METHODOLOGICAL BRIEF

Climate and Water Risk Profile of Jerash Refugee Camp, Jordan

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Front cover photo: Narrow ally within Jerash Camp (*photo*: Maha Al-Zu'bi/IWMI)
Back cover photo: Sky view of Jerash Camp (*photo*: Maha Al-Zu'bi/IWMI)

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1. Key findings on Jerash Camp's risks

- Water availability: The Amman–Zarqa Basin, where Jerash Camp is situated, faces severe water stress, with declining rainfall Per capita water availability is projected to decrease substantially in the future.
- Drought: The frequency and severity of drought events have increased over the past two decades and are projected to intensify further toward the end of the century as climate change progresses.
- Flood: Inadequate housing infrastructure, coupled with narrow alleys and high population density, significantly increases the flood risk in Jerash Camp.
- Integrated socio-climate risk: Most areas of the Jerash Camp fall within multi-hazard zones characterized by high to very high vulnerability levels. These risks are projected to intensify further as climate change impacts become more severe.

2. Background

In Jordan, fragility and displacement intersect with growing environmental pressures. Refugee camps such as Jerash are in areas already facing water scarcity, land degradation, and limited infrastructure. These fragile conditions heighten exposure to climate-related hazards, particularly droughts, floods, and heat stress—while straining local resources and services. Addressing these interconnected socio-climate risks is essential to strengthening resilience and reducing vulnerability among both displaced populations and host communities. In response, the CGIAR Food Frontiers and Security (FFS) Science Program within Area of Work 2 (AoW2), launched the project "Integrated Watershed and Climate Risk Hotspot Mapping to Support Adaptation Strategies in Refugee Camp Landscapes in Jordan", led by the International Water Management Institute (IWMI). The project develops an integrated approach that combines watershed characterization with climate risk hotspot mapping. The aim is to identify key risks to displaced and host communities, with Jerash Camp as a case study. Linking humanitarian action with climate planning and climate finance is crucial for building resilience (Al-Zu'bi et al., 2025). This brief translates the findings of this assessment on the Jerash Camp into a focused risk profile to support local adaptation efforts, planning and building resilience in displacement settings.

3. Overview of Jerash Camp

Jerash Camp, locally known as "Gaza Camp", was established in Jordan in 1968 by The United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) to host around 11,500 Palestinian refugees displaced from the Gaza Strip during the 1967 war. This camp is located about 7 km south of Jerash city and nearly 50 km north of Amman (Figure 1). Today, the camp hosts around 33,000 residents, living in an area of just 0.75 km2, making it one of Jordan's densely populated camps. Jerash camp's population suffers from high poverty, limited employment opportunities, overcrowding, and inadequate housing conditions. Al-Zu'bi (2025) provided detailed description of the camps' socio-economic and its governance setting.

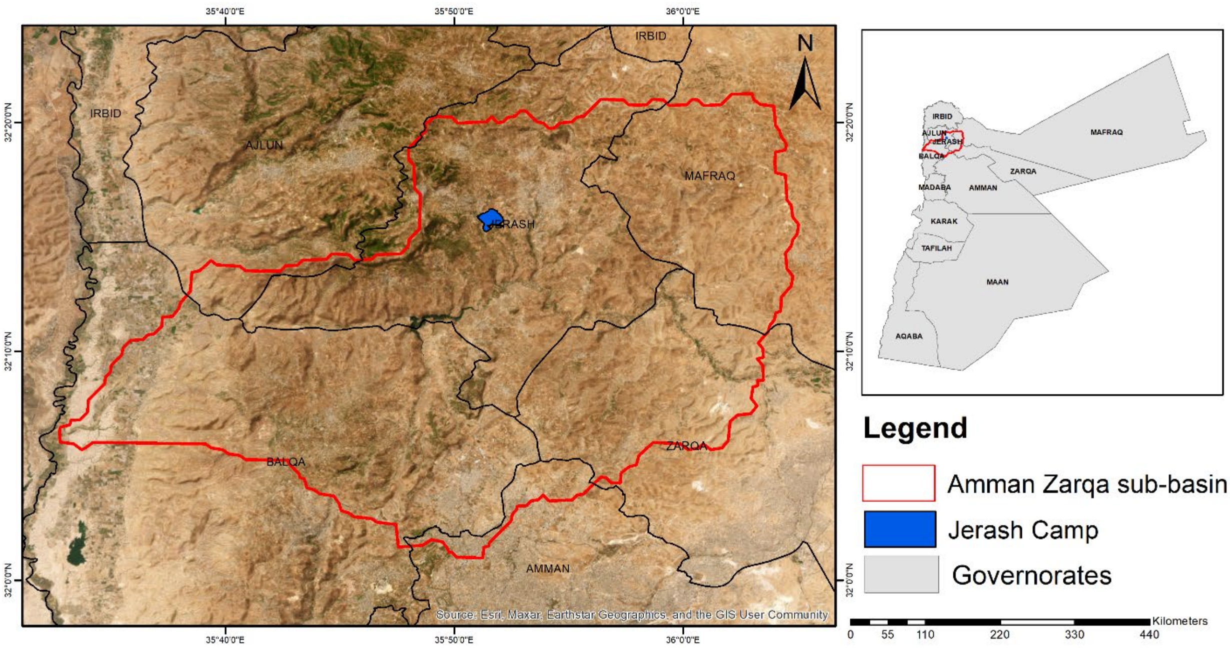

Figure 1. Location map of the Jerash map and the sub-basin of the Amman-Zarqa basin.

4. Overview of the methodological approach

For this assessment, IWMI developed a methodological framework (Figure 2) that integrates hydrological, environmental, and social dimensions into a comprehensive socio-climate risk assessment (Leh et al., 2025). It begins with watershed analysis to understand current and future trajectories of climate and water conditions, examining spatial and temporal dynamics to identify areas most exposed to extreme events such as droughts and floods. This includes evaluating water availability and accessibility for refugee and host communities during periods of stress, as well as screening environmental and social factors—such as vegetation cover, infrastructure quality, and settlement characteristics—that influence local sensitivity to hazards. The outcomes of these analyses feed into an integrated socio-climate risk assessment that combines information on hazard, exposure, sensitivity, and adaptive capacity to characterize community vulnerability. Comprehensive details of the methodological approach developed and adopted for this risk profile assessment can be found in the methodology brief (Leh et al., 2025).

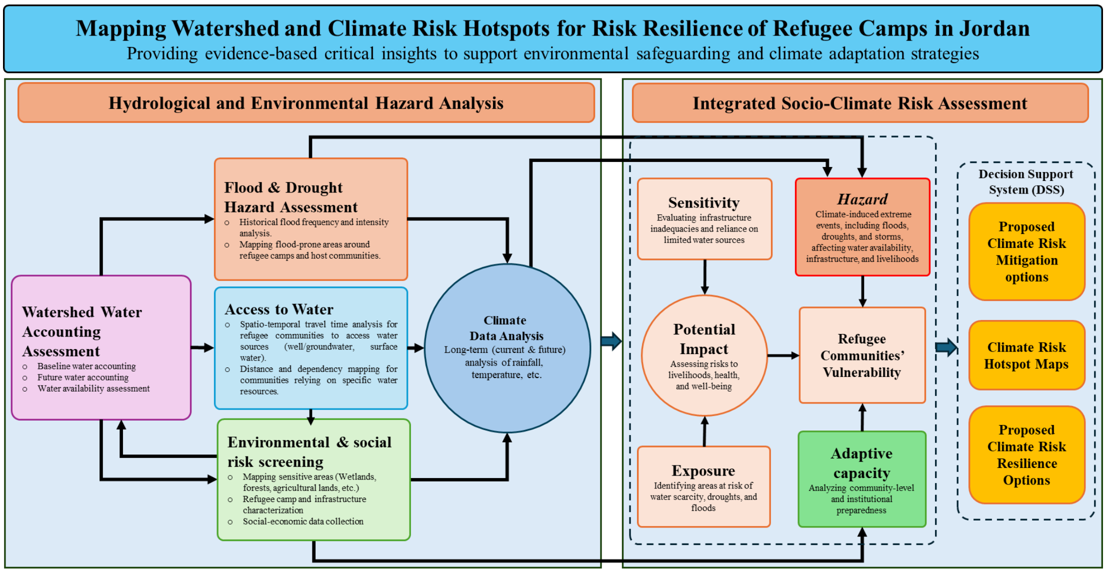

Figure 2. Methodological approach adopted for risk mapping in the Jerash Camp.

5. Hydrological and environmental hazard analysis

5.1 Water availability

Water Accounting Plus (WA+) approach was adopted to systematically evaluate water inflows, consumptions and outflow in a sub-basin of the Amman-Zarqa Basin that accommodates the Jerash camp. The results indicate that between 2010 and 2023, most of the inflow is used internally, either through natural process (landscape evapotranspiration) or anthropogenic use for agriculture, domestic and other purposes (Figure 3). While natural landscapes are the main water consumer (313 km3 out of 498 km^3 net inflow) in the basin, anthropogenic use is much less (around 32.8 km3). Future scenario (2025-2100) forecasts show that water inflow will reduce, mainly to reduction in rainfall and to a less extent to limited inflows from surface water. While landscape consumption remains major consumer, however, with reduced rates, human water use is projected to increase significantly from 33 km^3/year to 81 km^3/year.

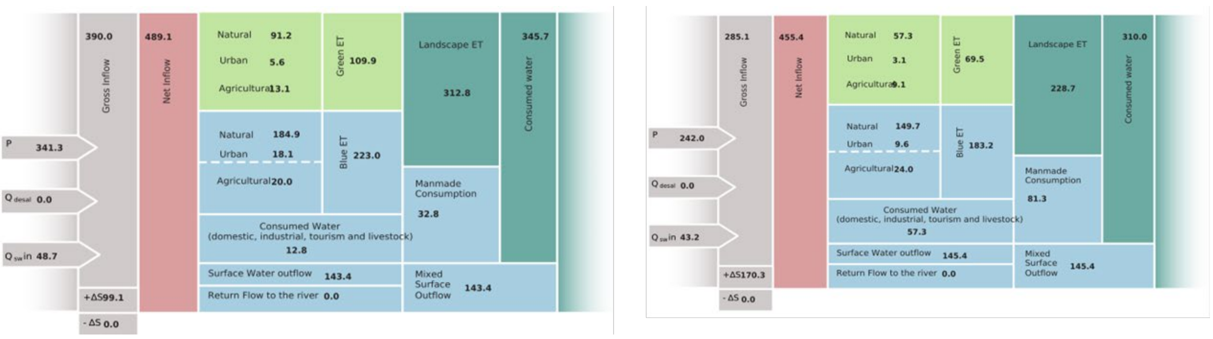

Figure 3. Water Accounting's Resources Base sheets for the Amman-Zarqa sub-basin for 2010-2023 (left), and for 2025-2100 (right). Values are in million m^3

Historical analysis (2010-2023) shows clear seasonality in per capita water availability, with higher availability peaks in May, though significantly lower than the United Nation's recommended minimums (50-100 litres per day), and lowest availability in January and February. Overall, mid-term future climate conditions (2025-2050) are projected to reduce per capita water availability in this basin. This reduction is notable across dry and wet months, and most pronounced in wet seasons (Figure 4 & 5).

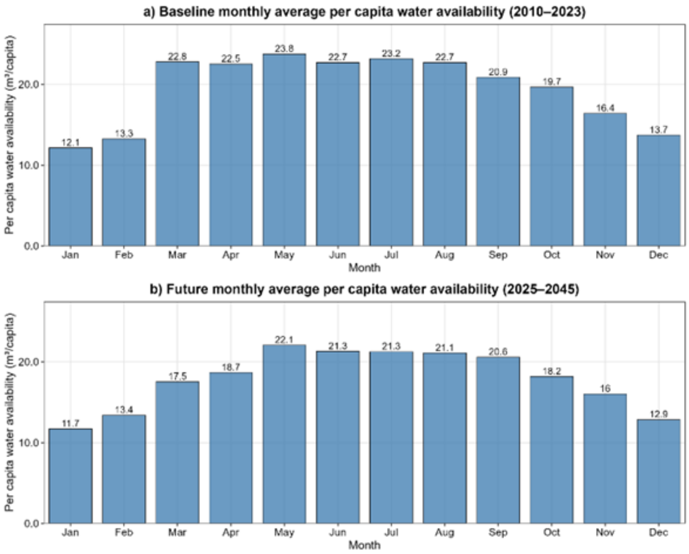

Figure 4. Monthly average per -capita water availability in the Amman-Zarqa sub-basin: (a) 2010-2023; (b) 2025-2045

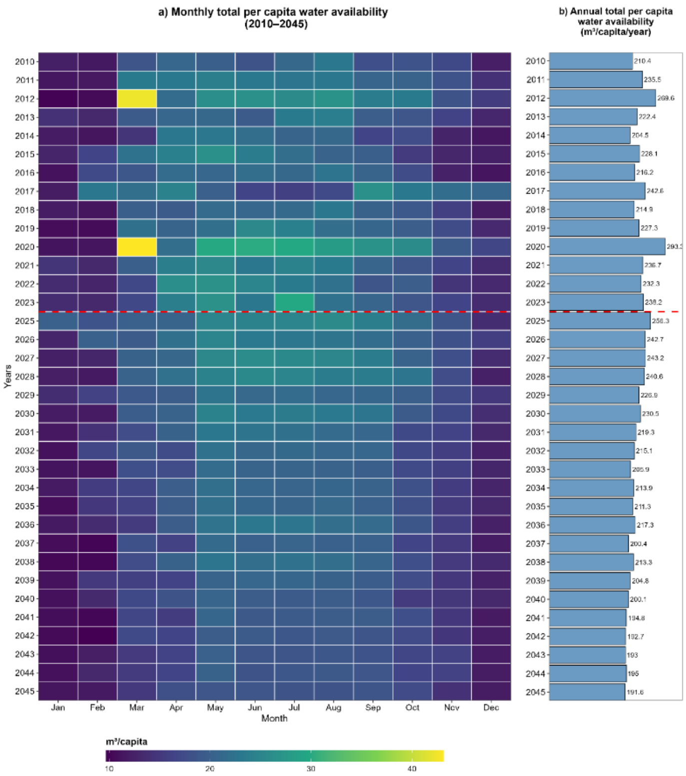

Figure 5. Monthly total and annual per capita water availability for the combined period 2010–2045. (a) Monthly total per capita water availability for 2010–2045, shown as a heatmap. Each cell represents the monthly per capita water volume in cubic meters. The red dashed line marks the transition between the baseline period (2010–2023) and the future projection period (2025–2045). (b) Annual total per capita water availability for the same period. Bars show yearly totals, with labels indicating the annual per capita volume (m³/person/year). The red dashed horizontal reference corresponds to the same baseline–future division used in panel (a).

5.2 Access to water

Access to reliable water resources is a key dimension of water security. The Access to Water (ACWA) analytical framework (Akpoti et al., 2025) integrates water availability, groundwater abstraction, and accessibility to evaluate service levels across the Amman–Zarqa Basin. Although Jerash Camp receives piped household water, the surrounding basin analysis provides important context for emergency planning and resource management under water stress scenarios. The analysis shows that groundwater remains a key source of supply in the basin, supported by about 174–182 active wells. Per-capita groundwater availability shows strong spatial variability, with urban zones generally better served than rural and refugee-hosting areas. The service-level assessment (Figures 6–8) indicates temporary improvement during late winter, but chronic water stress persists year-round due to over-extraction and limited surface water. Motorized water access indicates better conditions compared to walking-only access (Figure 7 and 8). These disparities underscore the need for sustainable groundwater management and contingency planning to ensure reliable supply for vulnerable populations, including those in and around Jerash Camp.

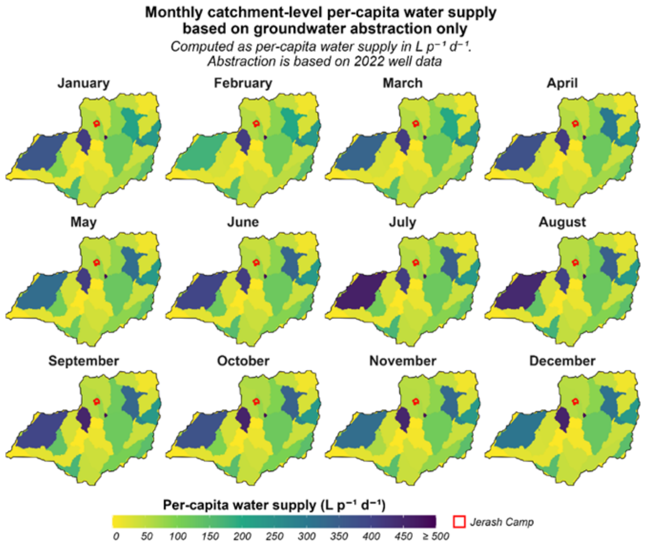

Figure 6. Monthly per-capita water supply based on groundwater only in Amman-Zarqa basin.

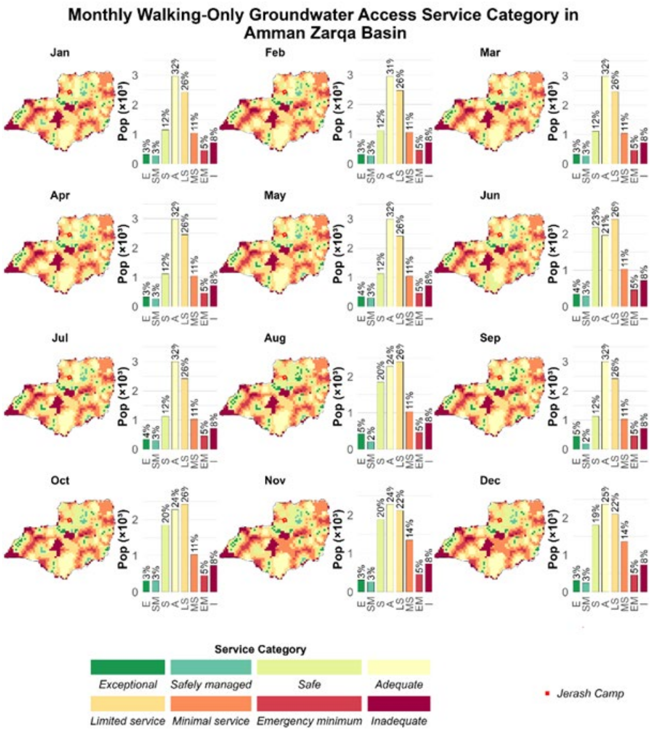

Figure 7. Monthly walking-only groundwater access service category in Amman-Zarqa basin.

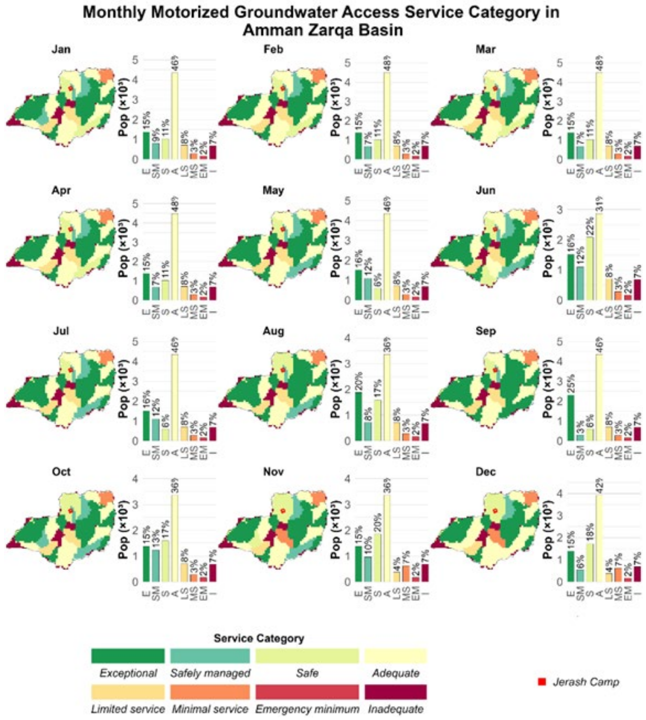

Figure 8. Monthly motorized groundwater access service category in Amman-Zarqa Basin.

5.3 Flood risk

Flooding represents one of the most severe climate-related threats to refugee settlements such as Jerash Camp. The rainfall Intensity–Duration–Frequency (IDF) curves developed for the camp (Figure 9) illustrate how rainfall intensity declines sharply with increasing storm duration but rises with longer return periods, underscoring the potential for short, intense convective storms to cause flash flooding. Simulated flood depths derived from these IDF relationships (Figure 9) reveal that inundation extent and depth increase markedly from 5- to 100-year events, with the most severe flooding concentrated in the camp's northeastern and central zones where drainage is poor and housing density is high. The Flood Hazard Index (FHI) map (Figure 10) further highlights localized high- to severe-risk areas that coincide with densely built-up sections and key road intersections. Although most of the camp experiences low to medium hazard levels, these hotspot zones pose significant threats to residents and infrastructure during extreme rainfall events, emphasizing the urgent need for improved drainage design and targeted flood-resilience interventions.

Figure 9. Flood risk in Jerash camp: The Intensity–Duration–Frequency (IDF) curves (left), water depth (right).

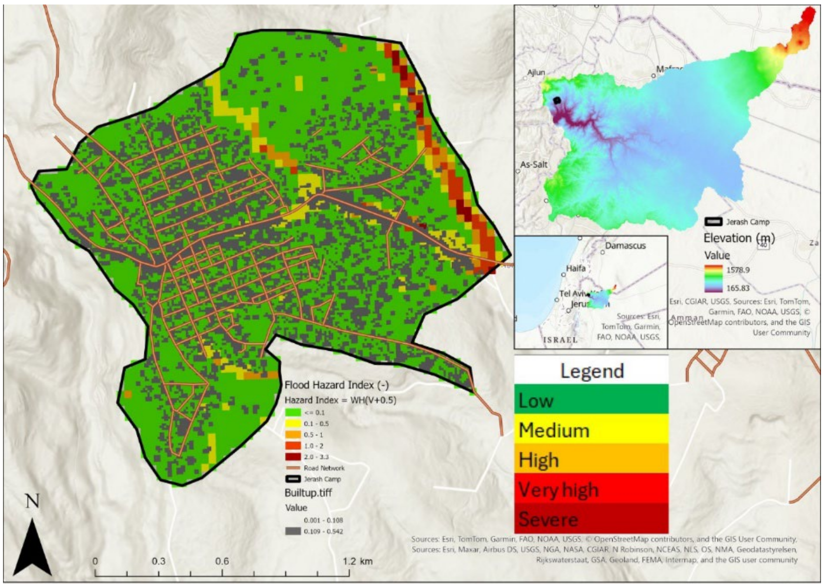

Figure 10. The 100-year Flood Hazard Index for Jerash Camp.

5.4 Drought risk

Drought conditions in the study area were characterized using the Standardized Precipitation Index (SPI) across multiple accumulation periods (1–12 months). The SPI time series highlights recurrent drought episodes and increasing interannual variability (Figure 11). These results underscore the tight coupling between climatic variability and ecosystem productivity, emphasizing the need for continuous drought monitoring and proactive preparedness planning to protect refugee communities and sustain surrounding ecosystem services.

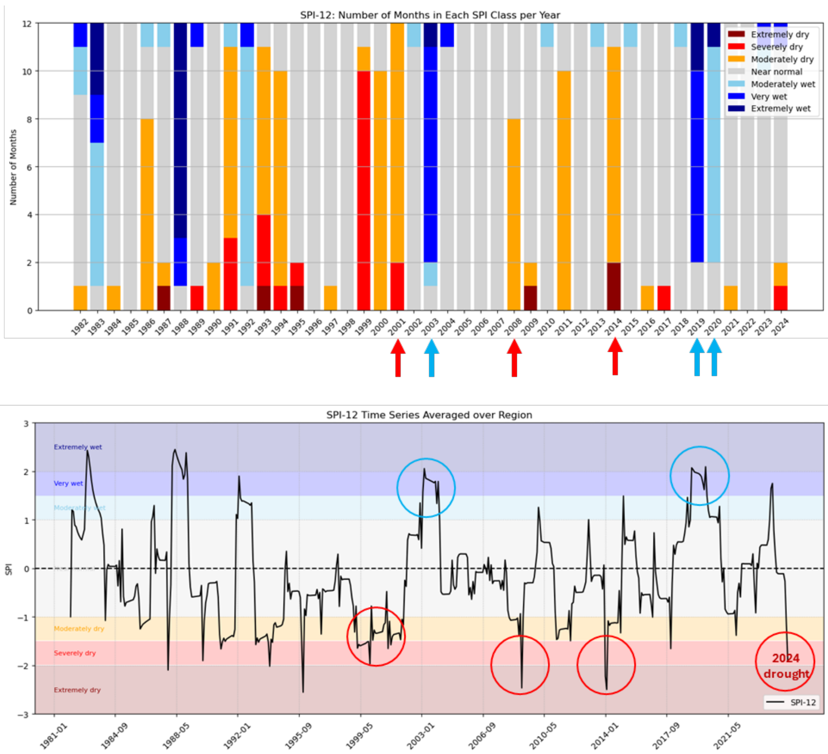

Figure 11. Time series of historical prolonged drought of 12 months in the Amman-Zarqa Basin using SPI-12 Note: red and blue squares and circles, respectively, denote dry and wet year.

Future projections indicate a marked intensification of drought frequency and duration across the Amman–Zarqa Basin. Compared with the historical record, the number of drought-class months increases substantially, with many future years experiencing 8–12 dry months (Figure 12). Multi-year drought episodes emerge around 2044–2070 and 2078–2100, lasting far longer than historical (1981-2024) events with a greater number of months with severe and extreme droughts. By the late century (2078–2100), many years show severe or extreme dryness, signaling near-permanent drought condition. This trajectory poses heightened risks to water security, agriculture, and settlements.

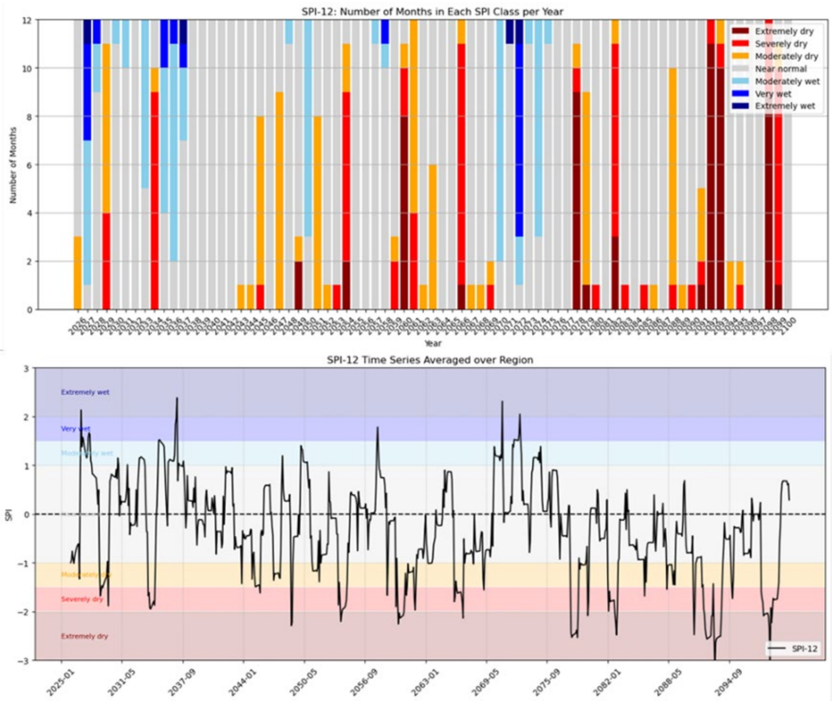

Figure 12. Time series of future prolonged drought of 12 months in the Amman-Zarqa Basin using SPI-12.

5.5 Integrated socio-climate risk assessment

At the basin scale, the baseline vulnerability map shows a diverse mosaic of conditions across the Amman–Zarqa Basin, with moderate and high vulnerability appearing to dominate much of the landscape (Figure 13). Large areas—particularly in the southern and eastern parts of the basin—fall within the moderate, high and very high categories covering an area of more than 60% of the total area of the basin, while low and very low vulnerability areas are concentrated mainly in western and north-western zones. In the future scenario, the basin retains this heterogeneous pattern, but the balance of classes shifts. The vulnerability-change map reinforces this interpretation by revealing large areas of decreased vulnerability in the west, southwest, and centre of the basin, while increased vulnerability is concentrated mainly in the east and northeast. This combination of opposing trends illustrates a basin experiencing both recovery and emerging pressures, with no single direction dominating. Overall, the basin exhibits a divergent vulnerability trajectory.

At the camp scale, the baseline socio-climate risk map shows a varied pattern across Jerash Camp (Figure 14), with low and very low risk dominating the southern and eastern areas, while high, and very high risk pockets appear in the central and eastern sections, with area of around 30% of the total area of the camp. These elevated-risk zones correspond to areas where multiple hazard intersect with local sensitivity and limited adaptive capacity. In the future scenario, this spatial structure remains largely unchanged, and the overall pattern shows only limited change. Some locations experience small reductions in risk, yet these improvements are highly localized. In contrast to the basin, where vulnerability decreases markedly in several regions, the camp does not exhibit comparable reductions in risk.

Even where basin-level improvements occur, they do not meaningfully buffer the camp, which continues to face concentrated socio-climate risks driven by its internal conditions and the persistent pressures of its surrounding landscape. This underscores the need for camp-specific adaptation efforts that account for both local vulnerabilities and the regional dynamics that continue to shape risk exposure. Vulnerability and risk maps, associated infrastructure and flood hazard maps can be assessed from the Amman Zarqa basin and Jerash Camp map gallery.

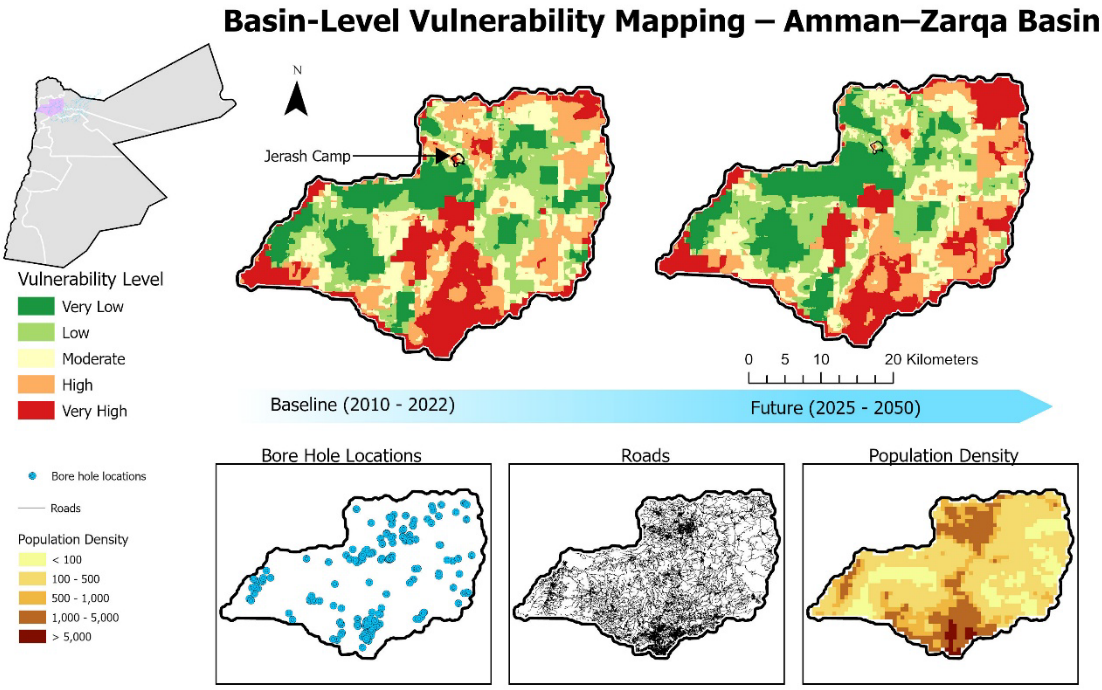

Figure 13. Basin-level vulnerability patterns across the Amman–Zarqa Basin under baseline (2010–2022), future (2025–2050) conditions, and vulnerability changes. Maps below the vulnerability maps show some of the underlying variables (boreholes, roads, population density) used to map vulnerability.

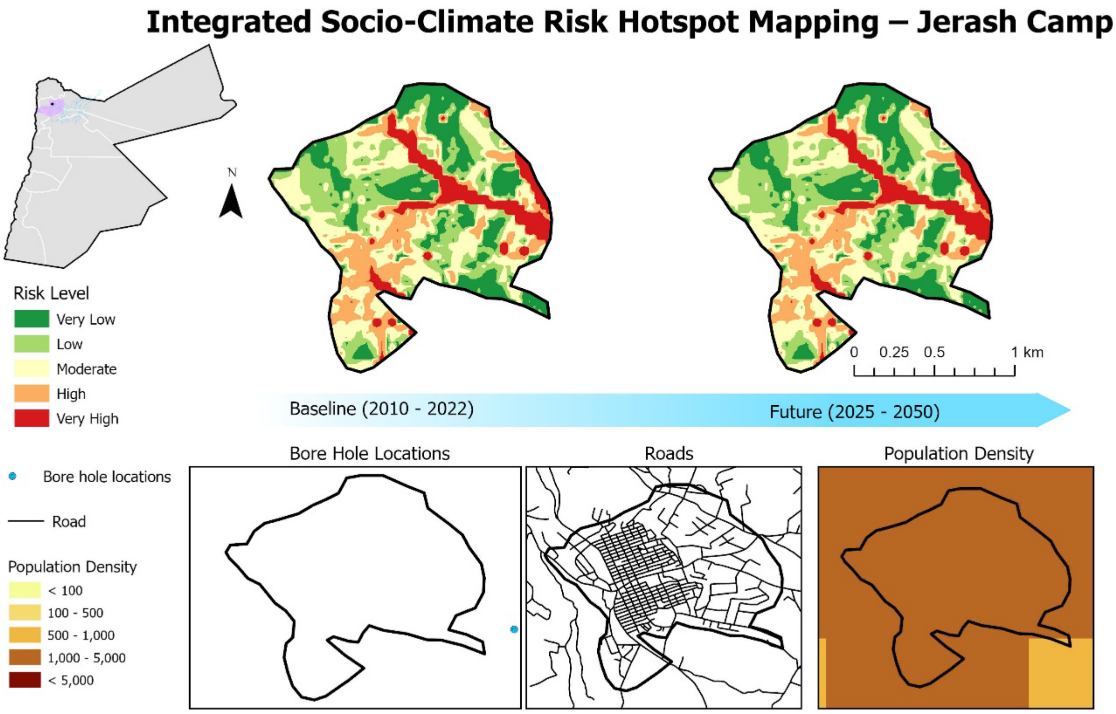

Figure 14. Camp-level risk patterns across the Jerash Camp under baseline (2010–2022), future (2025–2050) conditions, and risk changes. Maps below the risk maps show some of the underlying variables (boreholes, roads, population density) used to map risk.

Box 1. Risk maps for UNRWA planning

The baseline and future socio-climate risk maps clearly show where low, moderate, high, and very high-risk zones are concentrated within Jerash Camp, and how these risks are expected to change by 2050. The risk-difference map highlights areas of risk increase, stability, and reduction, allowing UNRWA to visually track where climate pressures are intensifying. These maps support spatial targeting of shelter upgrades, drainage improvements, water and sanitation investments, and emergency preparedness actions, ensuring that interventions are focused on the most exposed and rapidly worsening hotspots. They also provide a strong spatial evidence base for climate-proofing camp services, coordinating with national authorities, and strengthening funding and climate finance proposals.

Vulnerability and risk maps	What it shows	Operational use
Baseline risk map	Current low to very high-risk zones in the camp	Targets, shelter upgrades, drainage repair, and WASH investments in the most exposed areas
Future risk map (2050)	Where climate and water risks will intensify	Guides proactive upgrading of infrastructure and services before risks escalate
Risk-difference Map	Zones of increasing, stable, or decreasing risk	Targets, shelter upgrades, drainage repair, and WASH investments in the most exposed areas
Integrated Hotspots	Overlap of flood, drought, and water stress	Strengthens emergency preparedness, evacuation planning, and water trucking contingency

6. Conclusion

Jerash Camp and its surrounding areas within the Amman–Zarqa Basin face interlinked risks of water scarcity, drought, and flooding that are likely to intensify under climate change. The camp's high population density, poor infrastructure, and limited services make it particularly vulnerable, underscoring the need for targeted interventions guided by localized risk profiles. While vulnerability across parts of the wider basin is projected to decrease, risk within the camp itself shows far less improvement, highlighting localized sensitivities and landscape pressures continue to shape its risk. Strengthening drought resilience requires improving water availability through rainwater harvesting, expanding storage, and adopting managed aquifer recharge alongside sustainable groundwater management. Enhancing drainage systems can simultaneously reduce flood hazards and support water capture and storage. Overall, risk reduction must be pursued through an integrated resilience approach that links water security, climate adaptation, and infrastructure improvement. Aligning humanitarian priorities with national climate and development goals can help Jerash Camp—and similar refugee settlements—transition from reactive crisis management to proactive, long-term resilience planning. A structured pathway for advancing climate resilience in refugee camps is detailed in Al-Zu'bi et al. (2025), with Jerash Camp showcased as a transferable model for other sites.

7. References

Al Zayed I.S., Elagib N.A., Ribbe L., Heinrich J., 2015. Spatio-temporal performance of large-scale Gezira Irrigation Scheme, Sudan. Agricultural Systems, 133, Pages 131-142. https://doi.org/10.1016/j.agsy.2014.10.009.

Al-Zu'bi M., Ruckstuhl S., Leh M., Khalifa M., Akpoti K., Umer, Y. 2025. Climate resilience in Jordan's Jerash camp: integrating government plans, humanitarian action and climate investment. Colombo, Sri Lanka: International Water Management Institute (IWMI). CGIAR Food Frontiers and Security Program 13p.

Khalifa, M., Elagib, N. A., Ahmed, B. M., Ribbe, L., & Schneider, K., 2019. Exploring socio-hydrological determinants of crop yield in under-performing irrigation schemes: pathways for sustainable intensification. Hydrological Sciences Journal, 65(2), 153–168. https://doi.org/10.1080/02626667.2019.1688333.

Leh M., Akpoti K., Jayathissa I., Khalifa M., Umer Y., Al-Zu'bi M., Velpuri N., Ruckstuhl S., 2025. A framework for Integrated Watershed and Climate Risk Hotspot Mapping to Support Adaptation Strategies in Refugee Camp Landscapes in Jordan. Brief. International Water Management Institute (IWMI).

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