

# An Investigation into Emergency Planning Requirements and Challenges of Disaster Management in the Kingdom of Saudi Arabia

Naif Rashed Alrehaili

University College London, London, United Kingdom.

\*Corresponding author: [naif.alrehaili.19@ucl.ac.uk](mailto:naif.alrehaili.19@ucl.ac.uk)

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## Abstract

Every year, the Kingdom of Saudi Arabia (KSA) is exposed to different natural hazards. However, flash floods have been the most common hazard during the previous few decades. Between 2000 and 2020, over 1,000 people lost their lives from flash floods, resulting in an economic loss amounting to billions of US dollars. By focusing on flash floods, a systematic review of the extracted data was conducted. They were analyzed based on the suitability of their content and data for emergency planning requirements and disaster management challenges in the KSA. A total of 104 articles, papers, and plans were reviewed, of which only 18 complete papers met the inclusion criteria, including one plan and the General Directorate of Civil Defense (GDCCD) website. The author has concluded that: 1) the essential requirements for emergency planning in the KSA include: conducting studies that show potential natural hazards, their locations, and their implications, and taking appropriate measures that reduce the possible causes of natural hazards; 2) The challenges facing the disaster management in the KSA are: lack of policies; the ambiguity of legislation and plans; poor coordination between stakeholders; lack of databases. This is the first investigation into emergency planning requirements and challenges of disaster management in the KSA. Furthermore, a scientific consensus predicts an increase in the frequency and magnitude of flash floods in the KSA. Therefore, the gaps need to be addressed in order to reduce the impact on inhabitants and infrastructure.

**Keywords:** Emergency Preparedness; Emergency Planning; Disaster Response; Flash Floods; the KSA.

## Introduction

The Emergency Events Database (EM-DAT) still adopts the concept of “natural disasters” for meaning natural hazards triggering disasters and shows that a total of 7,348 events have occurred in the past two decades. Moreover, Table 1.1 illustrates that between 2000 and 2019, around 1.23 million people died due to a natural hazard, averaging 60,000 deaths annually, with wider impacts on more than 4 billion individuals. In economic terms, such hazards globally caused a loss of around US\$2.97 trillion (Mizutori & Guha-Sapir, 2020). Compared to the preceding two decades, the number and impact of natural hazards have significantly increased: between 1980 and 1999, there were 4,212 reported natural hazards across the globe, with loss of life of around 1.19 million and impacts on more than 3 billion individuals, plus US\$1.63tn lost in economic terms (Mizutori & Guha-Sapir, 2020). Remarkably, between 2000 and 2019, flash flooding made up 44% of recorded hazards and impacted 1.6 billion individuals globally, which was more than for any other kind of hazard, averaging 163 occurrences annually (Mizutori & Guha-Sapir, 2020).



**Table 1.** Effects of Disasters: 1980-1999 Compared to 2000-2019 (Mizutori & Guha-Sapir, 2020).

1980-1999	2000-2019
Reported disasters: 4,212	Reported disasters: 7,348
Total deaths: 1.19 million	Total deaths: 1.23 million
Total affected: 3.25 billion	Total affected: 4.03 billion
Economic losses: \$1.63tn	Economic losses: \$2.97tn2

The KSA is exposed to natural hazards, such as earthquakes, tsunamis, volcano eruptions, landslides, slope collapses, and flash floods. In mountainous areas of the country, slope collapses – particularly rockfalls – is common (Abualnaja, 2011; Ewing and Synolakis, 2011; Lam et al., 2016). Other common natural hazards in this arid country include drought, erosion, shifting dunes, dust storms, and salinization, which lead to the decline of agricultural areas (Al-Bassam et al., 2014). However, flash floods have been the most common hazard documented in the EM-DAT during the previous few decades (CRED, 2021). Between 2000 and 2020, over 1000 people lost their lives from flash floods, resulting in an economic loss amounting to billions of US dollars (GDCD, 2021).

The literature on emergency planning and disaster management continues to develop. With this in mind, this paper presents an investigation into emergency planning requirements and challenges of disaster management, focusing on flash floods in the KSA.

#### *Research Motivation and Rationale*

The emergency planning for disaster management varies significantly from country to country. In the KSA context, the GDCD is responsible for managing and planning disasters and emergencies and protecting lives and properties (GDCD, 2020a; 2020b). This can be characterized as 'working from the top-down. While the GDCD has sufficient will in planning for risk and disaster reduction, its policies, legislation, and regulations development concerning emergency planning and disaster management have been a prolonged process (Abosuliman et al., 2013). Furthermore, according to Almari (2010), the GDCD has struggled to be proactive when planning present risks related to natural hazards and maybe even less prepared for possible future events, so the disaster management approach currently in the KSA being mainly reactive rather than proactive.

The KSA has been subject to much criticism from individuals and local and international societies. The criticism extends to the policies, procedures used in planning flash floods. In order to improve upon the emergency planning and disaster management in the KSA, the emergency planning requirements must be explored, and the challenges are hindering the effectiveness of disaster management.

This investigation aims to understand disaster management's emergency planning requirements and challenges, focusing on flash floods in the KSA. Lessons learnt are also outlined.

## **Methodology**

### *Research Strategy*

This systematic review (SR) paper was conducted on separate databases such as Google Scholar and Scopus since each database has different functionality. The research was used terms such as: 'disaster management', 'emergency planning', 'emergency management policies and plans', 'emergency training or capability, and 'natural hazards' in the KSA. The full papers or national emergency planning and disaster management documents on natural hazards and management of risks, natural hazards guidance, and emergency policies/decrees were used,

whether they were in English or Arabic. The papers were evaluated based on their link with natural hazards and components of disaster management, especially emergency planning for natural hazards.

#### *Inclusion and Exclusion Criteria*

The research was limited to English or Arabic publications related to emergency planning requirements and disaster management challenges in the KSA from January 2000 to December 2020, which included compound terms such as: 'emergency policy', 'disaster management reforms', or 'natural hazards effects', were analyzed, regardless of the paper's form or content.

#### *Evaluation of Publications*

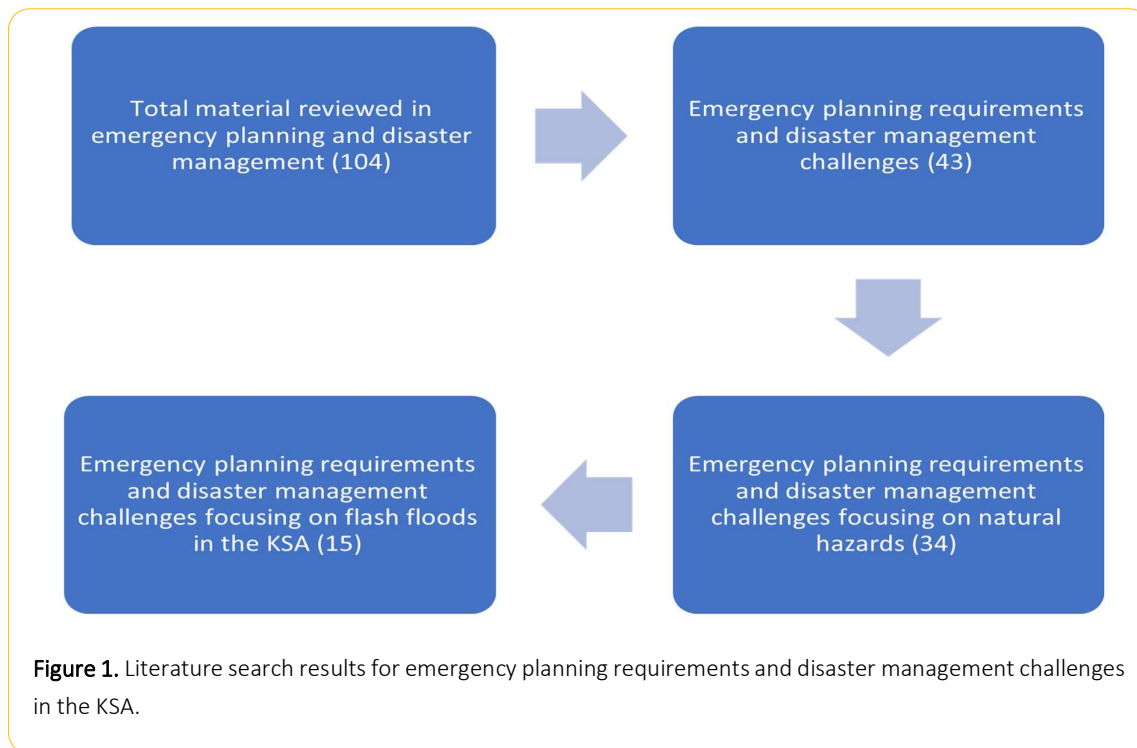
The researcher evaluated the full publication type for each paper on emergency planning requirements and disaster management challenges. In order to explore how prepared the KSA's government and emergency authorities are with regard to responding to natural hazards, national emergency plans have been reviewed. Emergency planning and disaster management papers linked specifically to natural hazards have also been used, except those which did not match the full criteria.

#### *Data Analysis*

Microsoft Excel was used to process the data and analyze the themes of the emergency planning requirements and disaster management challenges, particularly regarding natural hazards in the KSA.

## **Results**

A total of 104 articles, papers and plans were obtained and reviewed, of which only 18 complete papers met the inclusion criteria, including the GCD website. They were analyzed based on their content and data suitability for emergency planning requirements and disaster management challenges, focusing on natural hazards in the KSA (See Figure 1 below).



## Discussion

### *Flash Floods as a Hazard in the KSA*

Being an arid region, KSA has two short rainy seasons. The first extends from mid-October to mid-December, whereas the second ranges from late March to late May. Its climate is characterized by fluctuating low rainfall of an annual average of about 150mm (Ministry of Higher Education, 2015). Even though it has no permanent year-round rivers, the country is not immune to flash flooding, increasing frequency and severity. Flash floods caused by intense, continuous rainfall is the most common type of natural hazard in the KSA (Alamri, 2010; Youssef et al., 2016; Theilen-Willige and Wenzel, 2019).

Many cities in the KSA – such as Riyadh, Jeddah, Makkah, Yanbu, Jizan, Asir and Medina – are exposed to flash floods annually. The effects of these include injury and death, damage to the environment and personal property, and the breakdown of infrastructure (Al Saud, 2015; Abdalla, 2018). For example, in 2009, a flash flood swept through most of Jeddah city, resulting in more than 163 deaths, hundreds of injuries, thousands of rescued persons, and many more thousands of damaged properties and economic assets (Alamri, 2010). The city recorded 150mm of torrential rainfall within just four hours, an amount that has not been seen for the past quarter of a century (Almazroui, 2011; Almazroui, 2013; Alkhalaf and Basset, 2013; Haggag and El-Badry, 2013). Furthermore, in 2011, a wave of torrential rain (50mm in four hours) resulted in 10 dead and 114 injured, as well as thousands of damaged buildings, let alone the economic losses that have been estimated at billions of dollars (Almazroui, 2013).

Additionally, in November 2013, the city of Riyadh experienced heavy rainfall of 32.2mm within hours, causing a flash flood that resulted in some deaths and much devastation to many properties located in risk-prone areas of the city (Ledraa and Al-Ghamdi, 2014). Following on from this, in Jeddah in the last week of November 2015, 22mm of torrential rain disrupted life in the city, interrupting businesses, closing schools and universities, and forcing people to stay indoors (Gulf News, 2015). The floods mentioned above – as well as further examples – are displayed in Table 2.

**Table 2.** *Cases of Flash Floods in the KSA (GDCD, 2021).*

Floods	Descriptions
Yanbu Flood in 1997	Heavy showers fell on Yanbu, located in western Saudi Arabia (SA). The heavy showers continued for 24 hours, causing destruction to over 130,000 km <sup>2</sup> of land and killing 10 individuals.
Asir Flood in 1997	Asir is an area in southwest SA. Heavy showers fell on the province leading to floods that destroyed an area of just less than 100,000 km <sup>2</sup> , causing 16 fatalities.
Makkah Flood in 2002	Makkah is an area in western SA. Heavy showers continued for seven days which led to flooding in many zones, claiming the lives of 19 people. Almost 100 Makkah citizens were evacuated by the GDCD that week.
Makkah Flood in 2003	Still not fully recovered from the previous year's rain, Makkah experienced one more heavy rainfall, defined as the worst in Makkah for 25 years. The

	level of water reached 6 m, and 12 individuals were killed.
Jizan Floods in 2004	Jizan is an area in southwest SA. Two floods hit the province, leading to what has been defined as Jizan's worst floods in 45 years. The floods killed 13 individuals, left over 400 displaced, and damaged many farms and roads.
Medina Flood in 2005	Medina is an area in western SA. Very heavy rains poured down on the province, causing the Yatamah dam to fail, which resulted in a flood that killed 29 individuals. 17 further people were hurt, 50 were displaced, and 43 had to be rescued.
Riyadh Flood in 2005	Riyadh is the capital of SA and is located in the center of the country. Heavy showers fell on the province, resulting in a flood that claimed the lives of 7 individuals, displaced 700 others and required another 700 to be rescued via GDCD helicopters.
Jeddah Flood in 2009	Located in western SA, Jeddah was severely impacted by a heavy shower lasting for a few hours, killing 121 people and displacing more than 10,000 others. Further damages occurred to 11,849 properties and 10,913 cars and financial damage of 3bn riyals.
Jeddah Flood in 2011	At least 10 people died in this flood, with 3 went missing. Aid relief teams evacuated 1,451 individuals, and helicopters evacuated a further 498. Emergency shelters were required as more than 1,500 families were displaced.
Jeddah Flood in 2017	Hundreds of people were evacuated from flooded homes and cars after another heavy shower hit. Civil Defence groups stated that they evacuated 481 individuals – most of them from cars stuck in the flood water – and replied to almost 2,000 calls for assistance.
Tabuk Flood in 2019	Heavy rain fell in Tabuk, a province in north-western SA, causing a flood that resulted in the deaths of 12 citizens and severe damage to the properties of 271 residents.
Taif Flood in 2019	A flood which occurred in Taif – a province within Makkah – caused the death of 1 person and damage to the properties of 36 citizens.

Hafar al-Batin Flood in 2019	The flood here – located in eastern SA – caused the deaths of 7 people, injured 11 others, and damaged the properties of more than 1000 citizens.
Makkah, Medina, Asir, Jizan, Najran, and Al Bahah Floods in 2020	Heavy rains across these regions caused floods that resulted in the deaths of 3 people, and damage to the properties of 600 citizens.

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As shown in Table 3.1, not only were flash floods the most prevalent disasters in the KSA over the past decade, but they also occurred all over the country, although their impact varied from year to year. After reviewing the examples, it can be noted that in many cases, the flash floods resulted in injuries and loss of life, resources, properties, and infrastructure. These events indicate that cities and emergency agencies in the KSA are not yet adequately prepared in terms of emergency planning, disaster response, or civil defense (Ledraa and Al-Ghamdi, 2020).

Therefore, flash floods in the KSA will continue to be an important research subject since they are the country's predominant type of natural disaster. Moreover, their occurrences appear to have increased lately at an unprecedented pace. Furthermore, they cause many casualties, whether deaths or injuries. Finally, they also cause both severe devastations to properties and severe disruptions to economic activities. This shows that the emergency planning requirements for these recurring incidents need to be examined, indicating a gap in the current disaster planning strategies in the KSA. So, the following section discusses the requirements for emergency planning.

#### *Emergency Planning Requirements*

The planning process is one of the factors for addressing the problem by identifying it, assessing the scenario, creating possible solutions, and reviewing alternatives (Friedmann, 2020). According to Friedmann, the tasks of planners are as follows: monitor situations, recognize potential issues, and gather the details required to determine the main problems; view and evaluate the data to create information; apply expertise in the creation and design of practicable solutions; evaluate options and strategies for decision-makers who want a way to proceed to achieve results; examine the planning findings to produce new data, and follow the steps iteratively starting with the first stage.

The National Plan for Natural Disasters Risk Reduction (GDCD, 2020a) divided the management of disasters into three distinct stages: pre, during, and post. Preparedness lies within pre-disaster management and thus includes response planning. The report establishes six requirements for this:

Firstly, conducting studies that show potential disasters, their locations, and their implications. Secondly, taking appropriate measures that reduce the possible causes of disasters or diminish their risks, such as setting laws, legislation, regulations and safety standards for industrial facilities and buildings, and taking adequate measures to ensure implementation of those laws. Thirdly, public awareness through the media of the preventative measures must be taken to reduce the disaster's effects. Fourthly, preparing appropriate emergency plans to deal with disasters that include human capabilities and any available equipment provides the tasks of all parties involved in the implementation. Fifthly, a focus on group and individual training across each level to ensure they carry out their roles when disasters occur, following the plans that have been prepared. Lastly, executing virtual field experiments of the prepared plans, check their effectiveness, performance, the preparedness of the implementing agencies, and the quality of coordination among them in implementing the plans.

Furthermore, Abosuliman et al. (2014) address the management and planning for flash floods for the KSA. A survey was carried out before, during and after floods in 2009 and 2011 in Jeddah by interviewing Saudi decision-makers and Jeddah Disaster Management Managers. Participants were largely in consensus on the top four priorities for management and disaster planning: training of emergency responders; identification and coordination of responsibilities and roles of the agencies; community education; and preparedness. In addition, flash flood vulnerability mapping for any region was deemed essential. It allows decision-makers to consider any patterns of floods and assist with adequate flash flood prevention and preparation. For flash flood vulnerability maps specific to Jeddah, Youssef et al. (2016) show that mapping can assist in dealing with the management and planning of floods in this area, which is useful for all involved parties and decision-makers.

Moreover, one of the most critical emergency planning requirements for flash flood response is the ability for training planning. Amin et al. (2019) found evidence indicating a shortfall of training for flash floods response in Makkah and Jeddah. It is observed that present emergency responders training for this area is insufficient to handle current and future disasters. Furthermore, Jeddah's flash flood risk has significantly increased in recent years, showing that three flood risk levels are expected: low, medium, and high. Improved training programs and capabilities are needed for each level in order for future responses to be as effective and efficient as possible. It is also essential that any obstacles or challenges standing in the way of achieving this are removed, and the following section, therefore, discusses the challenges and issues of Disaster Management.

#### *Challenges and Issues in Disaster Management*

With a specific focus on those in the KSA, in a recent study Ledraa and Al-Ghamdi (2020) points out that the challenges face emergency planning include: how the authority responsible for dealing with disasters in the KSA is organized; the role assigned to GDCD in such events; poor – and sometimes absent – unreliable hydrological data; lack of information about rainfall and runoff intensity and magnitude; lack of policies for flash flood risk management; inefficient institutional mechanisms to deal with flash flood disasters; and the paucity of coordination among government agencies and stakeholders. Furthermore, Bin Ottai (2017) reveals that the disaster response training programs within the KSA have many shortcomings, and they do not address training needs, especially in flash floods events.

Additionally, study of Momani and Fadil (2010) regarding the flash flood in Jeddah in 2009 highlights a lack of emergency management plans of official bodies, especially the governmental bureaucracy. Furthermore, the lack of an advanced early warning system meant that the city's population were not informed promptly. There were delays in detecting those who were missing, as the use of modern technology was limited. The lessons learnt here dictated more preventative measures and improved mechanisms to report and deal with the disaster on time. Therefore, policy alteration is essential for developing response planning for future disaster events, especially as the government declared that negligence was a significant factor in the outcome of this disaster.

Moreover, Alharbi (2008) indicates that disaster response planning in the KSA remains inadequate to what is needed due to insufficient general cultural; strategic leadership; the lack of the administrative units required for strategic planning; poor coordination among existing layers in civil defense planning for activation of procedures; and the ineffective control and follow-up systems.

### **Conclusion**

In conclusion, this paper has presented an investigation into emergency planning requirements and disaster management challenges in the KSA to improve and increase the effectiveness of emergency planning and disaster management, especially for natural hazards.

It is clear that the most essential requirements for emergency planning in the KSA include: conducting studies that show potential disasters, their locations, and their implications; taking appropriate measures that reduce the possible causes of disasters or diminish their risks, such as setting laws, legislation, regulations and safety

standards for industrial facilities and buildings, and taking adequate measures to ensure the implementation of those laws; public awareness through the media of the preventative measures that must be taken to reduce the disaster's effects; preparing appropriate contingency plans to deal with disasters that include human capabilities and any available equipment, and which provide the tasks of all parties involved in the implementation; a focus on group and individual training across each level to ensure they carry out their roles when disasters occur, in accordance with the plans that have been prepared; and executing virtual field experiments of the prepared plans, to check their effectiveness and performance, the preparedness of the implementing agencies, and the quality of coordination among them in implementing the plans.

The paper also found that there are many challenges facing disaster management in the KSA. For example, lack of policies, the ambiguity of legislation and plans, poor coordination between stakeholders, absence of involvement from all stakeholders, lack of databases for disaster management, and inadequate or non-existent training for such disasters.

It has also been shown that emergency planning and disaster management in the KSA has been well-developed over the past two decades compared to some neighbouring countries. However, the main focus still seems to be handling existing disasters reactively rather than planning for possible future disasters and being proactive. Emergency planning, therefore, requires a proactive approach – a mixture of the dominant and community-based planning approaches – especially with regards to key priorities such as natural hazard preparedness, early warning systems, response planning, and disaster effects.

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