaves in Amman Governorate

Indicator 2: Heat-Waves in Sahab City

Sahab City shares many of the challenges faced by urban centres across Jordan but has its unique vulnerabilities when it comes to heat-waves. As a rapidly urbanizing area, Sahab is experiencing rising temperatures, amplified by its dense industrial zones and limited green spaces. The urban heat island effect is pronounced in Sahab due to the concentration of concrete structures, factories, and paved surfaces, all of which absorb and radiate heat, particularly during the summer months.

The socio-economic profile of Sahab further intensifies the impact of heat-waves. Many residents, especially those from lower-income households, lack access to adequate cooling systems or housing features such as shading, which would help mitigate heat. This makes them more susceptible to heat-related illnesses such as heatstroke, dehydration, and respiratory issues. Moreover, industrial workers in Sahab, who often perform outdoor labor, are at heightened risk during extreme heat events.

In addition to the public health impacts, heat-waves in Sahab place significant stress on energy infrastructure, with increased electricity consumption for cooling leading to power outages and grid instability. Water scarcity, already a pressing issue in Jordan, is further strained during heat-waves as higher temperatures lead to increased evaporation rates and demand for water.

Furthermore, heat-waves have had a pronounced impact on agriculture and rural livelihoods, as observed by the team of the Ministry of Agriculture office in Sahab City. Prolonged extreme heat has resulted in reduced crop yields and a shrinking of cultivated areas, driven by increased water demands and reduced rainfall. The timing of heat-waves in Jordan has also shifted, with extreme heat occurring earlier in the year. This shift has had a detrimental effect on crops such as olives, as heat-waves now strike during a period when the olives are still small, causing them to dry out prematurely and reducing overall yields.[41] The geographical distribution of crops has shifted, with some areas no longer suitable for traditional farming.[42]

Additionally, desertification has worsened, with a 10% reduction in vegetation cover, further degrading the land. Heat-waves have also facilitated the spread of agricultural pests, such as the olive fruit fly, which have become more widespread under hotter conditions. The extreme heat has led to a 35% decline in wild herbs, medicinal plants, and wild-flowers, all essential to the local ecosystem and agricultural diversity. Water scarcity has intensified as reservoir storage has decreased by 25%, exacerbating the challenges for farmers. Livestock farming in Sahab has been similarly affected, with heat stress reducing productivity and causing a decline in the number of operating farms. As a result, the income of agricultural workers and rural households has diminished, as both the crop and livestock sectors struggle to cope with the increasingly harsh heatwave conditions.

The map shows that Sahab experienced between 161 and 170 heatwave events from 1990 to 2020, underscoring the area's high exposure to frequent and intense heat-waves. These events resulted in significantly higher temperatures compared to the surrounding regions.

Addressing the heat-wave challenge in Sahab requires a combination of urban resilience strategies. This includes the introduction of green infrastructure, such as parks and tree-lined streets, as well as improved urban planning that reduces the heat retention of buildings and streets. Additionally, public awareness campaigns and emergency response plans will be crucial to protect the most vulnerable populations from the dangers of extreme heat These efforts align with Jordan's broader climate resilience goals, as outlined in the National Climate Change Policy (2022-2050).

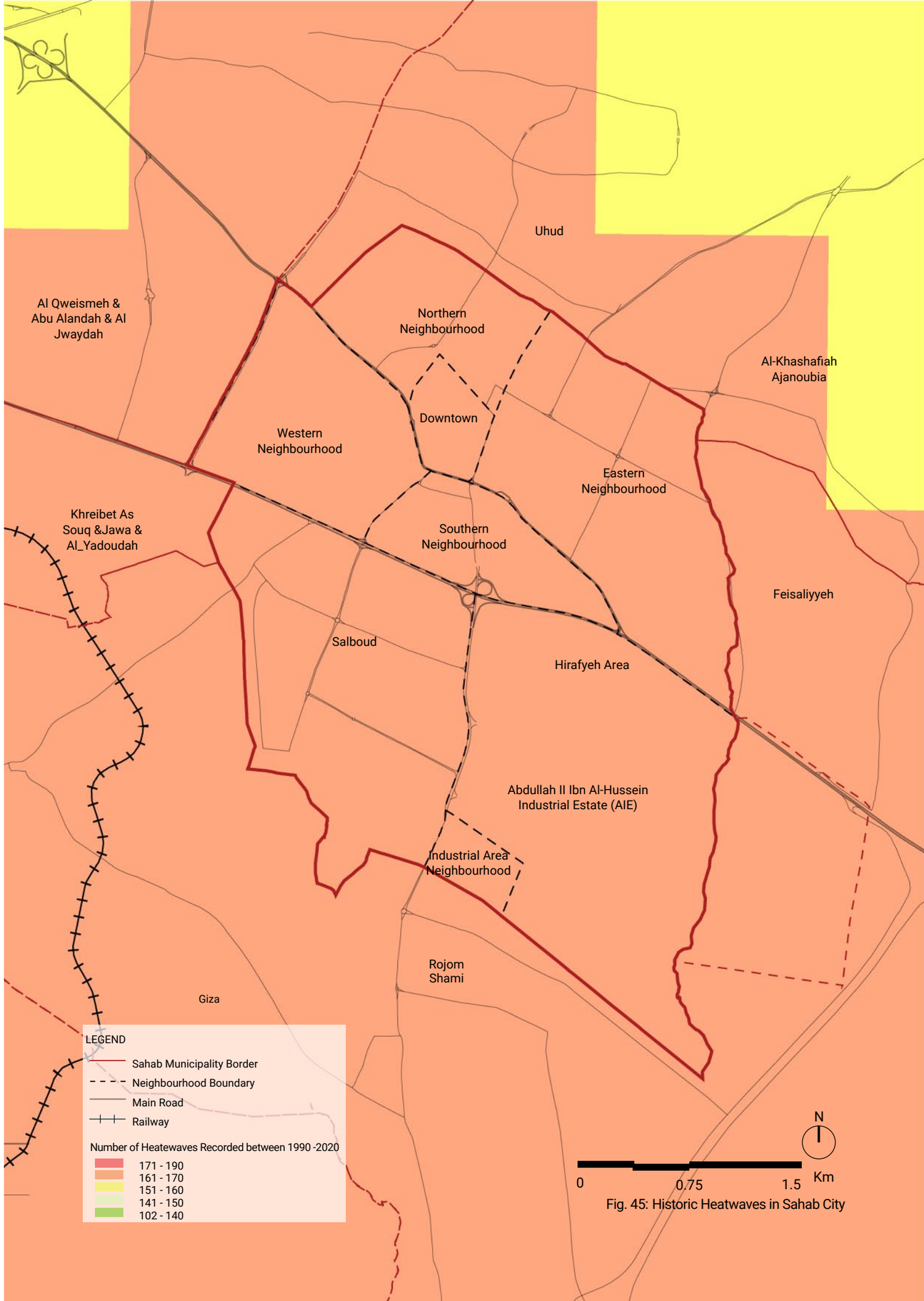


Fig. 45: Historic Heatwaves in Sahab City

Jordan's Drought Legacy: Historical Patterns Implications

According to the 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 evapo-transpiration, soil moisture levels, and temperature, all of which determine the actual water demand and availability in the affected area.

Jordan, classified as one of the most water-scarce countries in the world, faces immense challenges in managing its limited water resources. This scarcity exacerbates the impacts of drought, further straining the country's already fragile water systems. There are several types of drought, including meteorological, agricultural, and hydrological, each leading to negative impacts on economic and social factors. In Jordan, drought is a critical challenge that exacerbates the country's already severe water scarcity. The history of drought in Jordan shows a pattern of recurring dry periods, with notable years dating back to 1777, including 1800, 1827, 1895, and 1933. On average, one-year droughts occur approximately every 9.3 years, while two-year droughts happen every 51.3 years. In the past two decades, significant drought events occurred in 2001 and 2009, with intensifying conditions also observed in 2008, 2011, and 2021. Historic droughts, including those from 1958–1962 and 1997, severely impacted livestock, agriculture, and food security, affecting 25% of the population and 180,000 farmers and herders. By 1999, grazing lands and rain-fed crops produced drastically reduced yields, and dam water levels hit record lows. From 1923 to 2007, 20 of 84 years had below-average rainfall, with ten classified as severe droughts. Severe droughts occur every 20–25 years, while extreme droughts are rare. Climate change is projected to increase drought frequency, further threatening water resources, agriculture, and dependent livelihoods.

The negative impacts of historical droughts in Jordan have led to significant consequences, including the drying up of springs and a reduction in discharge rates. Over the past 30 years, groundwater levels have declined by approximately 1 meter per year. Additionally, there has been a decrease in the base flow of surface water and the side wadis of the Jordan Valley, along with a reduction in water storage rates in the main dams, which have dropped by more than 50% over the last two decades. Furthermore, the impacts of drought are amplified by underlying vulnerabilities and the responses of socio-ecological systems. For instance, initial effects on crops can lead farmers to increase irrigation, potentially degrading soil quality over time and reducing future agricultural productivity. Such feedback loops illustrate the interconnectedness of drought impacts across various systems. Droughts significantly affect rural livelihoods, resulting in direct and indirect consequences, including human health challenges and rural out-migration. Jordan's renewable water availability per capita has sharply declined, now 60% lower than in 1990, largely due to poor water management and the influx of refugees, which further strains the already limited water supply.

Jordan's agricultural sector, particularly rain-fed systems and smallholder production, is highly vulnerable. With less than 10% of land cultivated and only 1-2% irrigated, the sector heavily depends on rainfall, making it especially susceptible to precipitation fluctuations. Limited access to credit and inadequate financial risk management exacerbate these challenges. Moreover, prioritizing municipal and industrial water use over irrigation intensifies the vulnerability of agricultural systems. Despite consuming 70% of the country's water resources, agriculture contributes only 6% to GDP. The impacts of drought extend beyond immediate agricultural losses, significantly affecting agribusiness and agro-industry, both of which are crucial to the economy.

Jordan faces significant challenges in managing droughts due to a weak link between climate data and decision-making, a lack of specialized forecasting tools, and insufficient national capacity for proactive adaptation and mitigation measures. Drought is not treated as a disaster, and current efforts are largely reactive, lacking coordination among institutions. In response, the MOWI developed the Water Sector Policy for Drought Management (2023) to address these gaps. This Policy outlines several key objectives aimed at minimizing the negative impacts of drought in Jordan. These include ensuring an adequate water supply to meet the basic needs of the population, particularly focusing on vulnerable groups. The policy seeks to protect water resources, including freshwater sources, dams, and groundwater, while also reducing the impact of drought on agriculture and other economic sectors in line with national priorities. It aims to strengthen national capacities by establishing a drought forecasting and early warning system, and emphasizes the need for proactive drought management plans, ensuring effective coordination between public and private sectors. Additionally, the policy promotes educational and public awareness initiatives, engaging communities and encouraging self-reliance to enhance risk management. Through these measures, Jordan aims to shift from crisis-based responses to more sustainable and proactive drought management. Aligned with SDGs 6, 13, and 15, this policy is also backed by international frameworks like the Marrakesh Proclamation and the Paris Climate Agreement, which stress climate change adaptation and mitigation strategies for drought preparedness. Furthermore, the National Climate Change Policy of Jordan (2022-2050) focuses on several key actions to address droughts, including enhancing water conservation, promoting drought-resistant crops, and implementing climate-smart agriculture. It also emphasizes integrated water management, strengthening community involvement in drought management, and improving early warning systems to minimize socio-economic impacts.

The drought map was developed using annual rainfall data from 46 stations across the study area, based on information from the MoWI covering the years 1980 to 2016.

Future projections for meteorological droughts, expressed by the standardized precipitation index (SPI), showed that historically drought probability was relatively low, with a range of 10-14% in most parts of the country. Future projections for droughts, showed that drought probability would increase significantly until the end of the 21st century, especially in the northern region of the country, where probability would be in the range of 20 to 40% under RCP4.5 scenario and in the range of 60-70% under the RCP8.5 scenario. For the area from middle to northern Jordan, including Sahab, a maximum probability would reach 93% under RCP 8.5, compared to 50% using RCP 4.5. Drought duration would likely become longer, with more than 3 consecutive years using RCP 4.5 and more than 5 years using RCP 8.5.

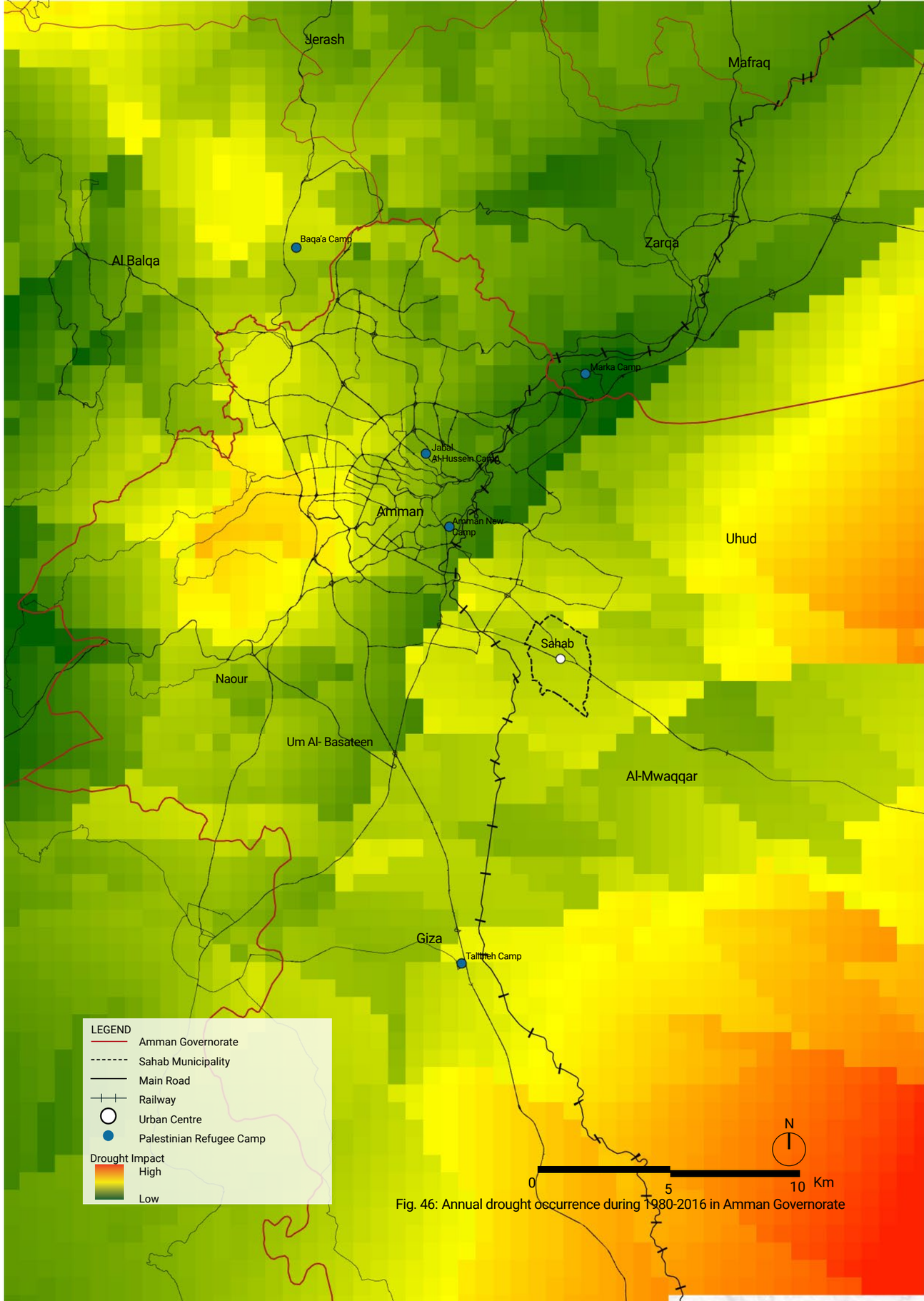


Fig. 46: Annual drought occurrence during 1980-2016 in Amman Governorate

Indicator 3:Drought Impact in Sahab City

In Sahab City, the interplay between high drought risk, extreme heat, and potential subsidence or soil erosion is a significant concern. Prolonged drought conditions can lead to the shrinking of foundational soil, increasing the risk of subsidence. Additionally, the urban heat island effect exacerbates soil degradation, making the area more susceptible to erosion. These combined factors threaten the stability of infrastructure and the health of local ecosystems. Communities may experience increased vulnerability to property damage, as subsidence can lead to cracked foundations and structural instability in homes and public buildings. This could further exacerbate socio-economic challenges, especially for low-income families who may lack the resources to repair or relocate. Additionally, the erosion of soil during extreme heat and drought can degrade public spaces, roads, and drainage systems, increasing the risk of flooding and disrupting transportation networks. For infrastructure, the combined impacts could necessitate costly repairs and upgrades, putting additional pressure on local governments and reducing the overall resilience of the urban.

As part of the broader challenges faced by Jordan, Sahab's agriculture heavily relies on rain-fed systems, making it particularly sensitive to fluctuations in precipitation. The city experiences vulnerabilities that are characteristic of the national context, including soil degradation and a reliance on high-water-demand crops, which further exacerbate sensitivity to drought conditions.

The local agricultural community faces significant challenges during drought periods, including reduced crop yields and increased dependence on irrigation, which can lead to over-extraction of groundwater. As a result, Sahab's farmers often struggle with maintaining sustainable practices while coping with water scarcity. The lack of financial support and resources further hinders their ability to adapt and manage risks effectively.

Moreover, the interaction between drought impacts and socio-economic factors in Sahab can lead to increased migration and shifts in rural livelihoods. While drought may not directly correlate with an increase in disease burden, its effects on temperature and water availability contribute to a decline in health outcomes for vulnerable populations.

The impact of droughts on Sahab is multifaceted and profound. In Sahab, the agricultural sector, which relies heavily on irrigation, is directly affected by water shortages. Farmers face lower crop yields and reduced livestock production, leading to increased costs and economic hardship. The loss of agricultural productivity can further fuel poverty and food insecurity, threatening the livelihoods of families in the area.

Economically, Sahab's industrial sector is also severely impacted by drought conditions. Many industries, particularly manufacturing and agriculture-related businesses, require significant amounts of water for production. Without water, industrial operations come to a standstill, leading to production losses, job cuts, and financial instability for businesses. In particular, industries like cement production, textiles, and food processing are vulnerable, as they rely on stable and adequate water supplies to run their operations. This leads to a chain reaction, contributing to economic downturns and unemployment in the region. Furthermore, energy production, which is closely tied to water resources for cooling processes in power plants, is disrupted during drought periods, leading to reduced energy availability. In a country already facing energy supply challenges, this exacerbates the economic strain on households and businesses.

Biodiversity in Sahab also suffers under prolonged drought conditions. The loss of biodiversity in Sahab further erodes the region's resilience to climate change, weakening ecosystem services.

Moreover, the socio-economic profile of Sahab amplifies the impact of droughts, particularly among the lower-income populations. Without access to adequate cooling systems in homes and workplaces, residents are more susceptible to the health risks associated with extreme heat events, such as heatstroke, dehydration, and respiratory issues. Vulnerable populations, such as the elderly, children, and those with pre-existing health conditions, face heightened risks.

The drought map was developed using annual rainfall data from 46 stations across the study area, based on information from the MoWI covering the years 1980 to 2016. The analysis revealed that the Sahab area experienced five dry seasons during this period, indicating a dry year occurred approximately every seven years. Notably, drought frequency was particularly high in the eastern and south-eastern regions of the study area.

The exposure to drought in Sahab is relatively uniform across the region, with water scarcity impacting various sectors equally. As such, adaptation strategies should be inclusive and comprehensive, ensuring that they address the needs of the entire area. It is essential to develop interventions that consider the diverse challenges faced by both urban and rural populations, as well as the agricultural and industrial sectors. Efforts to address drought in Sahab must consider both immediate coping strategies and long-term adaptation measures, including improved water management practices and community engagement in drought risk management.

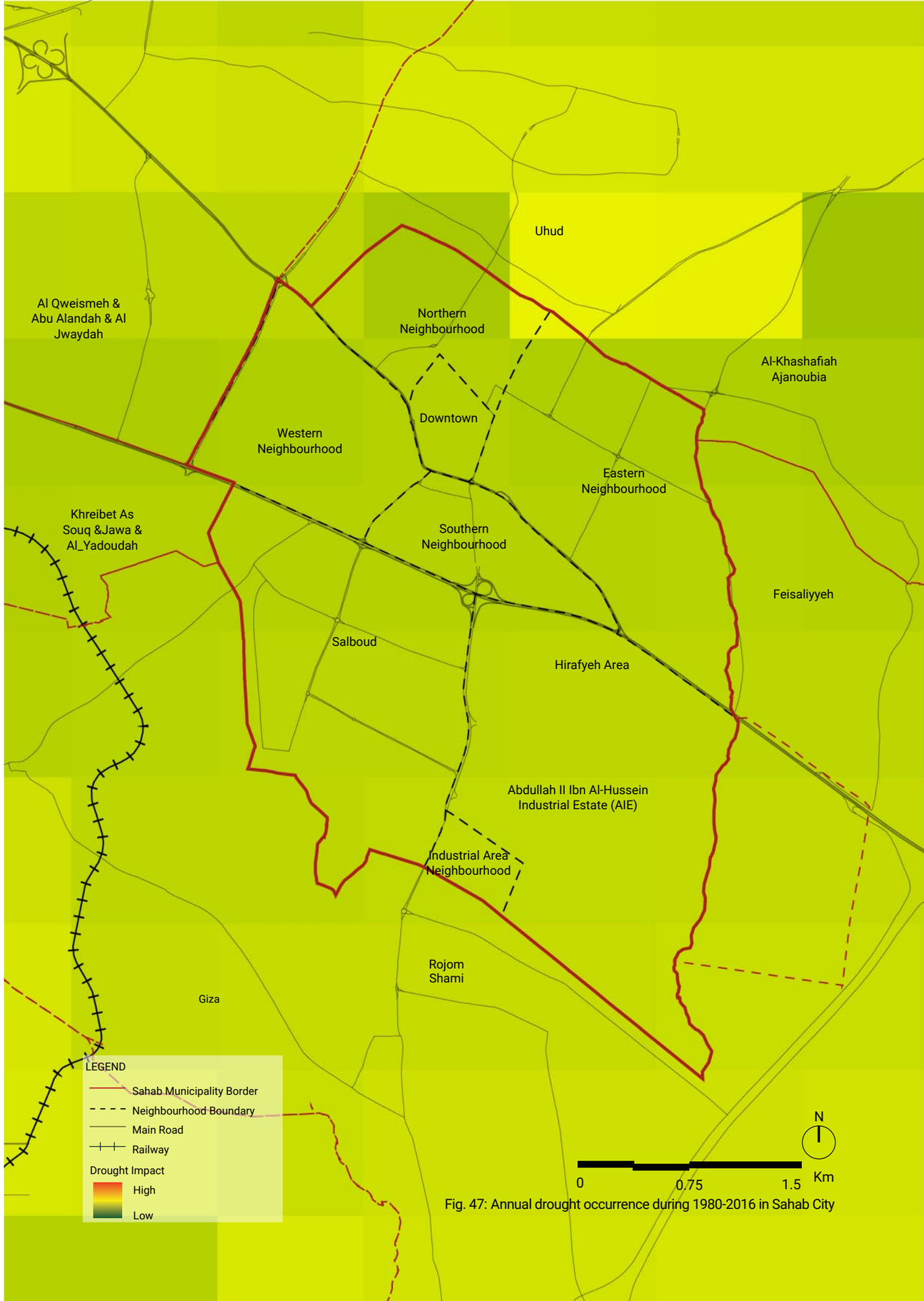


Fig. 47: Annual drought occurrence during 1980-2016 in Sahab City

Climate Multi-Hazard Mapping in Sahab City

To assess climate hazards in Sahab City, a multi-layer analysis was conducted using GIS tools to integrate three critical indicators under the climate change dimension: floods, droughts, and extreme heat. While all three hazards are considered high-impact across the city, their spatial variability differs significantly.

Extreme heat and drought were assigned equal weights of 25% each, reflecting their similar nature and uniform impact across the city. These indicators do not show significant spatial variation, as their effects are broadly distributed throughout Sahab.

Flood hazards, however, were given a higher weight of 50%. Unlike heat-waves and droughts, the flood hazard map reveals clear differences in exposure across various areas in the city. By assigning a higher weight to floods, the multi-layered analysis emphasizes these localized variations, allowing the hazard mapping to effectively highlight areas most exposed to multiple climate risks.

This approach ensures that the final map delivers a clear and actionable visualization of the areas most affected by the combined climate hazards. By offering a holistic perspective on the city's vulnerabilities, it empowers stakeholders to pinpoint priority areas for climate adaptation and resilience-building. The map serves as an invaluable tool for city planners and decision-makers, enabling them to strategically design interventions to mitigate the impacts of climate change and ensure that the communities most at risk receive the necessary support and protection.

Below are the key Highlights from the Map:

- **High Hazard Areas:** The high hazard areas in Sahab City, including the Downtown, Southern Neighbourhood, Industrial Area, and parts of the Salboud, Western, and Eastern Neighbourhoods, are exposed to a combination of climate change-related risks, such as flooding, drought, and extreme heat. These overlapping hazards increase the vulnerability of people, infrastructure, and ecosystems, as they exacerbate the challenges faced by already vulnerable communities. Increased flooding compromises residential areas, businesses, and transport networks, while drought conditions strain water resources, leading to water scarcity and affecting agriculture and livelihoods. Additionally, the intensification of heat waves in these areas further contributes to the urban heat island effect, increasing the health risks for residents, particularly the elderly, children, and low-income communities. The inadequate drainage systems, poor urban planning, and lack of green infrastructure heighten these risks, as these systems fail to adequately mitigate the compounded impacts of climate hazards. As a result, these high hazard zones are not only more susceptible to environmental damage but also face significant social and economic challenges, as the effects of flooding, drought, and heat disproportionally affect the most vulnerable populations, while weakened infrastructure struggles to support the growing demands of the city.
- **Medium Hazard Areas:** Certain sections of the Western and Eastern Neighbourhoods, as well as parts of Salboud and the Hirafyeh areas, fall into the medium hazard category. While these areas are still vulnerable to climate-related events, particularly droughts and heat waves, they experience less frequent and intense flooding compared to high hazard zones. These regions benefit from better infrastructure and service access, yet their proximity to higher hazard areas means that long-term sustainability remains a concern. Despite having relatively better infrastructure and service access, these medium hazard areas are still exposed to indirect risks from neighboring high hazard zones, such as water runoff from flooding or increased heat from surrounding industrial activities, which could strain their resources and reduce their resilience over time
- **Low Hazard Areas:** The southern and western portions of Salboud Neighbourhood and the north-western part of the Western Neighbourhood are classified as low hazard areas. These regions are less exposed to the combined effects of floods, extreme heat, and drought, making them more resilient in comparison to the rest of Sahab City. Although currently not a priority for immediate climate adaptation efforts, continuous monitoring is essential to ensure that these areas remain protected from future climate shifts.

The interrelations between flooding, drought, and extreme heat in Sahab create a complex web of environmental challenges with compounded impacts on both the city's residents and infrastructure. Flooding, often exacerbated by heavy rainfall in combination with inadequate drainage systems, can lead to damage to infrastructure, particularly in low-lying areas like Salboud Neighbourhood. On the other hand, the drought conditions in Sahab contribute to water scarcity, which, when coupled with extreme heat, increases the urban heat island effect, making the city hotter and more uncomfortable for residents. These extreme heat conditions intensify evaporation, leading to even more water loss, while at the same time creating a paradox where soil moisture is reduced, further exacerbating erosion risks.

When these three factors interact, they amplify each other's effects: flooding causes soil degradation and erosion, which in turn decreases the ability of the land to retain water during periods of drought, while extreme heat exacerbates evaporation rates and accelerates the depletion of local water resources. This creates a cycle of environmental degradation that affects the livelihoods of communities, undermines agricultural productivity, and strains the city's infrastructure—particularly its water supply systems, drainage networks, and buildings. Addressing this requires a holistic approach to urban planning, emphasizing climate-resilient infrastructure, improved water management, and sustainable land use to mitigate the cascading impacts of these climate-related hazards.

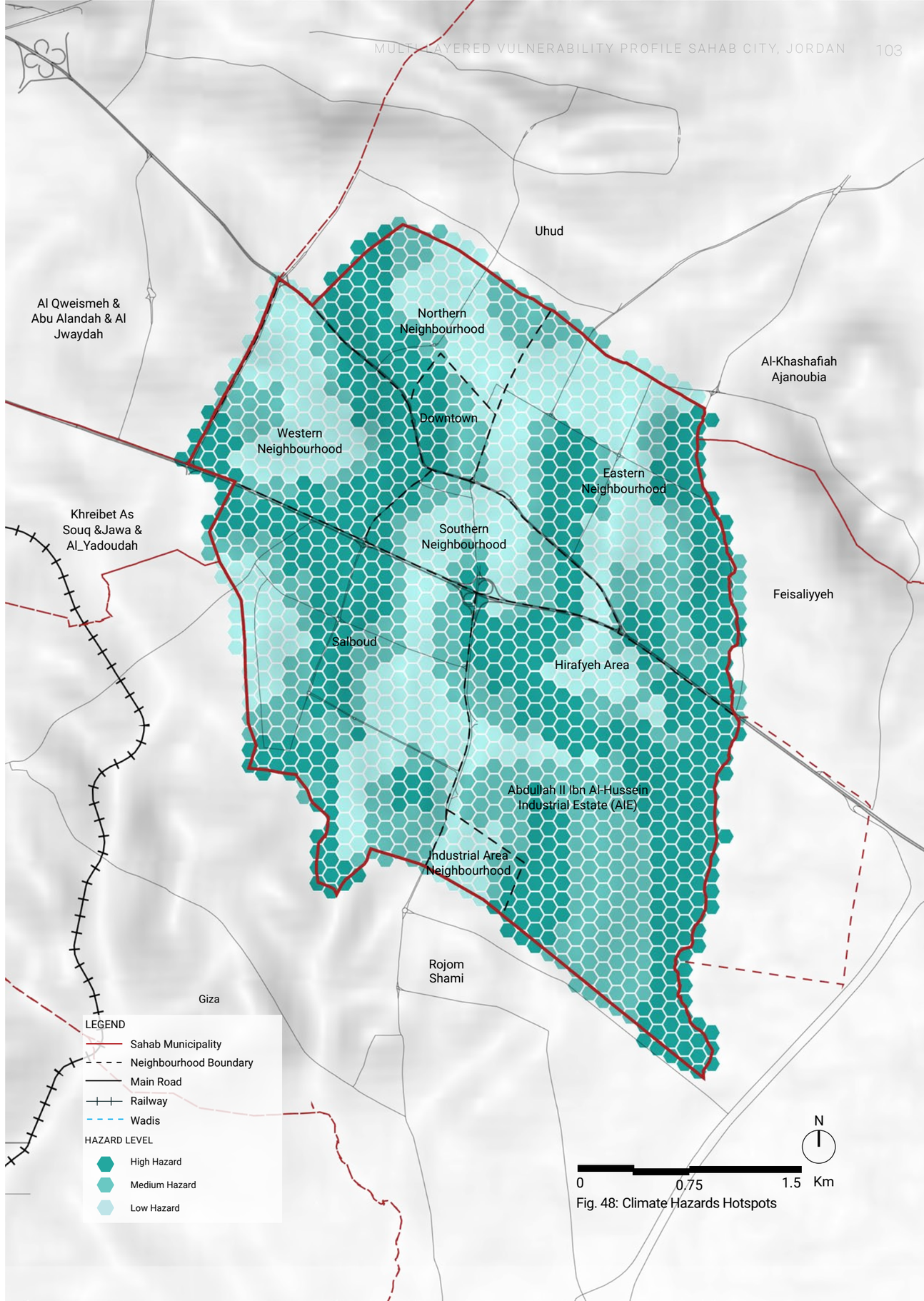
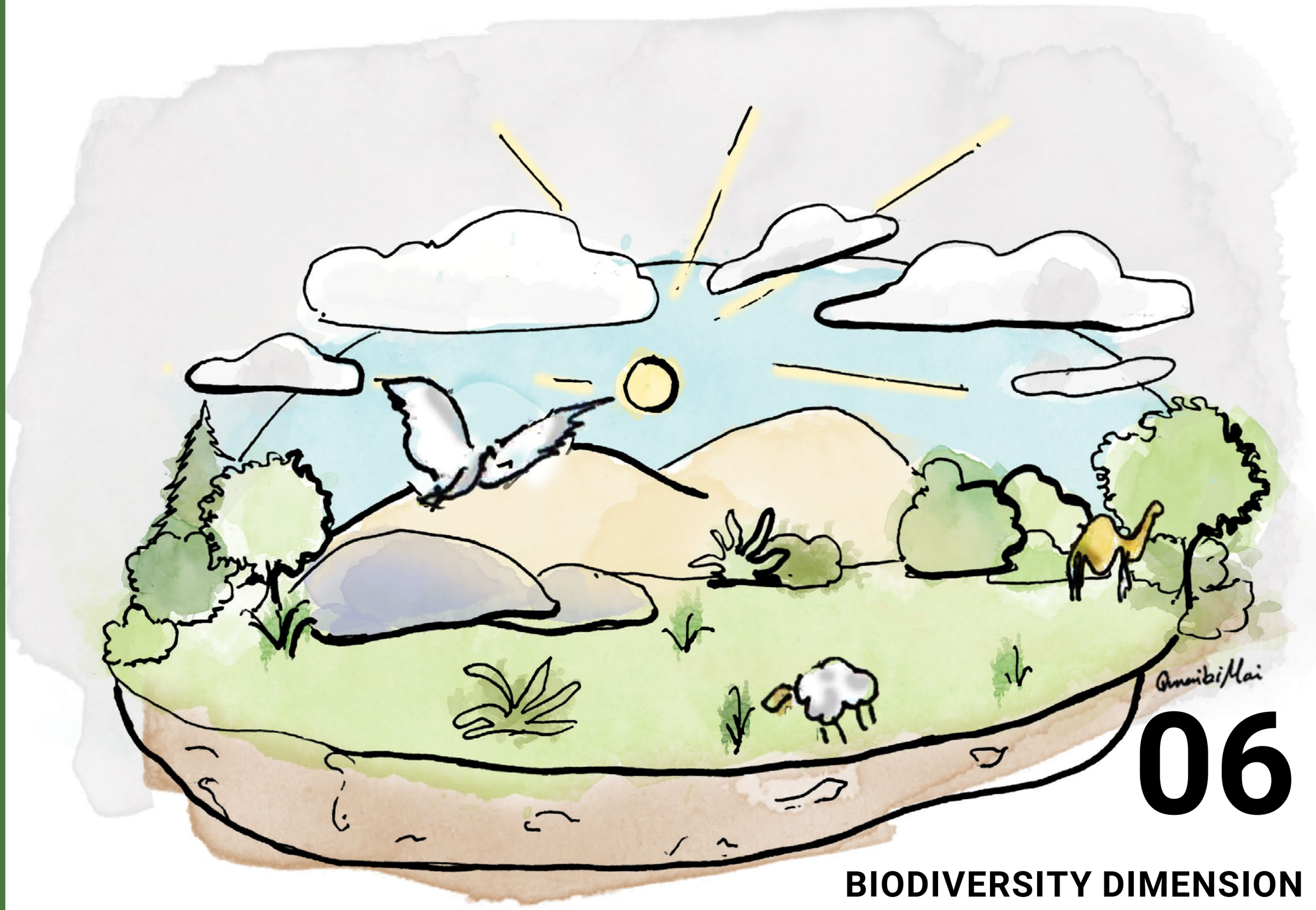


Fig. 48: Climate Hazards Hotspots



06

BIODIVERSITY DIMENSION

Introduction to Biodiversity Dimension

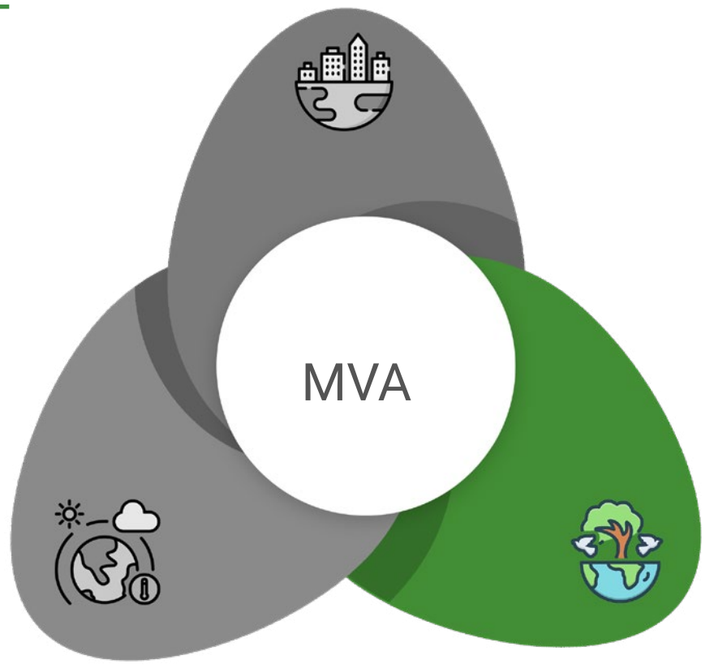
A key challenge in developing the biodiversity dimension of the Multi-Vulnerability Assessment (MVA) for Sahab Municipality was the lack of spatial data at the local level, making it difficult to accurately assess biodiversity. Given the data limitations at the local level, focusing on the "Biodiversity Connectivity" indicator suffices for the MVA as it offers valuable insights into how urbanization and population density influence the ability of ecosystems to adapt to climate change. Despite the lack of comprehensive spatial data, this indicator helps assess the critical relationship between urban growth, access to services, and the integrity of natural habitats, providing a relevant and practical basis for understanding biodiversity resilience in Sahab.

The emphasis on biodiversity connectivity aligns with national and local policy frameworks that promote sustainable development and enhance climate resilience. These frameworks emphasize the need for maintaining ecological networks and green spaces as part of broader climate adaptation strategies, ensuring that urban expansion does not come at the expense of essential natural habitats. Addressing the root causes of biodiversity and climate challenges requires a shift in perspective, emphasizing the value of natural systems as integral to urban resilience and adopting long-term planning approaches that balance growth with environmental and climate adaptation needs.

Indicator 1: Biodiversity Connectivity: This indicator was selected as the primary indicator for assessing the biodiversity dimension of vulnerability for several reasons:

- **Understanding Habitat Fragmentation:** The indicator helps analyse how urbanization affects the continuity of natural habitats. By mapping the spatial distribution of green spaces, parks, tree cover, and natural corridors, it assesses how species can move and interact within their environment. This is particularly important in Sahab, where rapid urban growth threatens to isolate pockets of natural habitat.
- **Assessing Climate Resilience:** Biodiversity Connectivity serves as a measure of ecological resilience in the face of climate change. Areas with higher connectivity are better equipped to support species migration, enabling plants and animals to adapt to shifts in temperature and precipitation patterns. This makes connectivity a crucial factor for long-term ecosystem stability.
- **Linking Human and Ecological Systems:** This indicator also provides insights into how human activities, such as increasing population density and expanding infrastructure, intersect with the natural landscape. By evaluating how well-connected green spaces are amidst urban areas, it offers a way to balance the needs for development with the need to preserve ecological functions.

BIODIVERSITY DIMENSION



SELECTED INDICATORS:

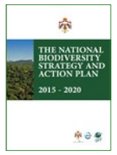
Biodiversity Connectivity

International

- UN Agreement on Biodiversity
- UN Agreement on Fighting desertification

National

- Jordan National Biodiversity Strategy and Action Plan (NBSAP)



- A Toolkit for Mainstreaming Biodiversity in Jordan

- Environmental Law 2017

- Soil Protection By-Laws

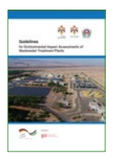
- Natural Reserves and National Parks By-Laws

- Air Protection By-Laws

- Strategy of Environmental Education for Sustainability

- Agriculture Law

- New Plant Varieties Protection Law



- Guidelines for Environmental Impact Assessments of Wastewater Treatment Plants

Indicator 1: Biodiversity Connectivity at Regional Scale

Jordan's landscape features three main topographic areas: the Jordan Rift Valley, mountain ranges extending from north to south, and a desert plateau. These variations contribute to the country's division into four main bio-geographic regions:

- **Mediterranean Region:** This area spans the highlands from Irbid in the north to Ras Al-Naqab in the south, with altitudes ranging from 700 to 1,850 meters. It receives 300-600 mm of rainfall annually, supporting fertile soil and making it home to 90% of Jordan's population. The Mediterranean region contains forests and diverse plant life, primarily on red and yellow Mediterranean soils.
- **Irano-Turanian Region:** Encircling the Mediterranean region except in the north, this treeless zone features small shrubs such as Artemisia herba-alba and Anabasis syriaca. Altitudes range between 500 and 700 meters, with annual rainfall of 150-300 mm. The soil is generally calcareous, and vegetation is dominated by low shrubs adapted to the semi-arid conditions.
- **Saharo-Arabian Region:** This region covers about 80% of Jordan's land area, encompassing the eastern desert or Badia. Characterized by a flat terrain with occasional volcanic hills, it experiences mean annual rainfall between 50 and 200 mm. Vegetation is sparse, mostly small shrubs and annuals, particularly in wadi beds, reflecting the harsh desert climate.
- **Sudanian Region:** This subtropical zone stretches from the northern Dead Sea to the Gulf of Aqaba, lying along the Dead Sea depression and Wadi Araba. It features the lowest point on Earth near the Dead Sea, at 410 meters below sea level. Rainfall is minimal, ranging from 50 to 100 mm, with tropical vegetation such as Acacia species and Ziziphus spina-christi. The soils are a mix of alluvial, saline, and sandy, with some granitic regions, and it is the only area in Jordan with inland sand dunes.

The country hosts 13 identified vegetation types, showcasing the interplay of these variations. This diversity contributes to the presence of approximately 4,000 species of terrestrial and marine flora and fauna across Jordan. Among its 2,622 recorded species of vascular plants, which account for about 1% of the world's flora, there are 100 endemic species, including Iris nigricans (Jordan's floral emblem), Plantago maris-mortui, Crucianella transjordanica, Centaurea procurrens, Scrophularia nabataerum, Tamarix tetragyna, and T. palaestina.

Jordan is home to 644 animal species, of which 83 are mammals, including several globally threatened species such as Capra nubiana (Nubian ibex), Gazella dorcas (Dorcas gazelle), Gazella subgutturosa (goitered gazelle), Gazella gazella (mountain gazelle), and Oryx leucoryx (Arabian oryx). The country's avifauna is particularly diverse due to its position along the Great Rift Valley, a significant migratory route for birds. Key bird species include Geronticus eremita (northern bald ibis), Chlamydotis macqueenii (MacQueen's bustard), Neophron percnopterus (Egyptian vulture), Serinus syriacus (Syrian serin), and Vanellus gregarius (sociable lapwing).

The Gulf of Aqaba, at the southern tip of Jordan, is a biodiversity hotspot in the Red Sea, home to more than 348 fish species, 151 species of hard corals, and 120 species of soft corals. This marine region also harbors a wide range of invertebrates, including snails, crabs, and sea worms, as well as three threatened species of sea turtles. The rate of endemism among the Red Sea's fish is notable, with about 13.7% of fish species endemic to this area, including seven unique species. More than 20% of mollusks, echinoderms, and some algae species in the Gulf may also be endemic. The freshwater ecosystems in Jordan, though limited, are significant, featuring 15 recorded species, including the endemic Aphanius sirhani.

The regional landcover map illustrates the landcover around Amman, including Sahab Municipality, highlighting the extent of built-up areas and their relationship with surrounding vegetation and landscapes. The massive grey areas representing the urbanized regions around Amman and Sahab Municipality reveal dense urban development. This urban sprawl fragments natural habitats, creating barriers that disrupt ecosystem connectivity. As a result, species that depend on expansive, continuous habitats for migration, feeding, and breeding struggle to move freely between suitable environments.

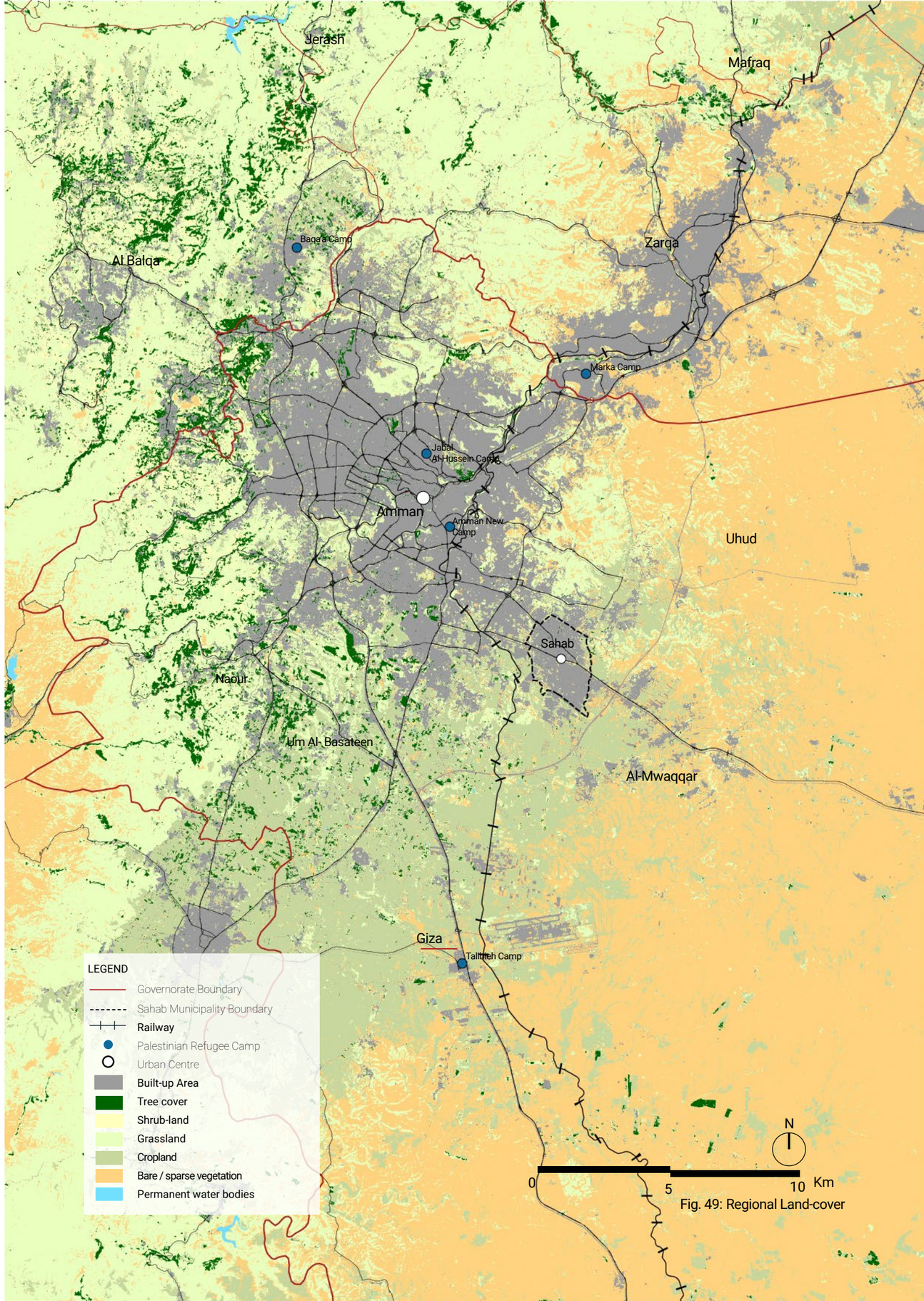


Fig. 49: Regional Land-cover

Biodiversity Connectivity at City Scale

The Sahab Municipality's environment is shaped by influences from two major biogeographical regions of Jordan, the Saharo-Arabian and Irano-Turanian zones. These regions bring a combination of arid and semi-arid conditions that have evolved over centuries, creating an environment where biodiversity is uniquely adapted to endure extreme conditions. Species in Sahab Municipality have developed resilience, thriving in areas where water is scarce, poor soil quality and temperatures fluctuate between intense heat in summer and cooler conditions in winter. The Municipality's bioclimatic profile, encompasses both Semi-Arid Warm and Arid Cool zones, creating a unique environment with specific temperature and moisture conditions. These zones are characterized by low precipitation levels and seasonal variations that influence the local vegetation and wildlife.

The vegetation type in Sahab Municipality is primarily characterized by Mediterranean non-forest vegetation and steppe vegetation, which represent a transition zone between the more humid Mediterranean regions and the arid deserts typical of the Saharo-Arabian zone. The mediterranean non-forest vegetation consists of drought-tolerant shrubs, herbs, and small bushes. Meanwhile the steppe vegetation is characterized by grasses, low shrubs, and herbs that are resilient to the dry conditions. Common plant species include Artemisia herba-alba and Anabasis syriaca. The fauna in Sahab Municipality includes species adapted to desert environments. While specific data on the Sahab Municipality's wildlife is limited, it is likely to host various reptiles, small mammals, and birds that thrive in similar arid regions. Species such as the Uromastyx aegyptia (Egyptian spiny-tailed lizard) and Varanus griseus (desert monitor) are examples of reptiles that might be found in the area. Given its proximity to migratory routes, Sahab may also see a variety of bird species passing through, especially during migration seasons. Birds such as the Neophron percnopterus (Egyptian vulture) and other raptors might be observed.

This natural resilience is critical for the Sahab Municipality's flora and fauna, as they navigate the challenges of limited water availability and harsh climatic conditions. However, despite their adaptability, these ecosystems face significant pressure from human activities. The rapid industrialization and urban expansion in Sahab have accelerated habitat degradation, posing a considerable threat to the area's ecological balance. The city's growth has converted large portions of natural landscapes into urbanized and industrial zones, leaving only small, isolated patches of natural habitats. These patches are often disconnected from one another, forming a fragmented ecological network that impedes the movement and migration of species. Pollution, including industrial emissions and waste, compounds these challenges by degrading the quality of remaining natural areas. Air pollution, such as elevated nitrogen dioxide (NO_2) levels, further impacts plant and animal health. The over-extraction of natural resources, such as water, strains the already scarce supplies, putting additional pressure on the natural systems that support biodiversity. These combined effects mean that restoration efforts in Sahab Municipality are difficult. Restoring ecological connectivity requires strategic planning to reconnect fragmented habitats, possibly through the creation of ecological corridors or green spaces that link isolated areas. On the other hand, conservation efforts are essential to protect the remaining natural habitats and species in the area.

The landcover map of Sahab City provides a detailed view of the spatial distribution of vegetation and built-up areas within the municipality, highlighting the mix of urbanized zones and the remaining patches of natural or agricultural land. This fragmented landscape has significant ecological impacts, as urban expansion reduces the availability of natural habitats, disrupts ecosystem connectivity, and limits biodiversity. The diminishing green spaces also reduce the land's ability to absorb water and regulate temperatures, contributing to issues such as urban heat islands and increased flood risks.

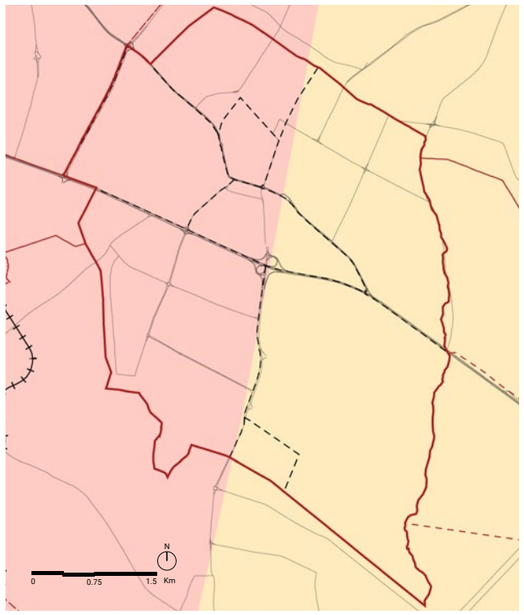


Fig. 50: Vegetation Type in Sahab City

LEGEND
- Sahab Municipality
- Neighbourhood Boundary
- Main Road
- Railway

VEGETATION TYPE
- Mediterranean non-forest vegetation
- Steppe vegetation

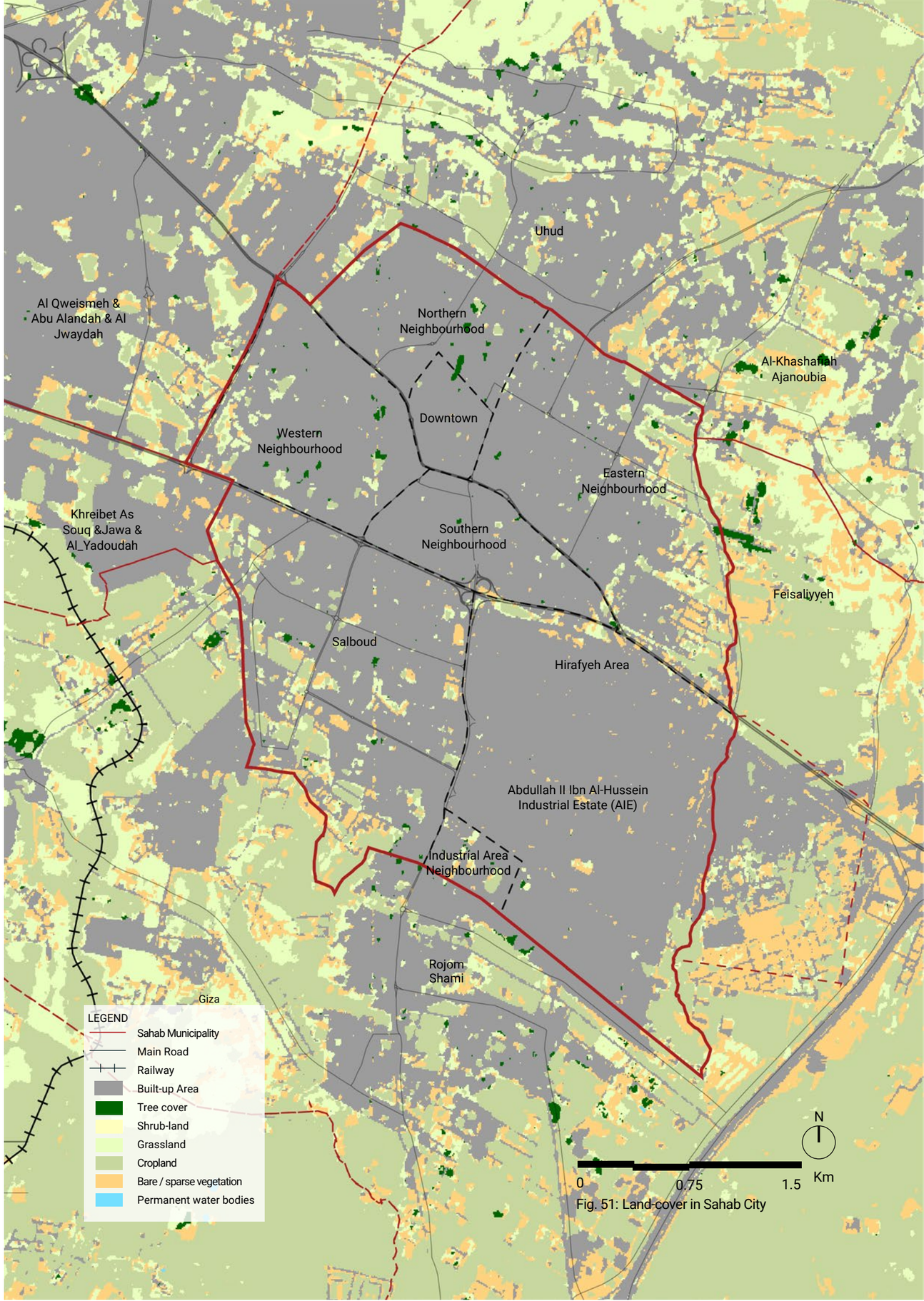


Fig. 51: Land-cover in Sahab City

Biodiversity Multi-Hazard Mapping in Sahab City

This MVA of this dimension highlights that biodiversity loss and ecosystem fragmentation are critical factors influencing Sahab's vulnerability to climate change. The degradation of natural spaces increases flood risks, exacerbates the urban heat island effect, and limits water retention, which poses direct threats to the community's well-being. Fragmented ecosystems reduce vital services like temperature regulation and carbon sequestration, weakening climate resilience. For Sahab's people, infrastructure, and systems, these vulnerabilities translate into increased risks from extreme weather, water scarcity, health issues, and infrastructure damage.

To overcome the limitations of available data and gain a clearer understanding of biodiversity vulnerability hotspots in Sahab Municipality, we conducted a comprehensive GIS analysis. This approach integrated multiple land cover layers, each given equal weighting, to provide a more detailed and accurate assessment of biodiversity vulnerability throughout the municipality.

The key findings of the analysis are as follows:

- **High Vulnerability:** Areas with high connectivity, mostly surrounded by natural ecosystems such as tree cover, shrub-land, and grassland. These zones exhibit a high level of connectivity between natural ecosystems, such as tree cover, shrubland, and grassland, making them essential habitats for local flora and fauna. Despite their ecological significance, these areas are highly vulnerable due to increasing urbanization and industrialization in surrounding regions. The pressure from expanding built environments can fragment these ecosystems, reducing their capacity to support diverse species and their resilience to climate change. Key areas at risk include Downtown, Eastern Neighbourhood, and Salboud, where development pressures continue to challenge ecosystem connectivity.
- **Medium Vulnerability:** Transitional zones where natural ecosystems (such as semi-arid shrubs or grasslands) mix with urbanized or degraded land represent areas of moderate vulnerability. These regions are characterized by moderate fragmentation, where some patches of natural habitats remain but are increasingly isolated by roads, industrial zones, and expanding infrastructure. While these areas still offer some level of ecological function, their ability to support biodiversity is diminishing as urban pressures intensify, potentially leading to the decline of species that depend on larger, continuous habitats.
- **Low Vulnerability:** These zones, characterized by a lack of connectivity, are predominantly surrounded by heavily degraded or developed land, including built-up areas, industrial zones, cropland, and barren land. These regions offer minimal ecological value for wildlife and contribute little to the broader landscape's biodiversity. The presence of industrial hazards, waste, and pollution further exacerbates the vulnerability of these areas. The absence of natural corridors and green spaces limits the movement of species, reducing opportunities for migration, genetic exchange, and overall ecological resilience. Notable areas facing these challenges include the Abdullah II Ibn Al-Hussein Industrial Estate (AIE) and the Hirafyeh Area.

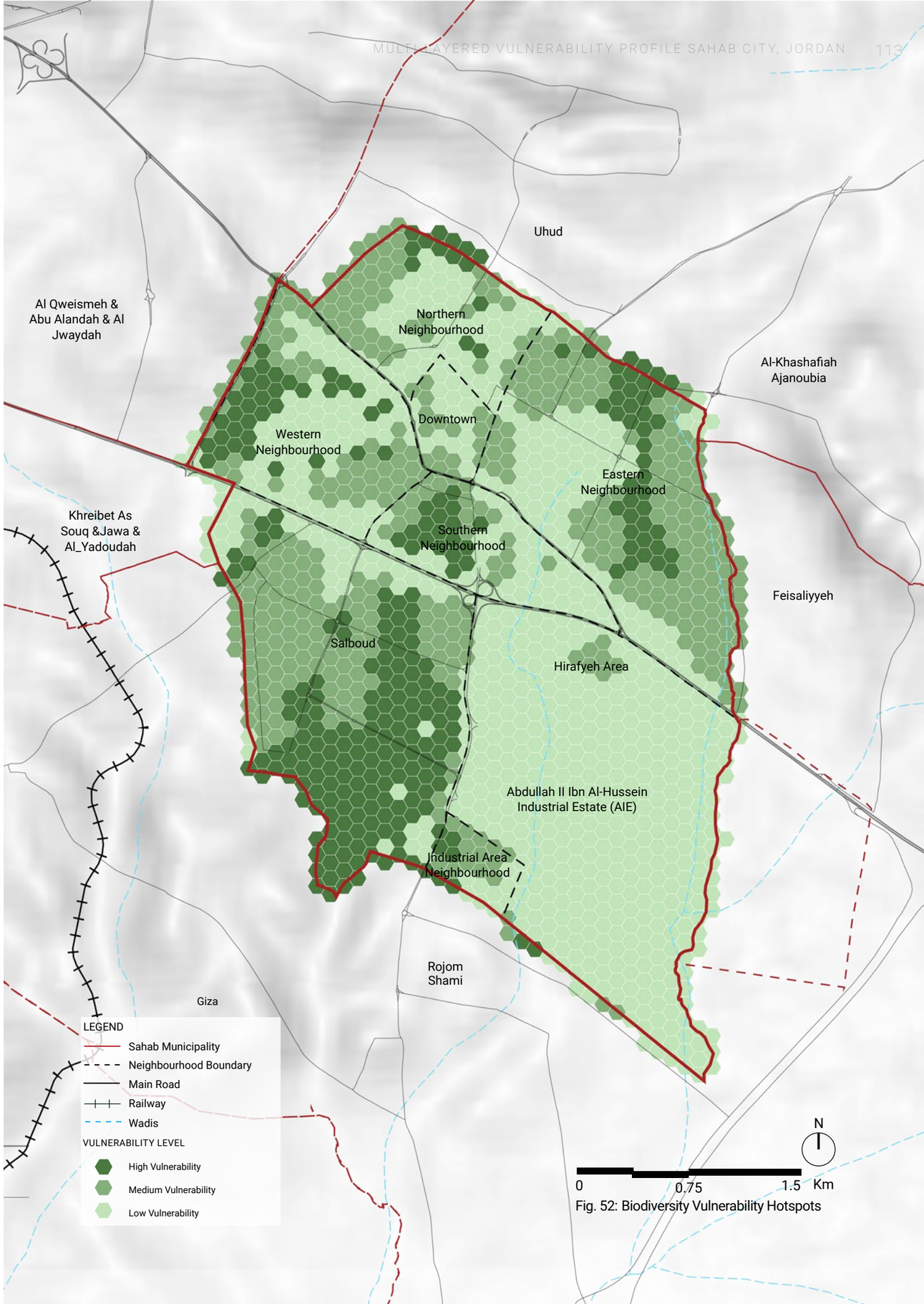


Fig. 52: Biodiversity Vulnerability Hotspots

07

STAKEHOLDERS VALIDATION

Stakeholder Validation Workshop

As part of the participatory approach adopted throughout the project, a validation workshop was held on the 30th of September 2024 with key stakeholders, including Sahab Municipality, the Ministry of Environment, the Ministry of Local Administration, other key stakeholders from relevant ministries and development entities relevant governmental entities, in addition to representatives from the industrial area, to review and validate the developed Multi-layered Vulnerability and Hazard Assessment for Sahab City.

The workshop began with a presentation of the findings from the city context analysis, followed by the vulnerability assessment of the urban and biodiversity dimensions, as well as the climate change hazard mapping specific to Sahab City. Following the presentation, participants were divided into three groups, each tasked with identifying hotspot areas for each dimension. Subsequently, the groups combined their findings to overlay all three dimensions, identifying areas where vulnerabilities intersected across urban, biodiversity, and climate change factors. Additionally, participants were asked to propose mitigation measures that could be integrated into the development of the action plan, ensuring a comprehensive approach to addressing these intersecting challenges.

Based on the interactive and participatory exercise, the main findings revealed several critical hotspots across Sahab City that intersect across the vulnerabilities of the three dimensions.

The black hatched areas on the map showed in Fig. 54 highlight regions in Sahab City where multiple vulnerabilities converge, making these zones critical for intervention. These areas face a combination of environmental, social, and infrastructural challenges, including poor vegetation cover, damaged infrastructure, and significant air pollution, all of which degrade the quality of life for residents. Additionally, these regions are prone to drought and heatwaves, leading to water scarcity and further stress on local resources.

Social vulnerabilities are also prevalent in the hatched areas, where poor access to public transportation and high population density exacerbate the challenges faced by the community. These factors, combined with the physical hazards, indicate that these regions are among the most vulnerable in the city. As a result, the black hatched areas represent the multi-vulnerabilityareas in Sahab from the key stakeholder's point of view where interventions should be prioritized to address the overlapping risks and enhance the city's overall resilience.

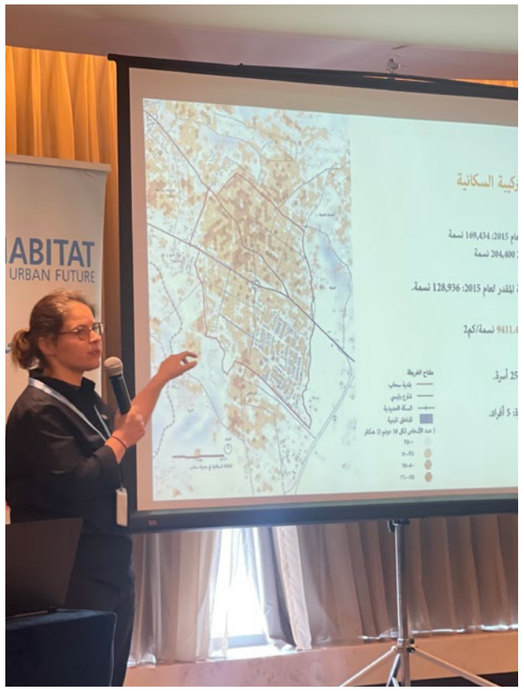


Fig. 53: Images from the validation workshop

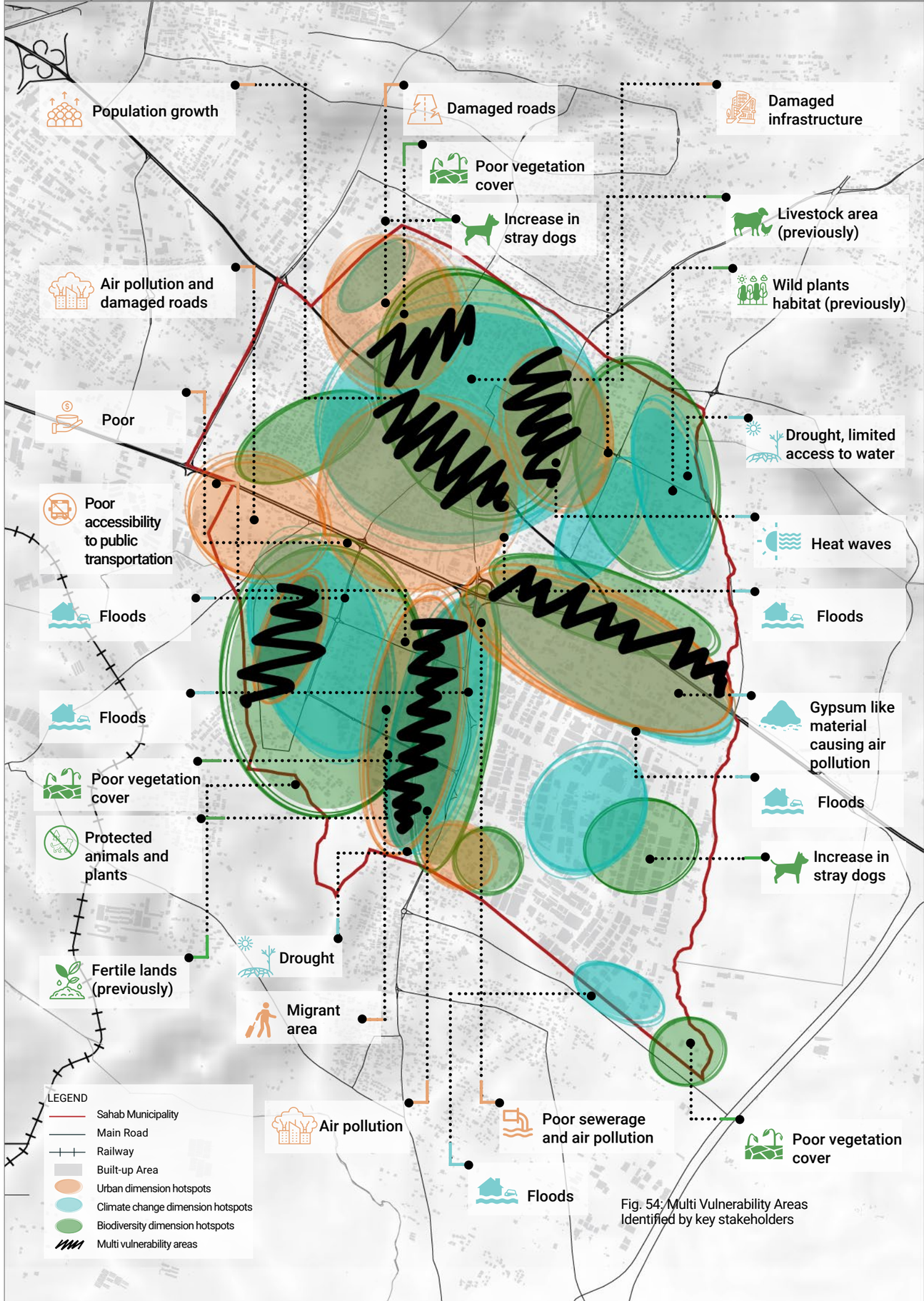
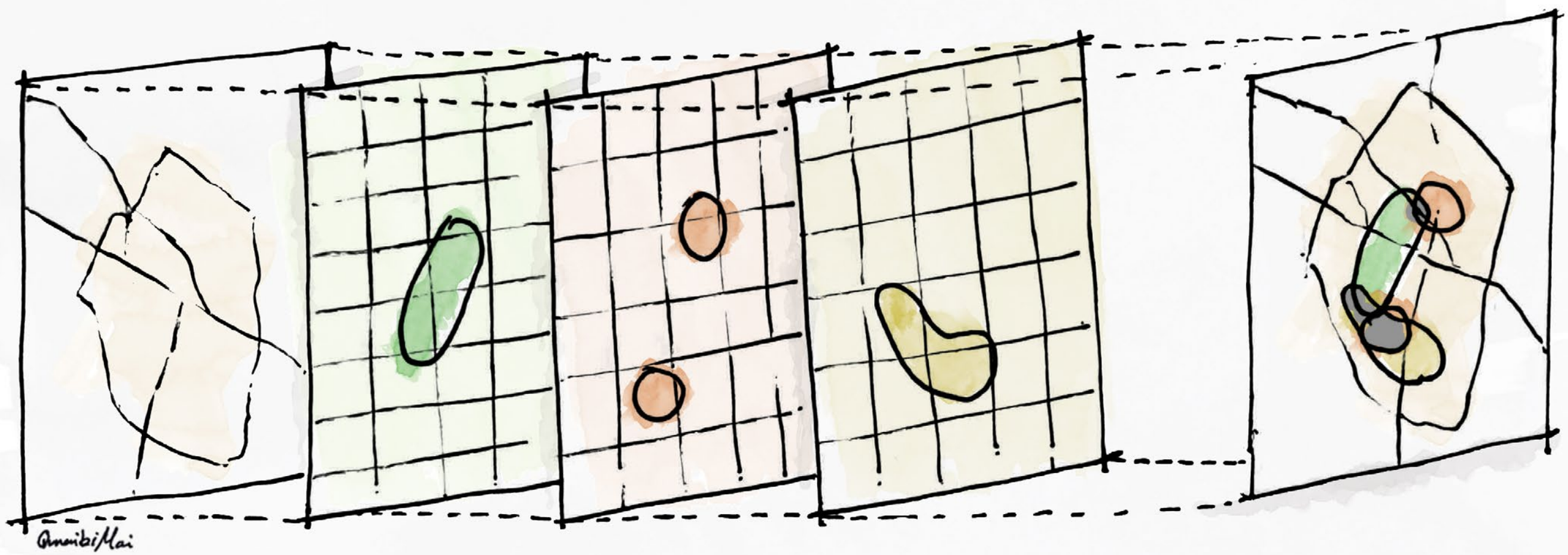


Fig. 54: Multi Vulnerability Areas Identified by key stakeholders



08

MULTI-LAYERED VULNERABILITY ASSESSMENT

Interconnected Dimensions

In this section of the assessment, we explore the interconnected vulnerabilities in Sahab Municipality, focusing on urban, biodiversity, and climate-related challenges. By overlaying areas of high urban vulnerability, high climate hazards, and low biodiversity, we can identify critical hotspots where these factors intersect. These hotspots represent areas in need of immediate and targeted interventions to mitigate risks and enhance resilience.

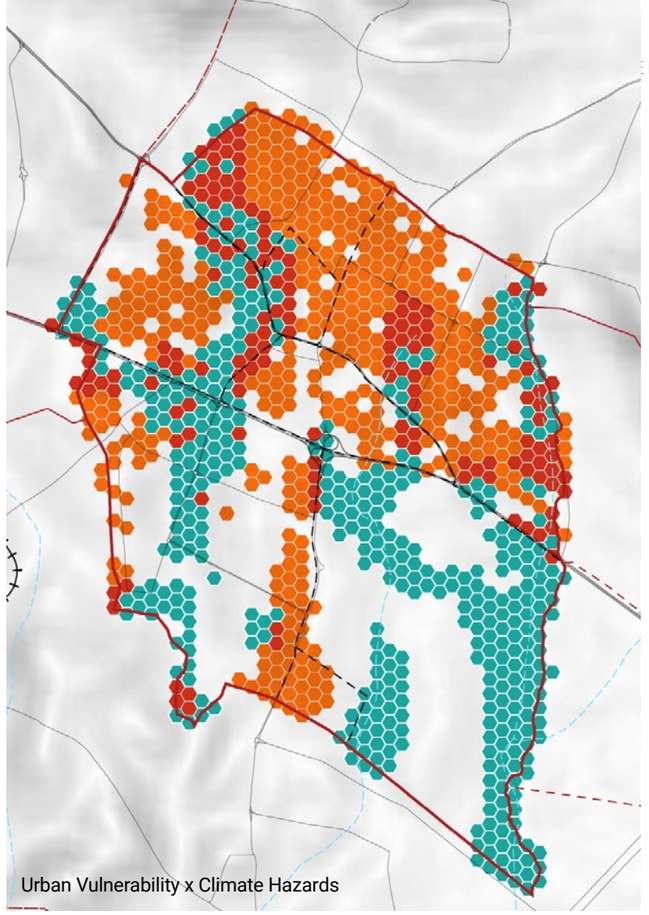
Urban Vulnerability x Climate Hazards: This map highlights areas where urban zones are particularly vulnerable to climate hazards, with the highest concentrations of vulnerability shown in red shade. The intersection of urban vulnerability and climate hazards in Sahab Municipality creates compounded risks for people, infrastructure, and ecosystems. Urban areas are particularly vulnerable to heatwaves, flooding, and droughts, with the Urban Heat Island effect exacerbating the heat, increasing energy demand, and stressing infrastructure. Poor stormwater management and fragmented ecosystems further elevate the risk of flooding and biodiversity loss, weakening the municipality's overall climate resilience. Additionally, the rapid urbanization in Sahab Municipality has led to the replacement of natural land cover with impervious surfaces such as concrete and asphalt, which not only intensify the heat but also reduce the land's natural ability to absorb water. This, in turn, exacerbates both the risk of urban heat islands and surface runoff during storms, leading to flash floods and erosion. The lack of green infrastructure limits the municipality's capacity to cool down urban areas, manage stormwater, and reduce air pollution. Furthermore, as climate change intensifies, the frequency and severity of extreme weather events, including heatwaves and intense rainfall, will likely increase, further amplifying these vulnerabilities. Without proactive climate adaptation strategies, such as investing in green infrastructure, improving urban drainage systems, and enhancing climate-resilient building codes, Sahab's urban areas will continue to face growing challenges in coping with climate-related hazards.

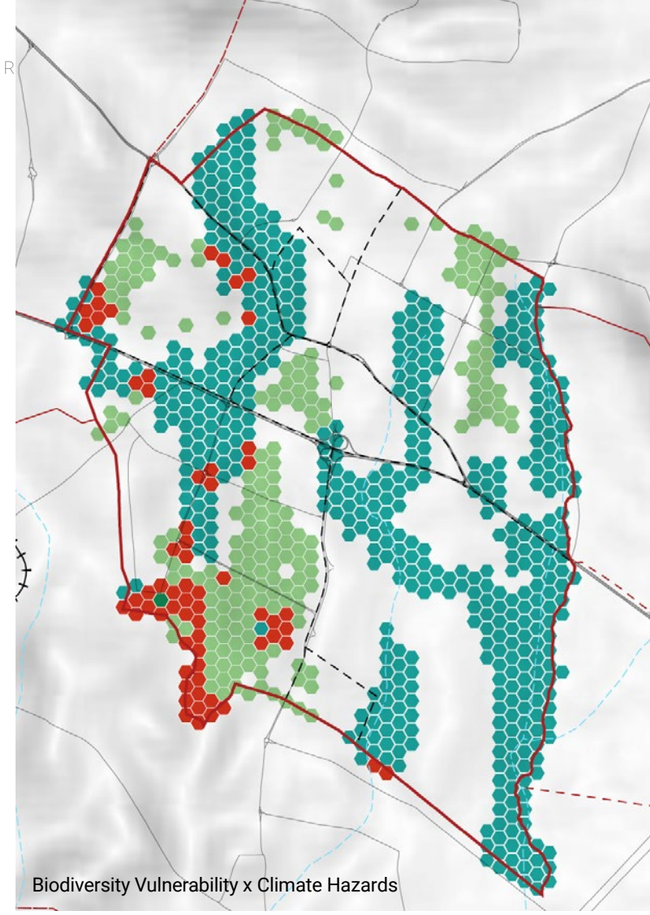
Urban Vulnerability x Biodiversity Vulnerability: This map showcases the overlap between highly vulnerable urban areas and biodiversity zones. By identifying hotspots where urban and biodiversity vulnerabilities intersect, we can target interventions that aim to protect the remaining natural ecosystems. These areas require integrated management strategies that balance urban growth with the need to conserve biodiversity. As Sahab continues to urbanize and industrialize, the encroachment on natural habitats intensifies the pressure on biodiversity, making it increasingly difficult for ecosystems to adapt to both urban growth and climate change. The expansion of built-up areas disrupts essential ecological corridors, isolating species and limiting their ability to migrate or adapt to shifting environmental conditions, particularly as rising temperatures and water scarcity make habitats less suitable. Pollution from industrial activities, combined with inadequate waste management and water contamination, further degrades surrounding ecosystems, diminishing their ability to regulate water flow, improve air quality, and provide other vital services. In a densely populated, heat-stressed city like Sahab, where water resources are already scarce, the depletion of natural systems further strains the city's resilience, amplifying the impacts of climate hazards such as heatwaves and droughts. These compounded challenges highlight the urgent need for integrated land-use strategies that balance urban expansion with the conservation of remaining natural spaces, ensuring the resilience of both ecosystems and urban communities in the face of climate change.

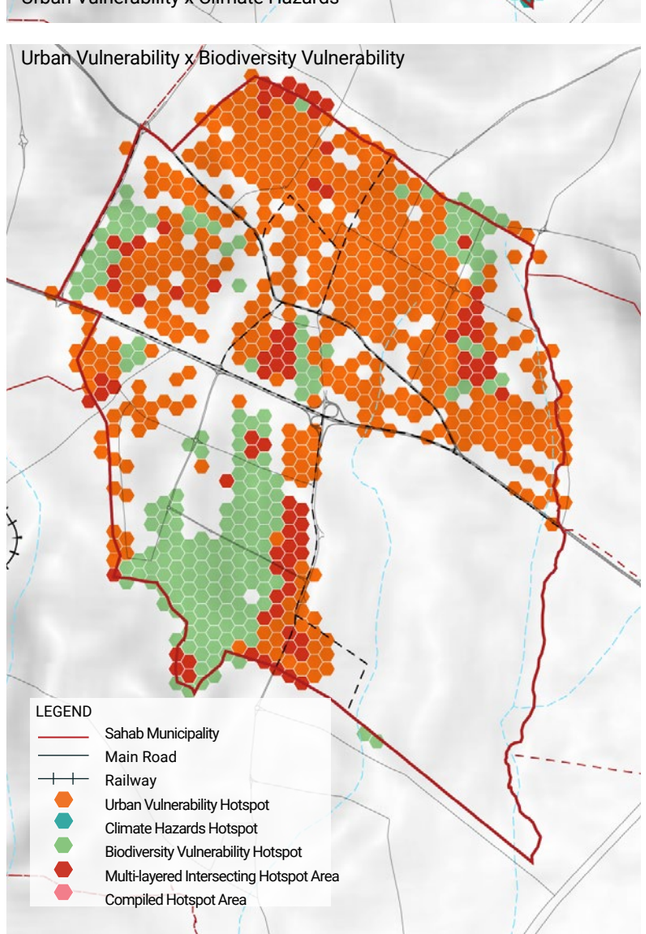
Biodiversity Vulnerability x Climate Hazards: The intersection of biodiversity vulnerabilities and climate hazards in Sahab creates compounded risks for people, infrastructure, and ecosystems. As natural habitats face degradation and fragmentation, the remaining ecosystems—already under pressure from urbanization—become less capable of providing essential services like regulating temperature, filtering water, and sequestering carbon. This loss of ecosystem services exacerbates climate vulnerabilities, particularly in urban areas where the heat island effect intensifies temperature extremes, increasing energy demand and straining infrastructure. For the population, the degradation of ecosystems impacts health, food security, and water availability, while simultaneously heightening exposure to climate-related risks such as floods and droughts. The lack of green infrastructure and natural buffers leaves the city increasingly vulnerable to climate shocks, and the encroachment on biodiversity-rich areas further compounds these threats. With ecosystems fragmented, species struggle to adapt to changing conditions, and urbanized areas become increasingly disconnected from essential ecological processes. This not only threatens the local biodiversity but also limits the capacity of Sahab's infrastructure to adapt to climate challenges. Integrated planning that recognizes the interconnectedness of climate hazards and biodiversity conservation is critical to protecting both people and ecosystems in Sahab. The simultaneous protection of natural areas and infrastructure improvements will enhance overall resilience, creating a more sustainable and climate-adaptive urban environment.This map overlays areas of high vulnerable biodiversity zones with high climate hazard zones to identify ecosystems most at risk from climate change. Safeguarding these remaining natural areas can help buffer against climate hazards and enhance the resilience of Sahab's environment.

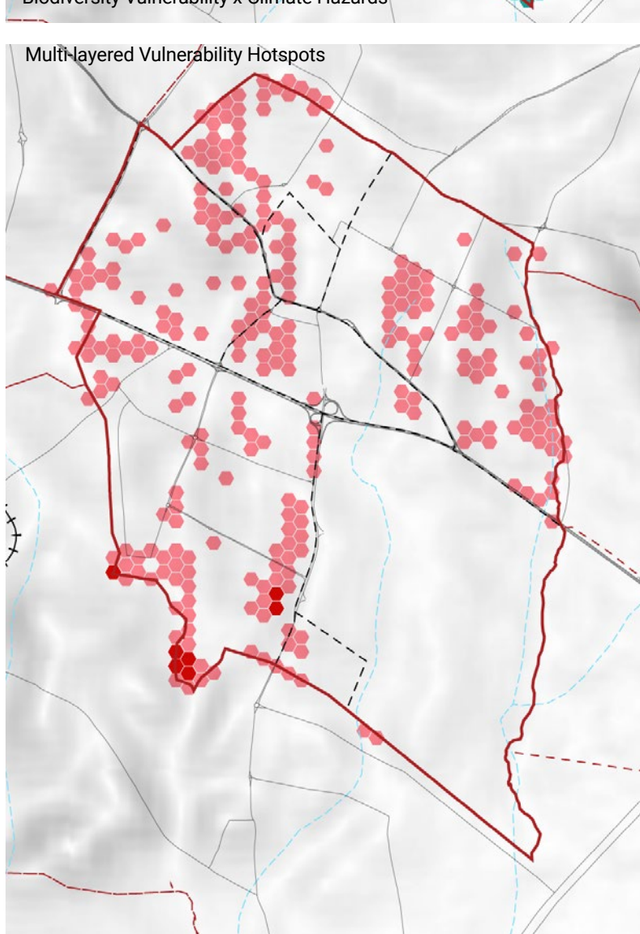
Multi-layered Vulnerability Hotspots: The comprehensive map that overlays multilayered vulnerabilities in Sahab, with the goal of identifying critical hotspots where the intersection of climate hazards, urbanization, and biodiversity loss is most pronounced.This map serves as a valuable tool for pinpointing areas in urgent need of intervention, allowing for targeted actions that improve resilience. The areas shown in red represent the most critical hotspots, face compounded threats, with urban expansion exacerbating climate vulnerabilities such as heatwaves, flooding, and droughts, while also fragmenting ecosystems and reducing biodiversity. The lack of green infrastructure, poor stormwater drainage, and pollution further amplify the challenges. These zones are primarily located in urbanized and industrial areas of Sahab, where rapid development has already placed immense pressure on both the environment and infrastructure. In these hotspots, the compounded effects of the UHI effect are felt strongly, with high temperatures exacerbated by a lack of green spaces and poor stormwater drainage systems, making the areas highly susceptible to flooding during heavy rains and heatwaves. The loss and fragmentation of biodiversity are also concentrated in these areas, where urban sprawl has encroached on natural habitats, disrupting ecological corridors and reducing the ability of species to adapt to changing environmental conditions. Additionally, pollution from industrial runoff, waste, and air contaminants further deteriorates these ecosystems, making them increasingly vulnerable to climate change impacts. These hotspots represent critical locations where integrated actions are needed to improve climate resilience, restore natural habitats, and mitigate the pressures of urbanization. These intersected hotspot areas were also part of the identified hotspot areas during the validation session with key stakeholders. This alignment ensures that the proposed interventions are responsive to community needs and grounded in on-the-ground realities.

By focusing on areas - and the communities, infrastructure, systems, assets, and ecosystems within them - highly vulnerable to climate impacts and significant biodiversity degradation, the map supports the development of integrated strategies—such as enhancing green infrastructure, promoting climate-adaptive urban planning, and restoring ecological corridors—to strengthen both the human and ecological systems in Sahab.









Conclusion and Next Steps

In conclusion, after overlaying the high vulnerability areas in the urban dimension with the high hazard areas in the climate change dimension, and the high vulnerability areas in the biodiversity dimension, multi-layered hotspot areas have been identified. These areas are represented in dark red on the map, where the overlap occurs across all three dimensions. The primary concentration of these hotspots is in the Salboud neighborhood, located in the southwest of the city.

Additionally, lighter pink areas on Fig. 55 indicate hotspots resulting from the overlap of two dimensions, reflecting areas with combined vulnerabilities and hazards. These hotspots are distributed across various neighborhoods, with the highest concentration found in the Eastern Neighborhood, located in the northeast of the city.

As a next step, the identified areas will undergo a detailed analysis to gain a deeper understanding of the specific vulnerabilities associated with each dimension. Based on this analysis, targeted actions will be developed to address the unique challenges faced by these hotspots.

A long list of potential projects for these hotspot areas will be identified and validated through engagement with key stakeholders. This long list will then be subjected to a prioritization exercise to produce a shortlist of actions aimed at addressing the most pressing vulnerabilities and challenges.

Building on this process, a vision will be formulated, and a Resilience Action Plan will be developed. Furthermore, action sheets for the shortlisted actions will be prepared to secure funding and support for implementing the necessary interventions.

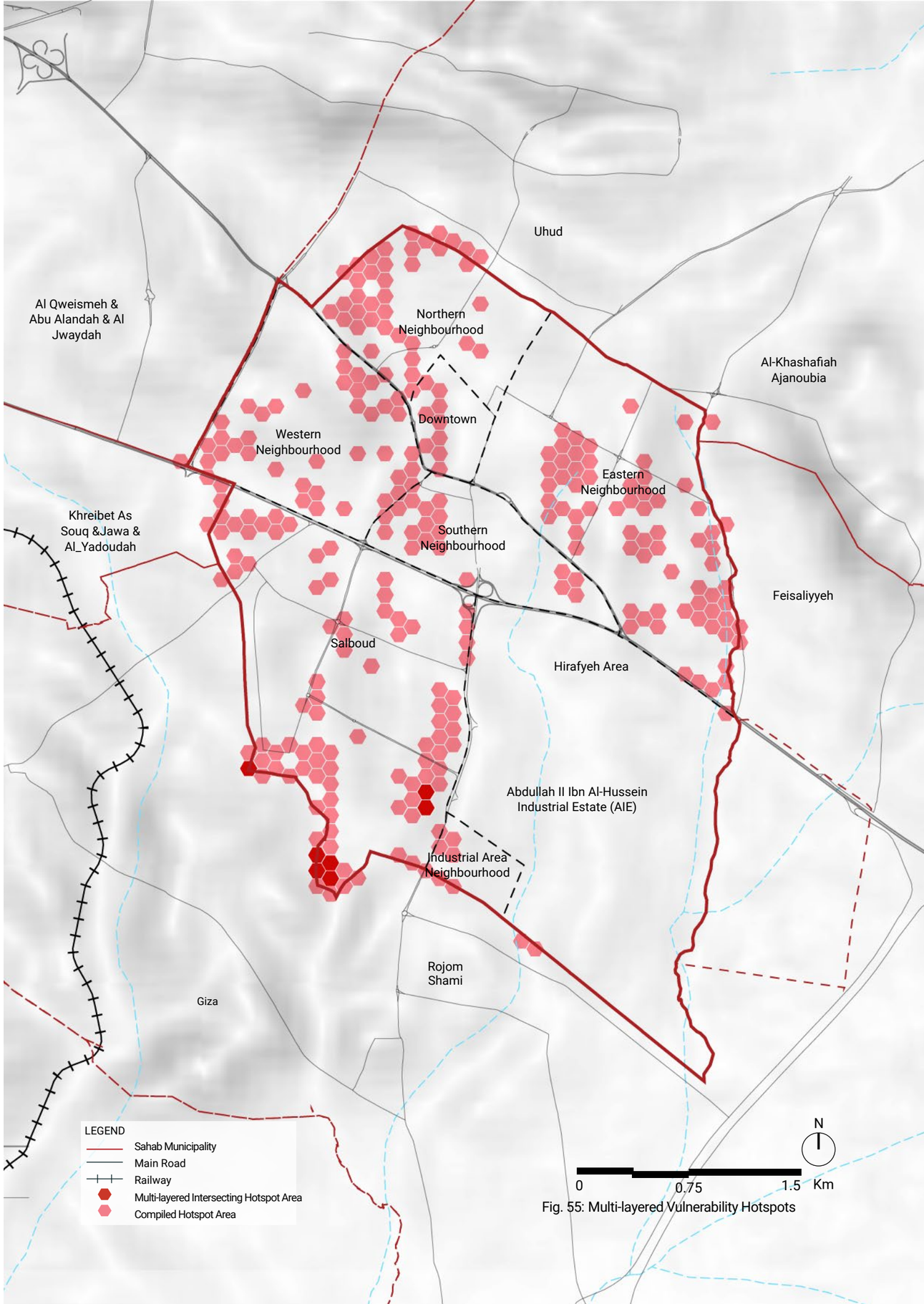


Fig. 55: Multi-layered Vulnerability Hotspots

09

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