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Title: Over Two Decades of Natural Disasters in Middle East, North Africa, Afghanistan and Pakistan : A Retrospective Descriptive Study (2000–2024)

Authors: Faezeh Rahmani¹, Zohreh Ghomian^{1,*}, Masoud Jobaneh¹, Behnam Esbakian Bandpey¹

1. *Department of Health in Disasters and Emergencies, School of Public Health and Safety, Shahid Beheshti University of Medical Sciences, Tehran, Iran .*

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Abstract

Background: The Middle East and North Africa, Afghanistan, and Pakistan are among the world's most disaster-prone areas, having suffered severe human loss and economic damage in recent decades. Analyzing the occurrence and nature of these disasters is vital for enhancing preparedness and informing effective risk reduction strategies.

Materials and Methods: Data were collected from international databases, including *EM-DAT*, *Our World in Data*, *World Bank*, *Statista*, and *World Population Review*. We analyzed disaster type, country, date, frequency, total number of deaths, economic loss, and affected population. We compared our findings with prior studies sourced from scientific databases and organizational reports.

Results: Between 2000 and 2024, the Middle East, North Africa, Afghanistan and Pakistan, faced a total of 696 natural disasters. These caused over 163,000 deaths, affected 180 million people, and led to nearly 115 billion dollars ("000 US\$) in damages. Floods, earthquakes, and storms were the most common and damaging natural disasters. Rising temperatures raised climate-related risks. Most deaths and economic damage hit low- and lower-middle-income countries.

Conclusion: The studied region's vulnerability to natural disasters is driven by rapid urbanization, inadequate infrastructure, and climate change. Addressing these challenges requires targeted efforts, including engaging communities, building climate-resilient infrastructure, implementing robust early warning systems, and strengthening cooperation. Focusing on these actions can directly reduce disaster-related casualties and losses in the region.

Keywords: Natural Disaster, Middle East, North Africa, MENA, Afghanistan, Pakistan

Introduction

Natural disasters are among the most significant challenges of this century in the fields of public health, sustainable development, and crisis management, and they have a profound impact on various aspects of human life. These events, including earthquakes, floods, droughts, storms, heatwaves, landslides, and other climatic and tectonic phenomena, cause human casualties, extensive economic losses, and disruptions in the functioning of social and infrastructure systems every year. In recent decades, the increasing intensity and frequency of some of these events globally, especially as a result of climate change, increasing global temperatures, changing precipitation patterns, and environmental degradation, have drawn the attention of researchers and policymakers to the need to study and monitor these phenomena [1-2].

According to the Center for Research on the Epidemiology of Disasters (CRED), in 2024, 393 natural disasters occurred worldwide, while the total number of natural disasters between 2004 and 2023 was 371. This report clearly confirms the increasing trend in the occurrence of natural disasters [3]. According to the Global Assessment Report (GAR, 2025) of the United Nations Office for Disaster Risk Reduction (UNDRR), direct costs from disasters averaged between 70 and 80 billion dollars (US\$) per year between 1970 and 2000, while this figure increased to 180-200 billion dollars (US\$) between 2001 and 2020. The total costs of natural disasters, including indirect and ecosystem impacts, now exceed 2.3 trillion dollars (US\$) annually, but this is an underestimate [4].

The Middle East and North Africa are one of the most vulnerable regions in the world to natural disasters. Water scarcity, flooding, drought, rising temperatures, and air pollution are among the most important natural threats in the region [5-7]. The number of natural disasters in the world has almost doubled since the 1980s, but in the MENA region, this increase has tripled. Earthquakes, floods, and droughts have been the most frequent and significant natural disasters in the region over the past thirty years [8].

Natural disasters are not simply environmental threats; they pose multidimensional challenges to human security, economic stability, and social sustainability. In the Middle East and North Africa, these threats are accompanied by aggravating factors such as rapid and heterogeneous urbanization, severe water scarcity, ecosystem degradation, and, in some cases, armed conflict and political instability. These factors make the severity of disaster impacts in this region higher than the global average and make the recovery process much more difficult [9].

Rising temperatures and changing rainfall patterns not only lead to more frequent long-term droughts and reduced food security but also directly threaten public health by causing extreme heat waves and dust storms in the MENA region. On the other hand, flash floods in densely populated urban areas (such as coastal or valley cities) cause heavy losses of life and property due to inadequate drainage systems and substandard construction [10-11].

In this context, a shift from purely reactive approaches (crisis response) to preventive and risk-based strategies (Disaster Risk Reduction - DRR) seems essential. The United Nations Sendai Framework for Disaster Risk Reduction (2015-2030) emphasizes the importance of integrating risk management into development planning, strengthening early warning systems, and

investing in resilient infrastructure. However, in the MENA region, the implementation of this framework faces challenges such as limited financial resources, weak inter-institutional coordination, and a lack of accurate local data [9,12].

Therefore, a retrospective descriptive study of natural disasters in the MENA region not only helps to better understand current trends but can also provide a basis for designing effective resilience policies, allocating targeted resources, and strengthening regional and international cooperation. This study examines natural disasters in the MENA region, with explicit inclusion of Afghanistan and Pakistan to reflect shared risks and regional classifications.

Materials and Methods

-Study Type

This research is a retrospective descriptive study that used only publicly available and open-access data from international databases.

-Data Sources

The original data were extracted from the EM-DAT database, which is maintained by the *Centre for Research on the Epidemiology of Disasters (CRED)* [13].

-Complementary Data

Complementary meteorological and climate-related data were sourced from databases such as the *World Bank, World Meteorological Organization, Our World in Data, Statista, and World Population Review*.

These sources were used only to extract background climate data (such as land surface temperature, water stress, drought risk) and were not merged with the main EM-DAT data in any way.

-Country Selection Criteria

The selection of countries in the EM-DAT database was done by applying a direct filter on the "Country". The countries included in this study were selected based on the latest World Bank regional classification. The list of countries includes: Afghanistan, Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, the Occupied Palestinian territories, Syria, Tunisia, the United Arab Emirates, and Yemen [14].

Although until a few years ago, Afghanistan and Pakistan were included in the South Asia region in the World Bank's classification and were not included in the classic MENA definitions, but since 2025, the World Bank has provided a broader definition and has placed these two countries within the framework of MENAAP (Middle East, North Africa, Afghanistan & Pakistan) [14]. This issue is quite explicitly mentioned in the "*Global Economic Prospects*" report published by the World Bank in January 2026. In this report, the World Bank has used the acronym MNA and defined it as equivalent to "Middle East, North Africa, Afghanistan, and Pakistan" [15].

The abbreviations MENAAP and MNA are used in this section solely to justify the inclusion of Afghanistan and Pakistan, in accordance with the recent World Bank regional classification. For consistency with the predominant terminology used in the existing literature and to ensure clarity for readers, the classic term “MENA” is used throughout the main text of the manuscript (Results and Discussion) to refer to the study region defined in the title.

-Exported Variables

- Disaster No. (Unique identifier for each disaster)
- Disaster Group (Natural disasters)
- Disaster Subgroup (Meteorological, Geophysical, Hydrological, Climatological)
- Disaster Type (earthquake, flood, drought, storm, wildfire, extreme temperature, avalanche, landslide)
- Country
- Total Deaths
- Total Affected
- Total Damages ("000 US \$)
- Total Adjusted Damages ("000 US \$)
- Event Date (year/month/day)

-Data Analysis Methods

Secondary data from EM-DAT were downloaded as an Excel file (.xlsx) and imported into Microsoft Excel without any changes or manipulation. The analyses performed included the following descriptive calculations:

Aggregating the number of disasters by country, type of disaster, and year / Examining the time trend of natural disasters (annual number of occurrences) to identify increasing or decreasing patterns / aggregating the total number of deaths and people affected for each event in each country and each year / aggregating the economic losses for each disaster, in each country and each year. All aggregations were manually validated for accuracy and consistency with EM-DAT raw records.

No inferential or advanced statistical analyses (such as T-tests, ANOVA, linear regression, or significance tests) were performed in this study, as the main purpose was to describe trends, patterns, and distributions of disasters and their consequences in the MENA region, not to test hypotheses or make causal inferences.

-Economic Damage Analysis

In this study, the total economic damages resulting from natural disasters are extracted, for each disaster in each country, from the column labeled “Total Adjusted Damages” in the EM-DAT database. The adjusted damages are calculated as monetary values in US dollars that have been adjusted for inflation. This adjustment is proportional to the Consumer Price Index (CPI)

provided by the Organization for Economic Co-operation and Development (OECD). The total adjusted damages are expressed in constant US dollars relative to the last available year in the dataset (rescale base year), as per EM-DAT protocol [16].

-Data Duplication Management

No duplicate records were identified or removed in the EM-DAT database, as EM-DAT stores unique records based on Disaster No. (Unique Disaster Identifier) and Country. There were no duplicates in the extracted data.

-Missing Data

Missing values (such as economic losses that were not reported in some records) were kept unchanged, and the calculation of total deaths, affected people, and economic losses was done as an aggregation of the available recorded values.

-Visualization of Findings

Online graphical platforms, including *Flourish Studio*, *MapChart*, and *SankeyMATIC*, were used to create the figures and graphs, including bar charts, line charts, heat maps, Sankey charts, and world maps[17-19].

-Literature Review Method

To contextualize the trends and impacts of natural disasters in the MENA region, a literature search was conducted in Google Scholar, Web of Science and Scopus using the English keywords such as Natural Disaster, Natural Hazard, Middle-East, North-Africa, Afghanistan, Pakistan, MENA, MENAAP, and MNA.

The time span of the literature search was from the beginning of 2000 to the end of 2024. Relevant articles (reviews, reports, and original studies) were screened and key references were used to interpret the findings.

In addition to scientific articles, authoritative organizational reports and documents were also reviewed. These sources included World Bank reports, World Meteorological Organization (WMO), United Nations Office for Disaster Risk Reduction (UNDRR), Intergovernmental Panel on Climate Change (IPCC) reports, and other official international documents. These sources were used to provide a more comprehensive and up-to-date picture of disaster trends, their impacts, and aggravating factors in the MENA region.

Results

Between 2000-2024, the studied region experienced 696 natural disasters (climatological, meteorological, geophysical, and hydrological). These disasters resulted more than 160000 deaths, affected over 180 million people, and caused nearly 115 billion dollars ('000 US\$) in economic damages.

Figure.1 illustrates that floods occurred most frequently, particularly in Pakistan, Afghanistan, Iran, Yemen, and Algeria. Earthquakes followed, most often occurring in Iran, Pakistan, and Afghanistan. The third disaster was storms, especially in Pakistan, Afghanistan, and Iran. Extreme temperatures were observed across almost all MENA countries, reflecting the rising

regional air temperatures. Droughts occurred intermittently throughout the region. Avalanches, mainly in Afghanistan's mountains, posed another hazard. Landslides, which are frequent in Pakistan and Afghanistan, have also occurred in several other countries (Figure.1).

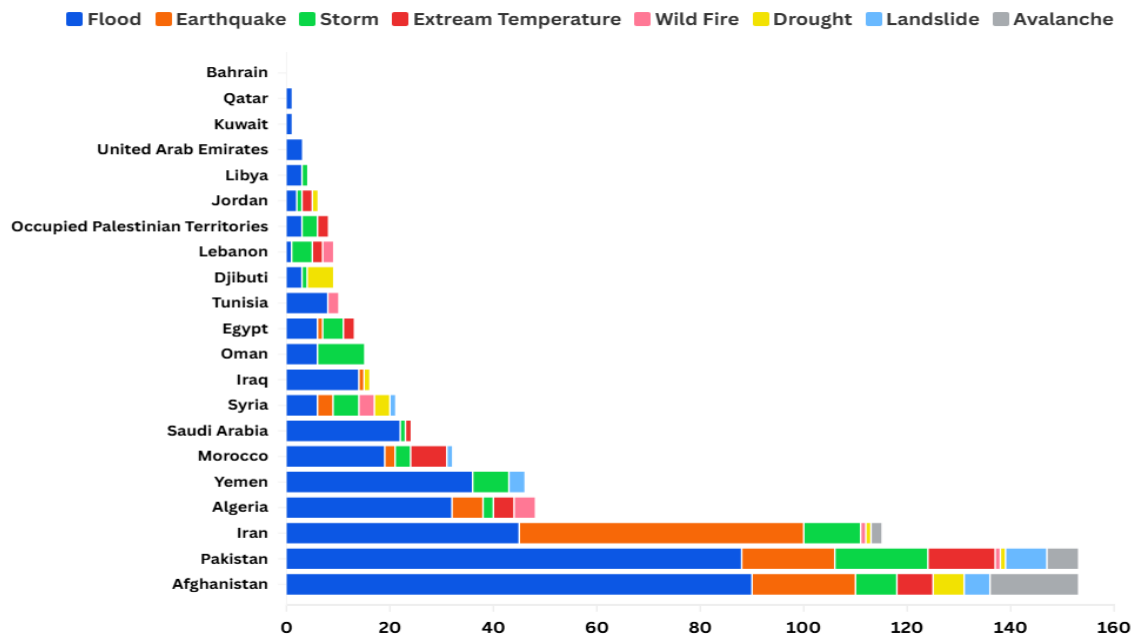


Figure 1. Frequency of Natural Disasters by Country in the MENA Region (2000 – 2024)

As shown in **Figure 2**, floods are the main natural disaster in the region. Their numbers changed a lot over time. There were peaks in 2003, 2007, 2010, 2015, and 2019. Flood events began rising again from 2022 to 2024. Earthquakes were the second most common type of natural disaster, changing less year to year than floods, although there was a notable rise from 2020 to 2023. Droughts have remained mostly stable, with a gradual increase in recent years. Storms changed a lot, showing their sporadic nature. Wildfires peaked in 2002, 2007, 2017, and 2020. From 2020 to 2023, the number of wildfires remained stable before declining. The occurrence of landslides showed alternating periods of increase and decline. From 2021 to 2023, the trend remained relatively stable, but starting in 2023, a noticeable increase was observed. Avalanches were highest in 2012 and stayed steady after 2021. Since 2021, extreme temperature events have increased, aligning with the warming trend in the studied countries.

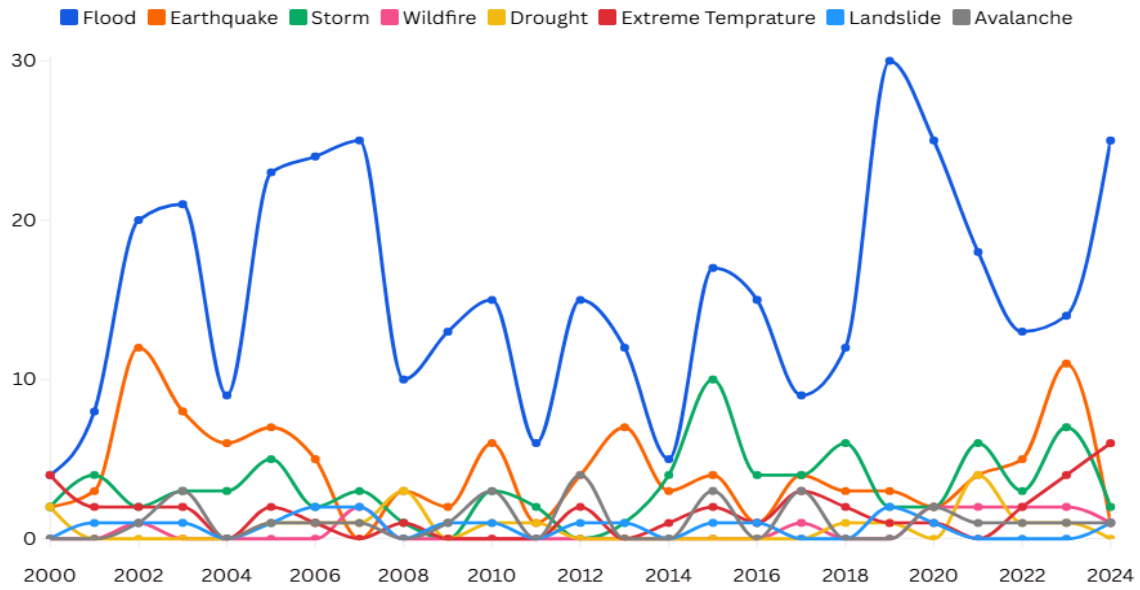


Figure 2. Annual Trend of Natural Disaster Frequency in MENA Region (2000 - 2024)

According to our findings, global surface temperature rise has become a critical environmental concern in the region. Figure 3 shows the average surface temperature anomalies in the region from 2000 to 2024. As the heat map (Figure 3) shows, between 2000 and 2010, the warming trend was gradual; but suddenly in 2010, there was a sharp increase in temperature in the region, which contradicts the previous steady trend and may be related to a climate event or drought. After 2010, the warming in the region has become more intense, as shown by the increasing number of dark red areas on the map. To facilitate comparison of temperature changes at the country level, we used the average annual surface temperature anomalies for each country between 2000 and 2024. In this study, Temperature anomalies refer to the difference between the average surface temperature of a particular year and its average over a base period, not the absolute temperature. This approach is standard in climate change research because it more effectively captures relative warming or cooling trends.

For this study (see Figure 3), we used the average temperature anomalies recorded in the *"Our World in Data"* database. The database calculated the average temperature anomaly for all countries in the world between 1940 and the end of 2025 and determined the difference with the average temperature anomaly constant over the 30-year climate base period (from 1991 to 2020) – recommended by the World Meteorological Organization (WMO) and also used in the *"Copernicus Climate Change Service"* dataset. This period represents “normal” climate conditions during the transition from the late 20th to the early 21st century and serves as a benchmark for calculating the anomalies [20].

Annual surface temperature anomalies for the MENA region over the period 2000–2024 have ranged mainly between about -1 and +2 degrees Celsius relative to the 1991–2020 climate baseline (Figure 3). This range reflects a significant warming trend in the MENA region in recent years.

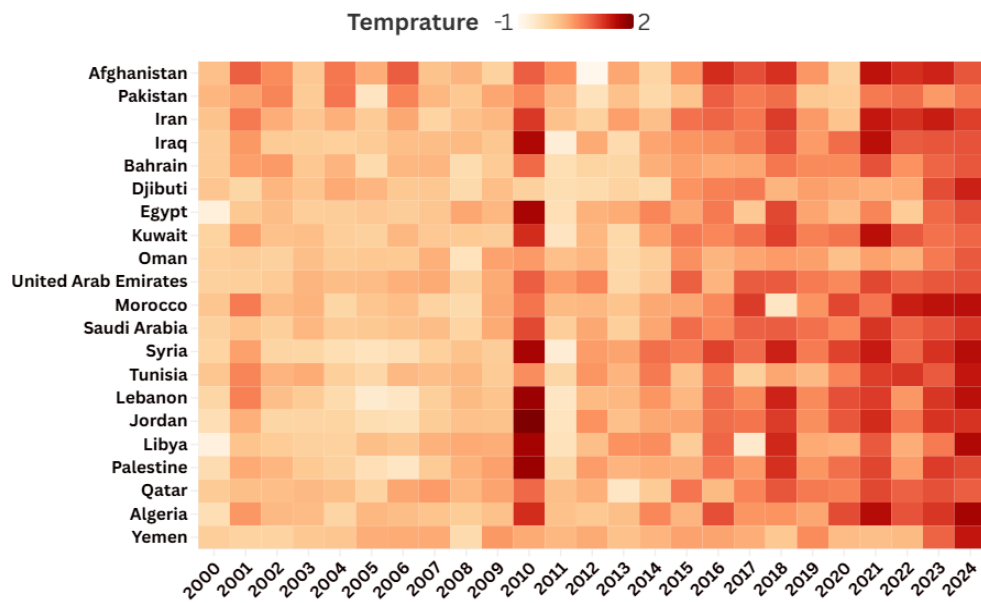


Figure 3. Surface temperature anomalies in MENA countries (2000-2024)

Water Stress in the MENA Region

Water Stress is a condition in which water consumption rate exceeds the renewable water resources. Water stress affects crop growth in various regions of the world, disrupts agriculture and food production, and ultimately leads to food shortages and famine [21]. The figure.4 illustrates water stress ranking stated by the *World Population Review* database. According to this ranking, Kuwait ranks first, exhibiting the highest level of water stress, while Djibouti, ranked 44th, has the lowest water stress among the studied countries [22].

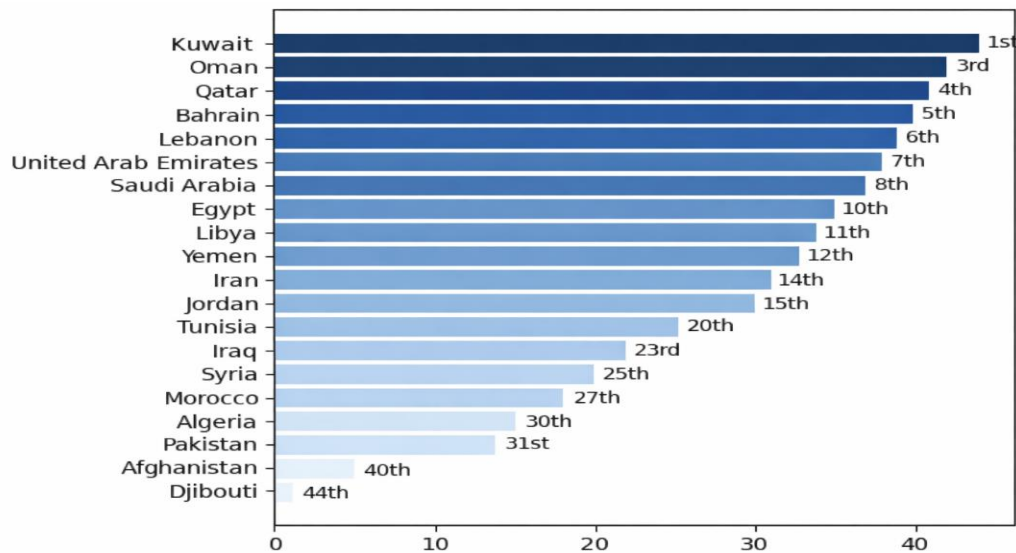


Figure 4: Water Stress Ranking in MENA Countries (2000-2024)

Drought Risk Index for Middle East, North Africa, Afghanistan and Pakistan

The Drought Risk Index utilized in this study is a component of the *INFORM Climate Change Risk Index* framework, developed by the *Euro-Mediterranean Centre on Climate Change and the Joint Research Centre of the European Commission*. This index is designed to assess the risk of humanitarian crises triggered by drought, incorporating environmental, social, and infrastructural factors. It is scored on a scale from 0 to 10, where 0 denotes a very low risk, and 10 indicates a very high risk [23]. **Figure 5** presents a spatial visualization of the studied region, color-coded according to the aforementioned index.



Figure 5. Drought Risk Index in the MENA Countries (2000-2024)

Consequences of Natural Disasters in the Middle East, North Africa, Afghanistan and Pakistan (2000-2024)

As indicated in the following Sankey diagram, earthquakes were responsible for the highest number of fatalities resulting from natural disasters in the region. Floods and droughts affected the largest number of people, while the greatest economic losses were attributed to floods, earthquakes, and storms (Figure 6).

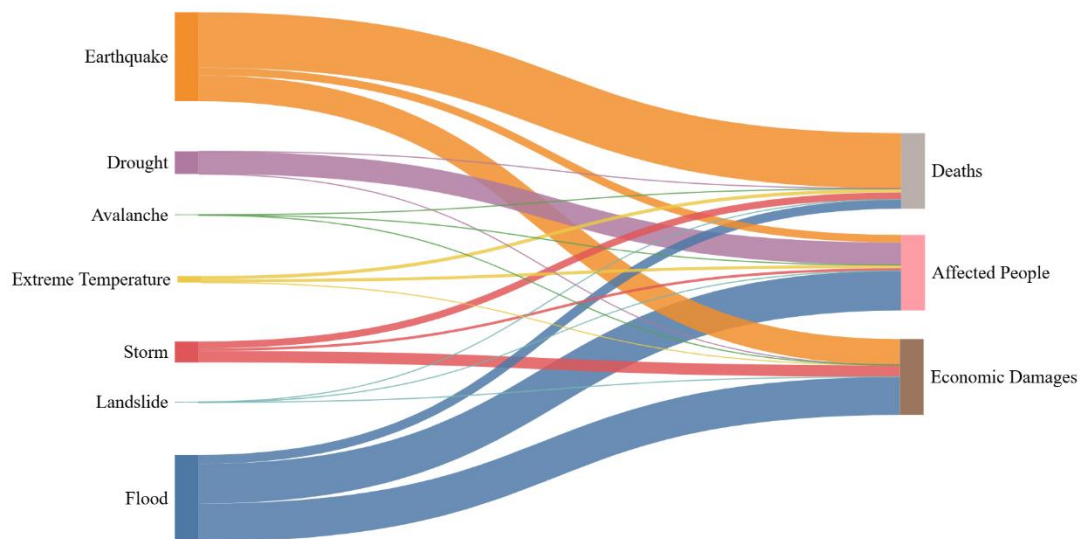


Figure 6. Impacts of Natural Disasters in MENA Countries (2000- 2024)

Income Classification of the Selected Countries

The MENA region comprises countries with diverse income levels, ranging from high-income oil-exporting states to middle- and low-income economies, reflecting significant economic heterogeneity across the region. In this section, the classification of these countries is presented according to the World Bank classification for 2023-2024 [24]:

- **High income:** Saudi Arabia, United Arab Emirates, Kuwait, Bahrain, Qatar, Oman
- **Upper Middle Income:** Iraq, Libya, Occupied Palestinian territories
- **Lower Middle Income:** Iran, Pakistan, Jordan, Egypt, Tunisia, Morocco, Djibouti, Algeria, Lebanon
- **Low Income:** Afghanistan, Syria, Yemen

As illustrated in **Figure 7**, according to data obtained from the EM-DAT database, the highest levels of economic losses, affected populations, and fatalities are observed in lower-middle-income countries, while the lowest figures are recorded in high-income countries of the MENA region.

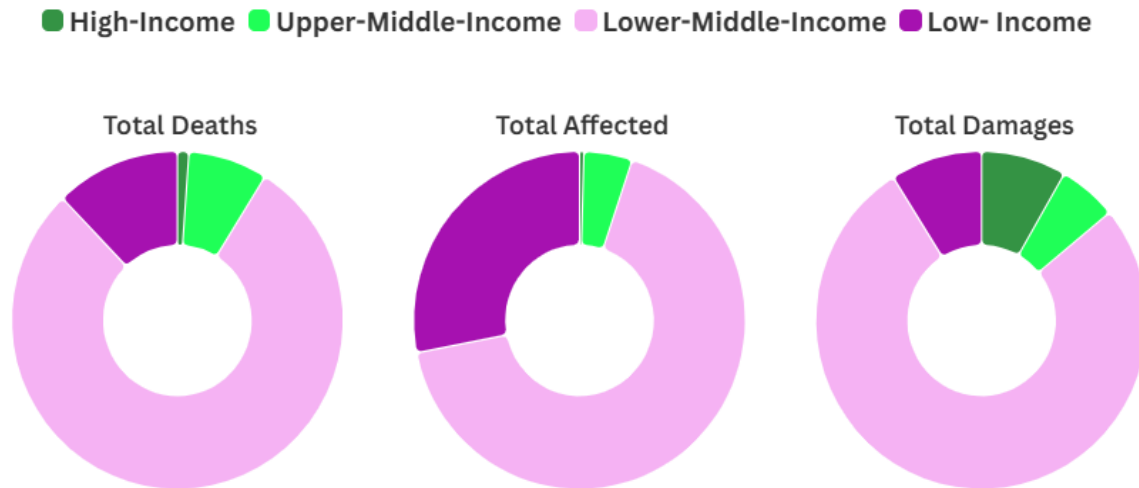


Figure 7: Natural Disaster Consequences in Different Income Groups (2000-2024)

The Most Important Natural Disasters in MENA during 2023-2024

Tables 1 to 3, provide a summary of the most significant natural disasters—floods, earthquakes, and storms—occurring between 2000-2024, highlighting key impact metrics such as fatalities, affected populations, and economic losses. Data directly extracted from EM-DAT. "Disaster No" as a unique identifier has been mentioned for each disaster. Economic damages were often underreported in EM-DAT [25].

Table1 : Major Floods in MENA Countries (2023-2024)

Disaster No.	Country	Deaths	Total Affected People	Total damages ("000 US\$)	Date
2023-0384-YEM	Yemen	248	308183	Not Mentioned	September 2023
2024-0481-PAK	Pakistan	368	551768	Not Mentioned	July 2024
2024-0285-AFG	Afghanistan	357	258422	Not Mentioned	May 2024
2024-0845-YEM	Yemen	240	655646	Not Mentioned	July 2024

Table 2 : Major Storms in MENA Countries (2023-2024)

Disaster No.	Country	Deaths	Total Affected	Total damages ("000 US\$)	Date
2023-0610-LBY	Libya	13200	1600000	6382870	September 2023

Table 3: Major Earthquakes in MENA Countries (2023-2024)

Disaster No.	Country	Magnitude (Richter)	Deaths	Total Affected	Total Damages ("000 US\$)	Date
2023-0054-SYR	Syrian Arab Republic	7.8	5670	8011774	9162506	February 2023
2023-0600-MAR	Morocco	6.8	2946	845674	7206466	September 2023
2023-0636-AFG	Afghanistan	5.4	2445	569240	Not mentioned	October 2023
2023-0047-IRN	Iran	5.9	3	262404	262521	January 2023

Natural Disasters in Iran during 2000-2024

As shown in Figure 1, the most important natural disasters in Iran between 2000 and 2024 were earthquakes, floods, and storms. These three natural disasters also had significant consequences, as shown in Figure 8.

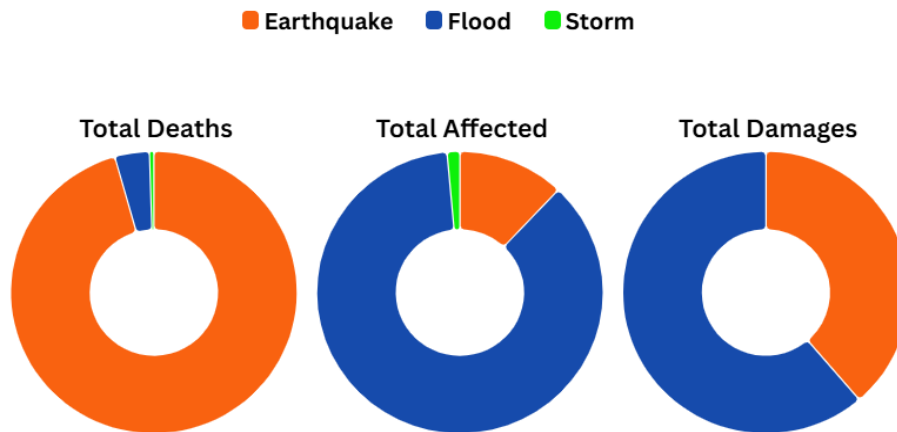


Figure 8: Consequences resulted from Earthquake, Flood and Storm in Iran between 2000-2024

According to **Figure.8**, most of the deaths from natural disasters in Iran are attributed to earthquakes. The occurrence of deadly earthquakes such as the Bam (2003) and Sarpol-e-Zahab (2017) earthquakes can be a testament to this. According to data recorded in EM-DAT, more than 26,000 people died in the Bam earthquake.

The largest number of people affected by natural disasters has also been attributed to floods. The devastating flood in Golestan Province (2001), the widespread national floods in March 2019, and the widespread flood in southern Sistan-Baluchestan in 2024 were among the most important floods that caused widespread disruptions in people's daily lives and agriculture.

According to Figure 8, the economic damage for floods and earthquakes was almost the same, while storms had a smaller share in all three measures. The pattern obtained in this figure is consistent with the geographical realities and high seismicity of Iran as well as credible international reports and emphasizes that although earthquakes are the main cause of deaths, floods are the main cause of displacement and widespread damage.

Natural Disasters in Iran and it's Neighbors

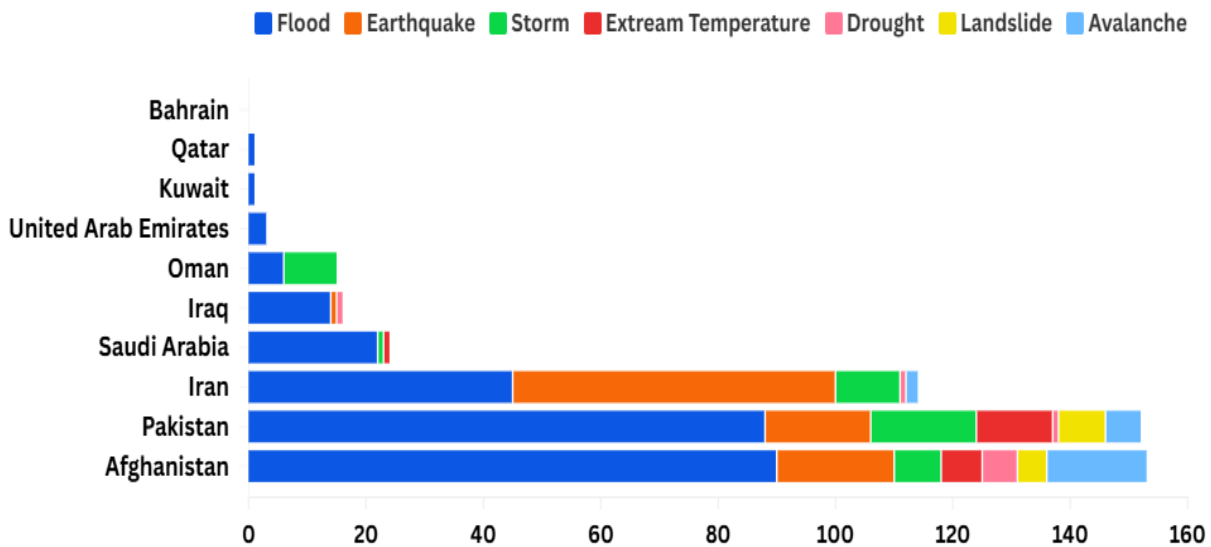


Figure 9: Natural Disasters in Iran and it's Neighboring Countries (2000-2024)

Figure.9 shows the trend of natural disasters in Iran and its neighboring countries between 2000 and 2024. As the figure shows, Afghanistan has the highest frequency and diversity of natural disasters. The two natural hazards of flood and earthquake are the most frequent natural hazards in Afghanistan. A significant number of avalanches have also been reported in this country. Pakistan ranks second after Afghanistan in the number and diversity of natural. Storms are also the third most important natural disaster in both countries. Very high temperatures have also been reported in Afghanistan and Pakistan, although their share is lower than that of the three flood, earthquake, and storm events. Iran is very similar to Afghanistan and Pakistan in terms of flood, earthquake, and storm occurrences, with the difference that the frequency of earthquakes in Iran is much higher than that of the other two countries. The share of storm occurrences in all three countries is much lower than that of flood and earthquake. As Figure 7 shows, the Persian Gulf countries have experienced a much smaller number of natural disasters, mostly just floods.

Discussion

This study demonstrates that the Middle East, North Africa, Afghanistan, and Pakistan have experienced a diverse range of natural disasters over the past 25 years. The frequency of these events has resulted in substantial human casualties and significant economic losses. Natural disasters now constitute a critical geo-environmental challenge. Both anthropogenic and natural factors have exacerbated these challenges, and their occurrence has shown a pronounced increase in recent decades [26-27]. Between 1900 and 2015, the MENA region witnessed 1,070 natural disasters. These events led to an estimated 212 million injuries, approximately 614,000 fatalities, and economic damages nearing 80 billion USD [7].

According to our findings, between 2000 and 2024, the studied region faced a staggering 696 natural disasters, leading to more than 160,000 fatalities, affecting over 180 million people, and causing nearly 115 billion dollars in economic losses. Floods, in particular, have relentlessly dominated as the most frequent and devastating hazard.

One contributing factor to the severity of floods in the Middle East is the phenomenon of "Atmospheric Rivers," defined as elongated, narrow bands of water vapor transported horizontally, typically associated with jet streams preceding cold fronts of extratropical cyclones. Recent studies have increasingly recognized the role of atmospheric rivers in triggering intense rainfall and rapid snowmelt, which subsequently lead to severe flooding across the Middle East [28-29].

This study identified 88 floods in Pakistan between 2000 and 2024, resulting in over 10,000 deaths, according to the EM-DAT database. Prior studies indicate that monsoon rainfall and Mediterranean storms are the primary contributors to floods in the Indus Basin and Pakistan, resulting in substantial economic losses. Despite yearly government investment in flood relief and management, evidence for a significant reduction in losses is limited [30-31].

Afghanistan, like Pakistan, faces a high level of flood vulnerability. This issue is heightened by its mountainous terrain, climate change, and socio-economic challenges. According to data recorded in EM-DAT, during the past 25 years, 90 floods struck Afghanistan, causing over 4,000 deaths. Key causes include intense rainfall, soil erosion, conflict-driven deforestation, and poor infrastructure. To reduce flood impacts, suggested measures are relocating communities, building dams, and using local knowledge. Addressing climate change, adopting resilient national policies, and supporting renewable energy remain key steps [32-33].

According to findings, Iran is the third most flood-prone country in the MENA region, facing major challenges from soil erosion, reduced vegetation, unregulated urban growth, intense rainfall, land use changes, and inadequate water management. Global warming has intensified floods by altering precipitation patterns. Heavy rains in 2019 and 2020, caused by interactions within the climate system, affected 25 provinces and nearly 10 million people [34-36].

As shown in **Figure 1**, Morocco has experienced significant flooding from 2000 to 2024. Prior studies have reported that, over the past 25 years, climate change has increased extreme precipitation, particularly in Morocco's mountainous regions with limited vegetation. These areas are highly susceptible to flash floods. Other factors include unregulated urban

development in flood-prone zones, insufficient integration of flood risk management into urban planning, poor protection of hydraulic infrastructure, and low public awareness [37].

Libya represents another flood-prone country, having experienced numerous devastating flood events. Heavy rainfall and storm surges in coastal areas constitute significant contributing factors to flooding in Libya. Furthermore, land use changes have diminished soil water absorption capacity, thereby increasing flood susceptibility. Climate change further amplifies the likelihood of flooding in the country. Implementing integrated flood risk management strategies, developing resilient infrastructure, establishing early warning systems, adopting comprehensive urban planning, and enhancing community engagement in risk reduction are among the key measures recommended to mitigate flood risk in Libya [38-39].

Among the Arab countries in our study, Yemen, Saudi Arabia, and Iraq have recorded the highest frequency of floods. In Yemen alone, 36 floods were recorded between 2000 and 2024 in the EM-DAT database, resulting in 1,422 fatalities and economic losses totaling 607 million dollars. Previous studies have indicated that factors such as heavy rainfall, rapid population growth, unregulated urbanization, and inadequate environmental monitoring have exacerbated flood severity in Yemen. Additionally, human activities, including deforestation and unsustainable urban development, have compounded these effects. As a result, low soil permeability during heavy rainfall has caused rapid inundation of residential and agricultural areas, posing substantial threats to Yemen's society and economy [40-43].

Saudi Arabia faces significant flood risks, second only to Yemen, due to its unique climatic and geographic conditions. Highly variable rainfall patterns, particularly in arid and semi-arid regions, frequently trigger flash floods that pose significant threats to both infrastructure and human life. Rapid economic growth, urbanization, and population increase, alongside inadequate construction and widespread land-use change, have exacerbated these dangers by reducing the land's ability to absorb water and increasing runoff. Effective solutions depend on resilient drainage systems, reliable dams, robust flood preparedness, and stronger community risk awareness [44-45].

Iraq stands at immediate risk of severe flooding, with danger escalating due to heavy rainfall, seasonal snowmelt, rapid urbanization along riverbanks, and accelerating climate change. The situation is exacerbated by the aftermath of armed conflict, which critically restricts access to vital hydrological data and severely undermines necessary research. Flash floods have resulted in alarming human and economic losses. Yet, Iraq's flood risk management remains considerably underdeveloped, and scientific research is still scarce [46-47].

Rapid urbanization in the Middle East and North Africa heightens vulnerability to natural disasters, especially floods. Approximately 62% of the region's population resides in urban areas, and this share is projected to double over the next three decades. Notably, 92% of the population occupies only 3% of the total land. Such density in limited spaces greatly increases exposure to hazards. Policymakers and stakeholders must urgently invest in robust infrastructure, accelerate drainage system upgrades, and implement effective flood risk reduction strategies immediately [48-50].

Earthquakes represent another major natural hazard in the region. Seismic activity is primarily driven by the northward convergence of the Arabian, African, and Indian tectonic plates toward the Eurasian Plate. This movement, known as continental convergence, results in the intense bending and breaking of the Earth's outer shell, a process referred to as crustal deformation [51]. Earthquakes are among the most destructive hazards in North Africa—they cause substantial human and economic losses. Shallow focal depths, meaning earthquakes that originate close to the Earth's surface, poor soil conditions, and high social vulnerability increase the risk of earthquake-related damage. Complex tectonic interactions between the African and Eurasian plates further elevate seismic risks in the region [52].

Located on a major seismic belt, Iran stands out as one of the most earthquake-prone countries in the Middle East. The 2003 Bam earthquake was particularly devastating, causing over 31,000 deaths and widespread destruction of infrastructure and housing [53]. Other major earthquakes include the 2005 Zarand event [54], the 2012 twin earthquakes in East Azerbaijan [55], and the 2017 Kermanshah earthquake, which destroyed more than 31,000 homes and vital public facilities. These recurring disasters highlight Iran's acute vulnerability and underscore the urgent need for rigorous enforcement of building codes, retrofitting of critical infrastructure, securing robust post-disaster funding, implementing comprehensive national risk reduction programs, and expanding earthquake insurance to offset economic losses [56].

Afghanistan faces a high earthquake risk due to its location at the junction of major tectonic plates and the abundance of deep, active faults, especially in the northeast. Since 1900, approximately 100 significant earthquakes have resulted in over 10,000 deaths in the past three decades [57]. This vulnerability is intensified by poor construction practices and weak enforcement of building codes. To reduce earthquake damage, Afghanistan must prioritize detailed seismic hazard mapping, creation of a comprehensive active fault database, strict enforcement of construction standards, and public awareness. Strengthening disaster management frameworks is crucial for enhancing resilience [58-59].

Morocco is one of the most seismically active countries in North Africa, primarily due to its intricate tectonic setting. As presented in **Table 3**, a particularly devastating event was the 2023 earthquake, which had a magnitude of approximately 6.8 and resulted in widespread casualties, significant economic losses, and extensive damage to essential infrastructure. Although Morocco is located within a recognized seismic hazard zone, the destruction was exacerbated by poor construction standards, inadequate infrastructure, and a lack of disaster preparedness. Additionally, negligent enforcement of building codes and zoning regulations significantly amplified the disaster's consequences [60-61].

As shown in Figure 1, most studied countries experienced extreme temperature events during 2000-2024, reflecting a regional trend of rising air temperatures. Building on this, Figure 2 highlights a marked increase in extreme temperatures across the region since 2021. Furthermore, Figure 3 illustrates a consistent warming trend in recent years, demonstrated by annual surface temperature anomalies.

Looking back, historical data indicate that between 1961 and 1990, the MENA region warmed at approximately 0.2°C per decade. This observed trend is projected to persist and intensify in the coming decades. Under various regional and global warming scenarios, countries such as Algeria, Libya, and large parts of Egypt are expected to experience mean temperature increases of up to approximately 3°C or more by the mid-to-late 21st century, with even greater rises possible under high-emission pathways.

Significantly, if global warming reaches 4°C, projections suggest that summer temperatures in Algeria, Saudi Arabia, and Iraq could rise by as much as 8°C by the end of the century. Previous studies indicate that North Africa may experience temperature increases of more than 8°C on the hottest days and nights each year. In warmer regions, maximum temperatures may range from about 50°C to at least 56°C. Looking ahead to the period between 2071 and 2100, the frequency of hot days (above 40°C) and nights (over 30°C)—especially in summer—is expected to rise. As a result, some areas could see more than 180 hot days and 100 hot nights become common [62-65].

As our findings in Figure 3 show, from the beginning of 2000 to around 2010, most of the cells forming the heat map are light in color, indicating that temperature anomalies were at negative values or close to long-term averages. In 2010, nearly all countries exhibited a marked darkening, reflecting a sudden increase in surface temperatures. From 2010 to the end of 2024, surface temperature anomalies have been on an increasing trend, with the last two years, 2023 and 2024, reaching their highest levels in the region. A review of organizational reports also confirmed our findings of a sudden increase in temperature in 2010.

According to a report from the World Meteorological Organization (WMO), 1998, 2005, and 2010 were the three warmest years between 1850 and 2010, with 2010 taking the top spot as the warmest year. According to WMO, the temperature increase in 2010 was 0.55 degrees Celsius higher than the average annual record since the early 1960s. According to the report, North Africa, the Arabian Peninsula, South Asia, and China experienced severe weather anomalies throughout 2010, with some regions experiencing temperatures 1 to 3 degrees Celsius above normal. Many countries in these regions experienced their hottest year on record. In the summer, temperatures in Jeddah, Saudi Arabia, reached a record 52 degrees Celsius, and in Doha, Qatar, 50.4 degrees Celsius. Even parts of northwest Africa, which are usually cooler, experienced extreme summers, with Morocco recording temperatures of 47.7 degrees Celsius. In the winter of 2010, the average temperature was 3.7°C above the long-term trend, the largest monthly anomaly recorded for the region [66].

According to the National Oceanic and Atmospheric Administration (NOAA), 2010 was one of the warmest years on record, in part due to a long-term warming trend driven by climate change. A strong El Niño in the first half of 2010 (through April) warmed waters and associated weather patterns in the tropical eastern Pacific Ocean, and this, combined with the warming trend of the previous decades, made the first half of the year one of the two warmest January–June periods on record.

Despite a rapid transition to La Niña in the second half of the year and its intensification by the end of 2010, sea surface temperatures in the Atlantic and Indian Oceans remained above average (especially in the tropical Atlantic), preventing a sharp drop in temperature. The Arctic Oscillation remained predominantly in its negative phase for most of the year, contributing to the observed distribution of temperature anomalies across the Northern Hemisphere [67-68].

Drought poses a significant risk of natural disaster in the studied region. According to our findings, Kuwait faces the highest level of water stress in the region, followed by Oman, Qatar, Bahrain, and Lebanon, which are among the countries experiencing the most severe water scarcity challenges. The World Bank identifies the MENA as the world's most water-stressed region, facing rising temperatures and water shortages. This crisis is expected to worsen due to rising sea levels, shifting rainfall, and more frequent heatwaves. Intensifying water scarcity will strain freshwater resources, lower agricultural output, and endanger public health and food security. Additionally, climate change will likely drive conflict, displacement, and migration [69-70].

The MENA region accounts for approximately 6.3% of the world's population but possesses only 1.4% of global renewable freshwater resources. Droughts in the region have extensive consequences, including disruptions to national economies, deterioration of trade balances, compromised public health, heightened social inequalities, reverse migration, and increased political instability. Previous studies indicate that between 1981 and 2021, the frequency of droughts in the MENA region increased from 12.9% to 19.4%. In recent decades, droughts have occurred with lower intensity but longer duration. Rising temperatures and increased water evaporation are identified as primary drivers of drought in the region. To address these challenges, the region must urgently implement effective water management strategies and adapt agricultural practices to higher temperatures—including cultivating drought-resistant crops. Additionally, policymakers should prioritize the adoption of drip irrigation, the use of low-water-demand seeds, and the expansion of wastewater treatment to effectively combat water scarcity trends in the MENA region [70-75].

Landslides are a major recurring natural hazard in the region, affecting Pakistan and Afghanistan most severely. Intense monsoon rains, seismic activity, steep terrain, and human activity primarily drive the region's frequent and destructive landslides on unstable slopes, particularly in northern Pakistan. These hazards result in severe social and economic impacts.

Key contributing factors include steep slopes, weak geological conditions, sparse vegetation cover, proximity to active faults and river systems, high soil moisture content, unfavorable lithology, and infrastructure development in mountainous areas. To reduce risk, comprehensive assessments, strategic land-use planning, and precise susceptibility mapping are essential. Ongoing research and monitoring are needed to strengthen disaster management and resilience [76-77].

As shown in Figure 1, avalanches pose a significant threat in Afghanistan. This country has experienced the highest frequency of avalanches due to its predominantly mountainous terrain, severe winters, complex geological setting, and cold climate. These hazards pose a threat to human lives, livestock, infrastructure, and local livelihoods. Climate change has reduced annual snow cover, increased winter temperatures, and contributed to an increase in the frequency of avalanches. To improve avalanche risk management in Afghanistan, key recommendations include: establishing high-altitude monitoring stations, enhancing early warning systems, conducting public awareness campaigns, maintaining emergency stockpiles, implementing advanced forecasting technologies, developing protection programs for vulnerable communities, and strengthening institutional coordination with dedicated funding [78-81].

According to Figure.7, high-income countries experienced significantly lower mortality, economic losses, and numbers of affected individuals from natural disasters compared to middle- and low-income countries. Natural disasters' impacts are considerably less severe in high-income regions due to more resilient infrastructure, effective early warning and emergency response systems, robust governance, proper policy implementation, and greater financial capacity. Although high-income countries may still incur substantial economic losses, their ability to invest in infrastructure maintenance, disaster education, and preparedness enhances social resilience and reduces mortality risks [82-83].

In contrast, low- and lower-middle-income countries have larger populations at risk and weaker infrastructure—such as communities in coastal areas and vulnerable buildings—resulting in higher human impacts even if financial losses are comparatively lower. These countries also experience higher mortality and economic losses, with the greatest numbers of affected individuals reported. Limited institutional capacity and income inequality further exacerbate vulnerability, leading to increased casualties and societal disruption. Overall, disasters in less-developed regions result in severe human suffering and economic setbacks, whereas in high-income countries the burden is primarily economic [84].

As shown in Figure 9, Iran, Afghanistan, and Pakistan exhibit substantial similarities in the types of natural disasters they experience. Earthquakes occur in all three countries, which are situated along the Alpine–Himalayan seismic belt and are affected by the collision of the Indo-Eurasian tectonic plates. This tectonic setting has resulted in a widespread distribution of seismic activity across the region [85-87].

Figure 9 also indicates that flooding is widespread in Afghanistan and Pakistan, while it occurs less frequently in Iran. Nevertheless, the underlying causes of flooding in all three countries are largely similar. Key drivers include climate change, rising temperatures, intense precipitation, and snowmelt. In addition, mountainous topography and human-induced factors such as deforestation and land-use change play a significant role in exacerbating flood hazards [35–36, 88–89].

According to figure.9 in the Arab countries of the Persian Gulf, the most important natural hazard has been flooding. Flooding in the Gulf states (such as the United Arab Emirates, Oman, Saudi Arabia, Kuwait, Bahrain, Qatar, and parts of northern Iraq) is largely the result of a combination of natural and human factors; naturally, this arid region experiences low annual rainfall (such as 70 mm in Bahrain and 116 mm in Kuwait), but sudden intense rainfall events (such as mesoscale convective systems or MCSs, the enhanced Somali low-level jet, the Arabian Cold Vortex, or converging low-pressure systems) cause heavy rainfall in a short period of time. These rainfall events are exacerbated by climate change, increasing their intensity by 10–76% (especially during El Niño), while the arid topography, steep mountain slopes (such as the Al Hajar in Oman or the Red Sea Hills in Saudi Arabia), dry valleys (Wadis), and low-permeable soil contribute to rapid runoff and flash floods.

On the other hand, human factors such as rapid and irregular urbanization, the expansion of impervious surfaces (such as asphalt and concrete), inadequate and outdated drainage systems, lack of accurate rainfall data, neglect of drainage design in dry areas, and construction on natural water flow paths greatly increase the risk and make infrastructure (roads, highways, airports) vulnerable; as a result, floods are sudden, destructive, and often associated with high economic losses, highlighting the need for sustainable planning, early warning systems, and resilient drainage [90-96].

Policy Recommendations

Our findings showed that the Middle-East, North-Africa, Afghanistan and Pakistan are facing an increase in the frequency and intensity of some natural disasters (especially earthquakes, floods, storms and droughts), which cause significant loss of life, affected people and economic losses. These results have important implications for policy-making and disaster management at different levels:

- **Policy-making level:** Governments, national and regional organizations should invest more in implementing early warning systems, strengthening critical infrastructure (such as urban drainage and earthquake-resistant buildings), and developing disaster risk reduction plans (based on the Sendai Framework 2015–2030).
- **Management level:** crisis management organizations, relief agencies and ministries of health should provide rapid disaster response capacity, including training local communities, stockpiling essential resources and better inter-agency coordination.
- **Implementation level:** Prioritizing high-risk areas for better budgeting and resilience planning is essential. Also, integrating up-to-date natural disaster data into sustainable development planning can significantly prevent future losses.

Study Limitations

- The data in this study are mainly extracted from the EM-DAT database and may be underreported (especially economic damage data).
- This study is a retrospective – descriptive research and the analyses conducted in it were limited to descriptive statistics only. No inferential statistical analyses (correlation, regression or significance tests) and examination of causal relationships were conducted in it.
- This study did not address multiple and complex factors such as forced migration, internal and external armed conflicts, pandemics, political instability, etc.
- The failure to fully record all variables studied for all natural disasters in all countries in EM-DAT database was another limitation of this study.

Suggestions for Future Research

- Using standard indicators such as economic losses (as a percentage of GDP), deaths per population, number of people affected per population, and per capita losses to make fairer comparisons between countries and regions.
- Performing statistical analyses such as correlations, multivariate regressions, etc. to examine possible relationships between factors that exacerbate the effects of natural disasters (such as urbanization, population density, critical infrastructure, climate change, etc).
- Investigating multiple factors and paying attention to the cascading effects of natural disasters.

Conclusion

The findings of this study showed that the significant increase in the frequency and intensity of natural disasters (earthquakes, floods, storms and droughts) in the studied countries has resulted in loss of life, damage to people and heavy economic losses. To cope with and reduce the impacts of natural disasters in this region, necessary measures should be taken by responsible organizations and stakeholders at various local, national and regional levels. According to the Sendai Framework (2015–2030), the priority of national organizations should be the implementation of multi-hazard early warning systems, the retrofitting of critical infrastructure (earthquake-resistant buildings, urban drainage) and the integration of flood zoning into urban planning. Regional organizations should also strive for coordination and knowledge exchange among countries. Disaster management organizations and ministries of health should strengthen rapid response capacity by training local communities, stockpiling resources and inter-agency coordination. Prioritizing high-risk areas for budgeting and integrating disaster data into sustainable development will effectively reduce future losses. This study had limitations such as incomplete EM-DAT data, lack of advanced inferential analysis, and failure to examine confounding factors (conflicts, migration, etc.). Future research could fill these gaps by using standardized indicators, advanced analyses, and in-depth case studies.

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Ethical Consideration:

This study used only publicly available, open-access data from international databases (e.g., EM-DAT, World Bank, Our World in Data, Statista, and World Population Review). No human subjects or confidential data were involved, and ethical approval was not required. Data interpretation was conducted with impartiality and without bias.

Conflict of Interests:

All the authors claim no conflict of interest in this study.

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