

**A Systematic Review of the Emergency Planning for Flash Floods Response in
the Kingdom of Saudi Arabia**

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Abstract

Background: Every year, flash floods hit many cities in the Kingdom of Saudi Arabia (KSA), leading to many injuries and deaths as well as a huge amount of damage to infrastructure. Risks of frequent flash floods have been linked to a lack of emergency planning. This paper aims to present a systematic review of the emergency planning for flash floods response currently in place in the KSA.

Methods: A systematic review of the extracted data was conducted. They were analysed based on the suitability of their content and data for emergency planning for flash floods response. The search also included a case study which focused on the response to flash floods in Jeddah in 2009 and 2011.

Results: A total of 123 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 Defence (GDCCD) website. The researcher has concluded that: 1) The dominant approach of emergency planning (from top to bottom) is the approach already applied in the KSA; 2) The challenges facing the emergency planning for flash floods response in the KSA are: lack of policies; ambiguity of legislation and plans; poor coordination between stakeholders; lack of databases.

Conclusion: To the researcher's knowledge, this is the first systematic review of the emergency planning for flash floods response in the KSA. Furthermore, there is a scientific consensus which 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.

1. Introduction

The Emergency Events Database (EM-DAT, 2020) shows that a total of 7,348 natural disasters have occurred in the past two decades. Moreover, Table 1.1 (below) illustrates that between 2000 and 2019 around 1.23 million people died due to a natural disaster, averaging 60,000 deaths annually, with wider impacts on more than 4 billion individuals. In economic terms, such disasters globally caused a loss of around US\$2.97tn² (UNDRR, 2020). Compared to the preceding two decades, the number and impact of natural disasters have significantly increased: between 1980 and 1999 there were 4,212 reported natural disasters 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 (UNDRR, 2020). Remarkably, between 2000 and 2019, flash flooding made up 44% of recorded disasters and impacted 1.6 billion individuals globally, which was more than for any other kind of disaster, averaging 163 occurrences annually (UNDRR, 2020).

Table 1.1. Effects of Disasters: 1980-1999 Compared to 2000-2019 (UNDRR, 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: \$2.97tn ²

The majority of related studies, including that of Alexander (2002), Shaluf (2008), Kusumasari et al. (2010), and Mikulsen and Diduck (2016), describe a four-phase approach to managing emergency, namely: mitigation, preparedness, response, and recovery, as shown in Figure 1.1. Each of these has a role in safeguarding lives as well

as property. Although there is significance to actions taken in all of these emergency management phases, preparedness activities which include emergency planning are considered to be the most significant.

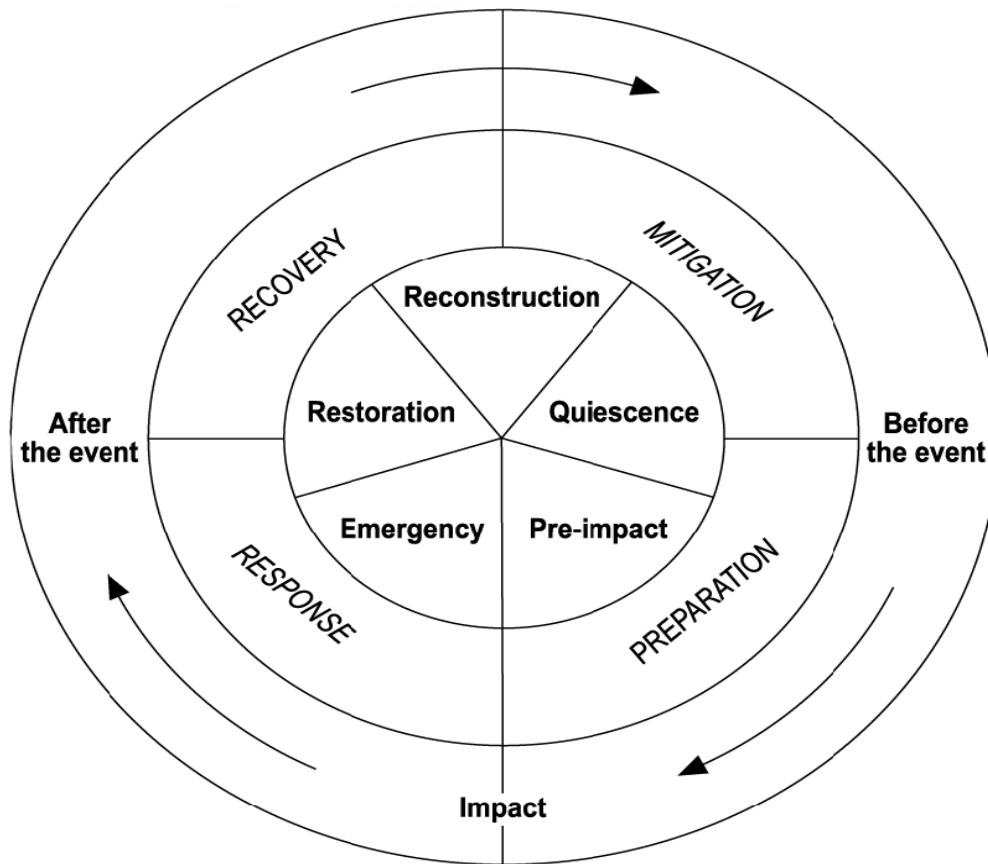


Figure 1.1. The Emergency Management Cycle (Alexander, 2002).

The literature on managing emergency continues to develop, and the central role of planning for effective preparedness and response activities has increased in this field. With this in mind, this paper presents a systematic review of the emergency planning for flash floods response in the KSA.

1.1 Motivations

Although the KSA climate is characterised as dry overall, flash floods are increasingly impacting on most of the Saudi cities (Mohamed, 2017; Chen et al., 2018). These flash floods have led to injuries and deaths, as well as general harm to residences, vehicles,

and other property damage because of the rise in the water levels (Youssef et al., 2016; Abdalla, 2018), as shown overleaf in the examples presented in Figure 1.2. Both socially and economically, such events severely impacted the country.

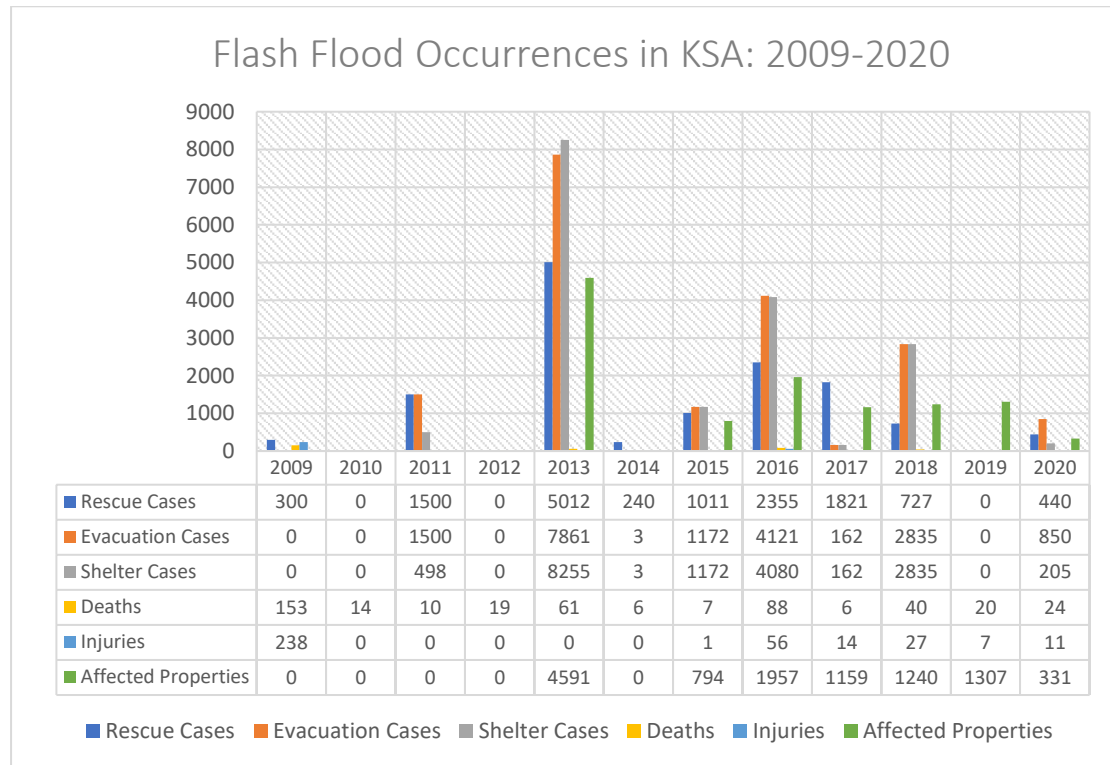


Figure 1.2. Frequency of Flash Floods in the KSA from 2009-2020 (GDCD, 2021).

The emergency planning for flash floods response varies significantly from country to country. In the KSA context, the GDCD holds overall responsibility for managing and planning disasters and emergencies, and for protecting lives and properties (GDCD, 2020a; 2020b). This can be characterised as, ‘working from the top-down’. However, while the GDCD has sufficient will in planning flash floods risks, its policies, legislations and regulations development in relation to the emergency planning for flash floods response has 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 flash floods responses and may be even less prepared for

possible future flash floods events, with risk reduction approaches currently 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 and plans used in planning flash floods, which makes it clear that there is a great need for effective disaster response planning on the part of the decision-makers and disaster response agencies in the KSA. In order to improve upon the emergency planning for flash floods response in the KSA, the current approach must be explored as well as the challenges hindering its effectiveness.

This systematic review of the state of the literature aims to understand the trends of the emergency planning for disaster response, focusing on flash floods response planning in the KSA. Lessons learnt are also outlined.

2. Methodology

2.1 Research Strategy

A systematic review (SR) is defined as, “A review of the literature on a clearly formulated question that uses systematic and explicit methods to identify, select and critically appraise relevant secondary data, and to extract and analyse data from the studies that are included in the review.” (Khan et al., 2001, p.12). The literature review for this paper was performed on separate databases such as Google Scholar and Scopus, since each database has a different functionality. The research was Used terms such as: 'disaster response', 'disaster preparedness', 'emergency planning', 'emergency management policies and plans', 'emergency training or capability', and 'flash floods in the KSA'. The full papers or yearly national emergency prevention and response documents on flash floods, threats and mitigation of floods, emergency preparedness,

emergency response, flood guidance, and emergency policies/decrees were used, whether they were in English or Arabic. The papers were evaluated on the basis of their link with natural disasters and components of disaster management, especially preparedness and planning for response to flash flooding.

2.2 Inclusion Criteria

English or Arabic publications relating to disaster preparedness and response planning research in the KSA from January 2000 to December 2020, and which included compound terms such as: ‘emergency policy and preparedness’, ‘disaster management reforms’, or ‘floods impacts’, were analysed, regardless of the paper's form or content.

2.3 Evaluation of Publications

The researcher analysed the full publication type for each paper on disaster preparedness and response planning, and noted if there were any overlaps, such as between preparedness and response policy, and disaster management. In order to explore how prepared the KSA’s government and response authorities are with regards to responding to flash flooding, national emergency plans have been reviewed. Emergency planning papers linked specifically to flash floods have also been used, except those which did not match the full criteria.

2.4 Data Analysis

Excel (Microsoft, WA, USA) was used to process the data and to analyse the themes of the emergency planning for flash floods response and its challenges, particularly in relation to flash flooding events in the KSA.

2.5 Results

A total of 123 articles, papers and plans were obtained and reviewed, of which only 18 complete papers met the inclusion criteria, including the GDCD website. They were analysed based on the suitability of their content and data for emergency planning for flash floods response, focusing on flash floods in the KSA (See Figure 2.1, below).

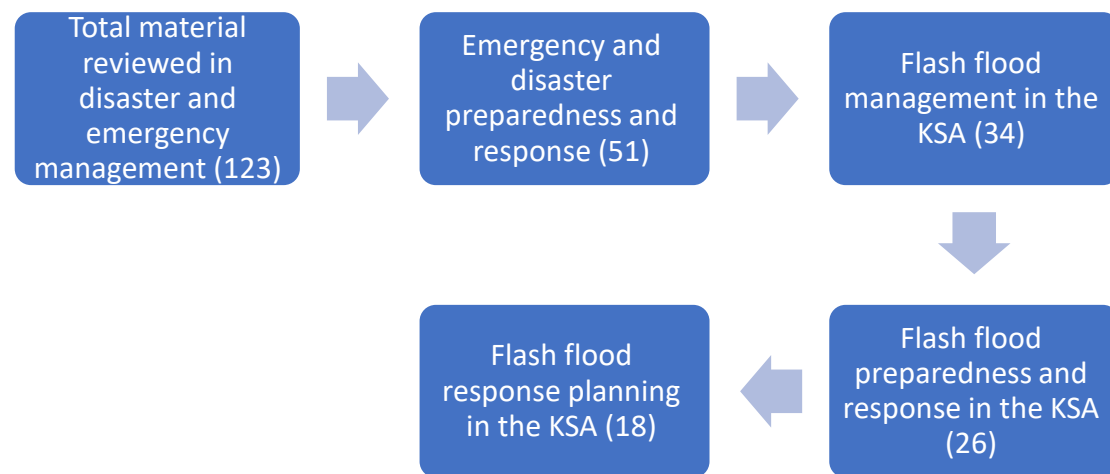


Figure 2.1. Literature Search Results for Emergency Planning for Disaster Response.

3. Discussion

3.1 Emergency Planning

Governments, experts, and organisations are continually working on methods to prepare for and respond to disaster threats and minimise the severe effect of these disasters on all individuals and infrastructure. Planning is an essential and vital part of the preparedness phase for a disaster or emergency event .

The concept of planning varies according to the field in which it functions. Generally, scholars have held that it has been taking place since biblical times: the story of Noah's Ark is often cited as one instance where plans were developed in advance of a severe

disaster. Additionally, Alexander (2002, p.10) states that emergency planning started to spread everywhere in government, business, and culture in the 1990s, and he further defines emergency planning as, “A response to the requirement to enhance safety as well as progressing understanding of hazards.”

The wide range of disasters that humans have experienced which have led to extensive harm and lives lost certainly attests to the importance and value of planning. In addition, Zhao et al. (2017) indicate that before an event can occur, emergency planning can effectively minimise the harm from disasters; in other words, emergency planning is key for effective emergency management.

The approaches to emergency planning discuss how planning should be performed and who should be doing it. In general, two different viewpoints have been established over the last two decades: the ‘community-based’ and the ‘dominant’. The two separate approaches will be explored in more detail, with the dominant approach being outlined first.

3.1.1 The Dominant Approach

Looking into history, planning was a unidirectional, information-driven process implemented ‘top-down’ by practising specialists of emergency planning (McGuirk, 2001). This approach in emergency planning is called the dominant approach. The dominant approach in emergency planning concentrates upon hazards as the main factor in any emergency, and thus positions hazards as central to all response planning. Based on this interpretation, the dominant approach to emergency planning tends to concentrate on infrastructure strategies such as flood dams and technological solutions to control the hazard. A dominant ‘top-down’ strategy may also recommend, for instance, moving individuals to neighbouring safer areas to avoid the flood threat.

The historical record for concentrating on emergency planning in this manner is clear. For instance, constructed flood controls such as dams are as ancient as urban civilisation (Jones, 2000; Fleming et al., 2001). Additionally, the tsunami of 2004, which occurred in the Indian Ocean, was controlled by a highly technical early warning system. Consequently, this disaster's severity encouraged a request from the British government for a 'Natural Hazard Working Group' meeting to be held for advice on the monitoring of tsunamis, floods, cyclones, and other worldwide natural disasters (King et al., 2005) .

The dominant approach, however, is marked by many flaws, and several studies have criticised the organisational 'top-down' tendency towards emergency planning, especially for the developing world (Jain, 2000; Magrabi, 2012). Such difficulties and shortcomings of the dominant planning approach prompted planning thinkers to begin seriously investigating other decision-making methods and to encourage community participation practices to be undertaken with the community and organised by planning practitioners. Although a gradual transition from the dominant approach to a community-based is ongoing, it is still slower than expected (Buckle et al., 2003). The next subsection highlights the community-based approach.

3.1.2 The Community-Based Approach

The community-based approach is planning that is being carried out through the people, and typically stresses democratic and opinion values. There is a heavy dependency on popular engagement and consultation, and also on the representation and interaction of a wide variety of participants. The community-based approach, therefore, emphasises the inclusion and participation of all partners in the planning stage, as well as the enhanced cooperation and coordination between decision-makers and all impacted

communities (Innes, 2004; Koontz and Johnson, 2004). It is more widely indicated as 'community-based' in Non-Governmental Organisation (NGO) and Community-Based Organisation (CBO) circles.

Giddens (2013) indicates that the theoretical framework for the community-based approach is presented by Jürgen Habermas' Critical Theory: in the decision-making phase, planning would have to include and involve all stakeholders, and planners must facilitate shared comprehension of the information based on real, truthful communication and discussion between planners and community members. In this aspect, the community-based planning approach is intrinsically collaborative, consultative, and participative.

The main difference between this more recent approach and the dominant one is its stress on susceptibility to a hazard instead of the hazard itself, with groups who were considered vulnerable being able to participate more effectively as part of the problem-solving efforts. The community-based approach then gives an alternative strategy guided by a 'bottom-up' procedure from the people at risk, showing the connection between disasters and humans, and their physical, economic, and social situations. Thus, Heijmans (2004) argues that successful emergency planning should be based on social, political, and economic community factors.

Although the community-based approach's importance is widely acknowledged by many influential community foundations, other members are likely to underestimate the local communities' role. India's 'High Committee on Disaster Management, for example, argued that due to India's low literacy levels and extensive poverty levels the community as an important entity has yet to take form (National Centre for Disaster Management, 2001). However, there have been many attempts made to shape and

enhance local community-based organisations. The following section discusses a case study of flash floods in Jeddah in the KSA.

3.2 Jeddah Flash Floods as a Case Study for the Emergency Planning

The KSA statistical analysis of natural disasters has shown that the most widespread threat in the past two decades has been flash floods (Alamri, 2010; Youssef et al., 2016). This flash flood risk is largely due to the geography and topography of the KSA (Solecki et al., 2011). To explore the effectiveness of the emergency planning for flash floods response in the KSA, this section analyses the Jeddah flash floods in 2009 and 2011, using the events as a case study. Figure 3.1 (below) illustrates the location of Jeddah city within the KSA.



Figure 3.1. Location of Jeddah City Within the Map of the KSA.

On 25th November 2009, the city of Jeddah suffered substantial rainfall with 90mm within just four hours, which was twice the city's annual average (Azzam and Ali, 2019). Flash floods then hit multiple areas across Jeddah at noon, with poorer neighbourhoods in the south of the city being most affected (Abosuliman et al., 2014). Less than two years later, on 26th January 2011, the city suffered from more heavy

rainfall, this time of 111mm (Ameur, 2016). Azeez et al. (2020) state that this heavy rain led to a flash flood, causing a dam – the Um al-Khair Dam – to break. As a result, many inhabitants, homes, and other properties were severely affected. Figure 3.2 (overleaf) shows satellite images of the Um al-Khair Dam: image (a) shows the dam before the collapse; image (b) shows the dam during the failure; image (c) shows the second day of the flash flood; and image (d) shows the dam several days after the flash flood.

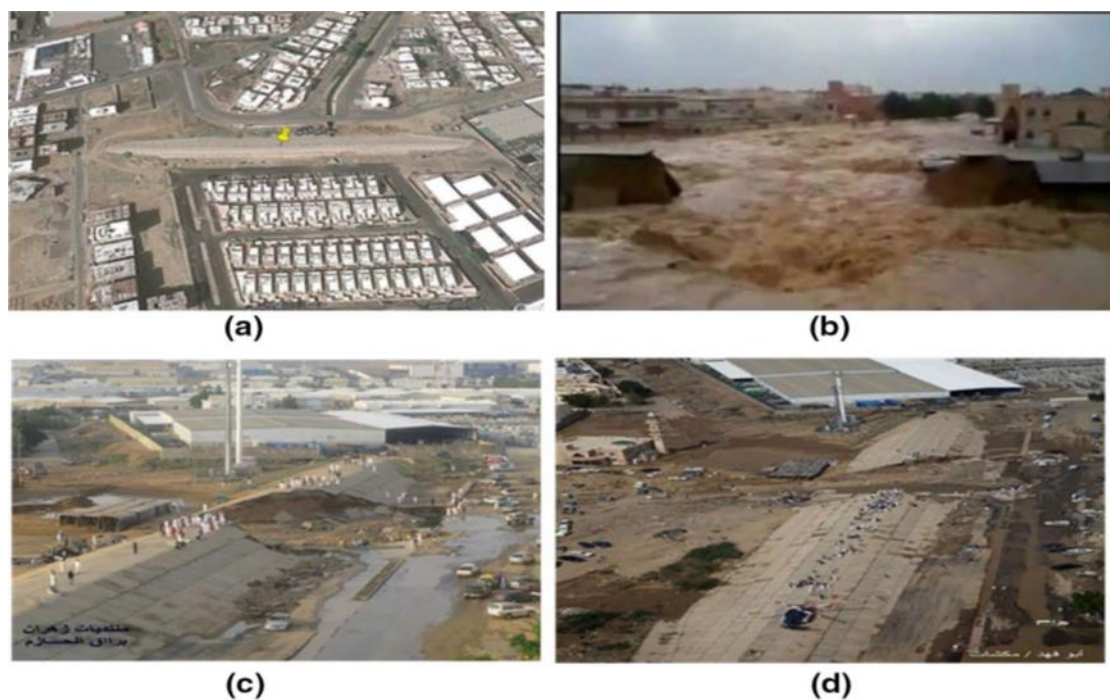


Figure 3.2. Satellite Images of the Um al-Khair Dam Before, During, and After the Collapse. (Azeez et al., 2020).

Information gathered from multiple journal articles indicates that the damage from both flash floods was vast, and 161 people lost their lives in the first occurrence, with a further 11 dying in 2011 (Ameur, 2016; Youssef et al., 2016; Azzam and Ali, 2019). Furthermore, 8,000 homes and over 7,000 vehicles were damaged (Abosuliman et al., 2014), plus the sum of economic damages totalled approximately US\$1bn, and the reimbursement for those impacted was projected at a further US\$2bn (Ameur, 2016).

In addition, the floodwater washed across 80% of the city, including on highways, sidewalks, and structures, covering around 400–600km² (Azzam and Ali, 2019). Some of the damage is shown in Figures 3.3 and 3.4 (overleaf). The flash flood effects have led to condemnation by numerous accountable Saudi Government Organisations, including wastewater control, flood prevention, and emergency response (Al-Saud, 2010).



Figure 3.3. Flash Flood in Jeddah – November 2009.



Figure 3.4. Flash Flood in Jeddah – January 2011.

Therefore, the primary objective of the investigation into these Jeddah flash floods is to determine how they were planned by the GDCD. Firstly, there was a lack of data on forecasting, mitigation, and emergency planning activities. An ineffective advanced

warning system and an incomplete ‘Emergency Relief Plan’ also played parts in the failures, and a further fundamental reason for this inefficiency is thought to be the strictly centralised aspect of the current emergency management system. Furthermore, even though relief activities were mainly visible in the processes of rebuilding and rehabilitation, and there was a greater focus on the response and recovery phases, it does not mean that such phases were successfully applied. In fact, difficulties were likely to arise in each of the phases. Additionally, the lack of a ‘Master Flood Management Plan’ was also an important underlying reason. Lastly, there wasn’t any professionally qualified team or special emergency response training at either city or national levels.

4. Conclusion

In conclusion, this paper has presented a systematic review of the emergency planning for flash floods response in the KSA. This included an in-depth discussion of the approaches in emergency planning which are: the dominant, ‘top-down’ approach, and the community-based, ‘bottom-up’ approach. The overall objective was to examine the current approaches of the emergency planning for flash floods response in the KSA, by discussing a case study of the flash floods which occurred in Jeddah city in 2009 and 2011 in order to improve and increase the effectiveness of emergency planning in the KSA.

Despite advances towards a community-based approach for emergency planning, there are many limitations on what could be accomplished through the identification and analysis of the disasters – as well as potential solutions – at a community level. For instance, when identifying and analysing potential disasters or hazards, communities

may not put an adequate focus on those they have not yet encountered, like dormant volcanoes or threats associated with climate change such as flash floods.

On the other hand, the execution of remedial steps for the dominant approach could also be hampered by the substantial economic costs required in the implementation of such physical steps towards responding to flash floods. Moreover, the flood risks found in upstream communities would also affect downstream communities, which would equally need to be considered. In addition, the resources needed to address the factors could generate further risks. Consequently, it can be concluded that a mixture of 'top-down' and 'bottom-up' approaches is the most effective method for emergency planning for flash floods response, with data moving mostly upwards and resources flowing downwards.

The main obstacles faced – and subsequent lessons learnt – from the case study of the Jeddah flash floods are highlighted below:

- Inefficiency in advanced emergency planning for the response of the disasters
- A 'top-down' military-centralised system for the emergency planning was used, rather than a 'bottom-up' approach
- Stakeholders were not involved in the disaster response planning process
- Poor contact, collaboration and cooperation between related organisations, the local community, and stakeholders
- Inefficient or non-existent training in relation to responding to the flash flood disasters
- A lack of preparation, experience, and knowledge in the major risk areas
- There was not a central database system, or a way to monitor and control the information management system

The paper found that there are many challenges facing the emergency planning for flash floods response in the KSA, including lack of policies, ambiguity of legislation and plans, poor coordination between stakeholders, lack of involvement from all stakeholders, lack of databases for emergency planning, and poor training for such disasters.

Compared to some of its neighbouring countries, the emergency planning in the KSA has greatly improved over the past two decades. However, the main focus still seems to be on trying to handle existing disasters reactively, rather than on 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 flash flood preparedness, early warning systems, response planning, and disaster risks.

Acknowledgements

There was no funding for this paper. The researcher is grateful to the General Directorate of Civil Defence in the KSA for facilitating access to the data and documents related to this study. Thanks also go to the Saudi Arabian Cultural Bureau in London and to the Institute for Risk and Disaster Reduction at the University of London for providing an appropriate environment for the research. The researcher confirms that there is no conflict of interest.

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