Assessing the Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia

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Declaration

I, Naif R Alrehaili, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the work.

[redacted]

January 2024

Abstract

This thesis aims to explore and assess emergency planning for responding to flash floods in the Kingdom of Saudi Arabia (KSA). The study adopts interpretivism as its philosophical assumption; an inductive approach; a descriptive survey; and qualitative methods to address the research aim and objectives. The techniques used include a literature review, a case study strategy, and semi-structured interviews. The research sample consists of 13 expert officers from the General Directorate of Civil Defence (GDCD) in the KSA. The data are analysed by using content analysis. The research findings reveal that the GDCD is responsible for managing flash floods in the KSA. Its responsibilities include legislation, regulations, coordination with various government institutions, and implementation. Since it is a military agency, it adopts a top-down approach regarding emergency planning, which is strict and centralised. The research also finds that although emergency planning requirements are more or less in place, there is a need for further improvement and development; specifically, there is a need for better understanding, knowledge, and awareness. Furthermore, the National Plan for Natural Disaster Risk Reduction needs updating. Another finding is that it is more appropriate to rebalance emergency planning to focus equally on both the community-based and the dominant approaches. Lastly, it is found that emergency planning for responding to flash floods faces varying challenges and deficiencies. Consequently, this study recommends that during emergency planning for responding to flash floods, the GDCD should focus as much on achieving the community-based bottom-up approach as it does on the dominant top-down approach. It also strongly recommends that all emergency planning requirements developed from this study should be implemented simultaneously and as an integrated whole. By doing so, this study could help decision-makers and emergency planners at government emergency agencies to improve, develop, and reinforce emergency planning, specifically in reducing flash flood risks.

Impact Statement

This thesis aims to explore and assess emergency planning and its requirements and challenges, with a focus on flash flood response planning in the Kingdom of Saudi Arabia (KSA), from the perspectives of expert officers at the General Directorate of Civil Defence (GDCD). The findings of this study have a variety of impacts on the field of emergency planning and flash flood response, both inside and outside academia.

When reflecting on the impacts inside academia, this study presents a better understanding of emergency planning for responding to flash floods. In addition, it also has an impact as it explores and evaluates the emergency planning requirements, examines and assesses the National Plan for Natural Disaster Risk Reduction, determines the most appropriate approach to emergency planning, and explores the perceived challenges. Therefore, the findings of this study benefit academia by improving and developing a better understanding of emergency planning in general and flash flood response planning in particular.

In contrast, several impacts exist beyond the scope of academia as well. For example, the emergency planning requirements in this study may guide emergency agencies and local communities on how and what they need to develop effective emergency planning in order to respond to future flash floods. Although these research findings have revealed the emergency planning requirements for the KSA, they may also be applied to other countries or emergency agencies with similar emergency planning approaches.

Finally, the findings of this study have already been published in a number of peer-reviewed journals – such as the Australian Journal of Emergency Management, the International Journal of Disaster Management, and the Journal of Emergency Management and Disaster Communications – and has been presented at various conferences, such as the annual conference of the Institute for Risk and Disaster Reduction (IRDR) in London, England; the annual conference of the Society for Risk Analysis (SRA) in Herndon, Virginia, USA; and

the 6th Global Summit of GADRI at the Disaster Prevention Research Institute (DPRI) in Kyoto, Japan. Furthermore, several papers are due to be written based on this thesis.

Therefore, all of the above will contribute to reinforcing and increasing the impact of this study.

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In the Name of Allah, the Most Gracious, the Most Merciful.

Praise be to Allah, the Lord of the Worlds, and may His blessings and peace be upon His last Messenger, Mohammad. Peace be upon him. First and foremost, uttermost thanks and praise to Allah for giving me the ability, strength, and patience to complete this thesis successfully. His will has made this work possible.

I would like to thank my supervisors, principal supervisor Prof. David Alexander and subsidiary supervisor Dr. Gianluca Pescaroli, whom without their continuing support, advice, guidance, assistance, and encouragement the completion of this PhD would not have been possible. I deeply appreciate your support over the last three years. Special gratitude and appreciation also go out to the academic and administrative staff at the University College London and the IRDR for their support and for creating a conducive environment for the completion of this work. Thanks and gratitude also go to the examiners, Professor Fatima Jalayer and Professor Andrew Collins, for accepting the invitation to participate in Viva session and for their constructive feedback on the thesis.

I am immensely grateful to the Government of Saudi Arabia, represented by the Ministry of Interior and the GDCD, for providing a fully funded scholarship, which enabled the completion of this work. This support is greatly appreciated. Likewise, special thanks goes to the 13 participants who took part in this study for kindly volunteering their time and enriching this research with their valuable insight and information.

Finally, I want to express my great gratitude to my lovely wife, Maryam, and my sons, Nawaf and Abdallah, for their continued support, patience, understanding, and encouragement throughout my PhD journey. My sincere thanks and appreciation also extend to my friends and colleagues for their encouragement, support, and prayers. May Allah reward them.

Dedication

I dedicate this thesis to:

My country, the Kingdom of Saudi Arabia. I hope to contribute to developing emergency management.

The soul of my late mother, Norah. Although she was not with me throughout my PhD journey, I always feel her existence. She taught me that discipline, commitment, and persistence are the root of all successes.

My father, Rashed, for his persistent prayers and encouragement.

My lovely wife, Maryam. I offer her my deepest thanks and gratitude for her endless support, understanding, and encouragement.

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And finally, my brothers and sisters, for their support and prayers.

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LIST OF ABBREVIATIONS

BASIC	British Association for Immediate Care
BWH	Hot deserts climate
CBO	Community-Based Organisation
CCS	Civil Contingencies Secretariat
CEM	Comprehensive Emergency Management
CRED	Centre for Research on the Epidemiology of Disasters
DRR	Disaster Risk Reduction
EM-DAT	Emergency Events Database
FFRM	Flash Flood Risk Management
GDCD	General Directorate of Civil Defence
GFDRR	The Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information Systems
GO	Governmental Organisation
HFA	Hyogo Framework for Action
ICRC	International Committee of the Red Cross
IEMS	Integrated Emergency Management System
KSA	Kingdom of Saudi Arabia
MOI	Ministry of Interior
Natech	Natural Hazards Triggering Technological Disaster
NGOs	Non-Governmental Organisations
SFDRR	Sendai Framework for Disaster Risk Reduction
SPSS	Statistical Package for Social Sciences
UCL	University College London
UK	United Kingdom

UN	United Nations
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNISDR	United Nations International Strategy for Disaster Reduction
US/USA	United States/United States of America

LIST OF APPENDICES

Chapter One: Introduction

1.1 Overview

This thesis seeks to assess the emergency planning requirements for responding to flash floods in the Kingdom of Saudi Arabia (KSA). This first chapter presents the research background about emergency planning and flash floods. Then the research problem is presented, and the aim, objectives, questions, and assumptions are developed. This is followed by an outline of the research stages diagram. The research contribution and importance are then discussed. Followed by an overview of the research scope and limitations, it concludes with an overview of the thesis structure and content.

1.2 Research Background

Flood is the most common type of hazard worldwide. Remarkably, between 2000 and 2019, floods made up 44% of recorded hazards, averaging 163 occurrences annually, and impacted 1.6 billion individuals globally, which was more than any other kind of hazard (UNDRR, 2020). In the coming years, the trend of increasing flood occurrences is expected to continue (Wannous & Velasquez, 2017).

In this context, a recent study confirmed that flooding is among the leading climatic threats to people's livelihoods, affecting development prospects worldwide – and floods can also reverse years of progress in poverty reduction and development. Flood risk already affects 1.81 billion people (23% of world population). While the threat is already substantial, climate change and rapid urbanization in flood zones are likely to further drive up flood risks. (Rentschler, Salhab, & Jafino, 2022).

A flash flood is a flood of short duration with a relatively high peak discharge in which the time interval between the observable causative event and the flood is less than four to six hours (WMO, 2006). It is typically in reaction to heavy rain on dry land (Gourley et al., 2013).

A flash flood is generally characterised by raging torrents after heavy rains, a dam or levee failure or a sudden release of water in a previously stopped passage, for example, by debris that rips through urban streets or mountain canyons sweeping away everything in its path. Steep terrain tends to concentrate runoff into streams very quickly and is often a contributory factor. Changes in soil properties, hydrophobic or impervious soils, and removal of surface vegetation can also be important contributors (AMS, 2017).

Flash floods are caused by a number of factors. Rainfall intensity and duration are the two most important factors. The rate of rainfall is called intensity, and the length of time it rains is called duration. In addition, topography, soil conditions, and ground cover all have an impact (Wang & Bi, 2020).

Flash flood loss rates have increased globally over recent decades due to several reasons, such as: (i) rapid increase in population, as well as on developing land which is vulnerable to flooding (Neumayer & Barthel, 2011); (ii) rapid shift in the pattern of land use in order to resolve the expansion of urban areas and slums (Jódar-Abellán et al., 2019); and (iii) changes in precipitation patterns, along with growth in cities and settlements (Olsson et al., 2012). Since flash floods are the main focus of this thesis, specifically those in the KSA, other types of floods – such as coastal and river – will not be examined.

The complex process of handling flash floods, as well as the rapid escalation of emergencies, requires an understanding of how to better plan and respond to such situations. This highlights the importance and necessity of emergency planning, which is a process that enables the development of the capacity for responding to flash floods that have the potential to escalate or those that could have a negative effect on residents, properties, and the environment (Alshamsi, 2017).

As a result, in view of the losses caused by flash floods, and their complex effects on the population and infrastructure, the literature on managing flash floods continues to

develop. In particular, the central role of emergency planning for response activities has increased significantly (Pescaroli & Alexander, 2016; Pescaroli & Alexander, 2018; Pescaroli et al., 2018). The following section explains the research problem.

1.3 Research Problem

Topographical factors play a significant role in the occurrence of flash flood disasters, serving as important geographical conditions that contribute to their formation. Additionally, soil type influences flash flood disasters, as different soils have varying levels of permeability that affect how rainfall is retained and drained. Areas with primary and ferruginous soils are particularly susceptible to flash floods. This is because regions with primary soils often have sparse vegetation, severe soil erosion, and poor water retention, making them more prone to flash floods. In areas with ferruginous soils, strong leaching leads to high rainfall amounts, which can trigger flash floods (Li Q, Li Y, Zhao, Zhang, Wang, & Ma, 2024).

Desert countries, often associated with arid landscapes and scorching temperatures, are not typically thought of as places prone to flash floods. They are characterised by low precipitation levels and a scarcity of vegetation, creating a common perception that they are immune to the destructive forces of flash floods. However, the relationship between flash floods and desert environments is more intricate than one might assume. It only takes a reasonable amount of rainfall to create one in a dry region.

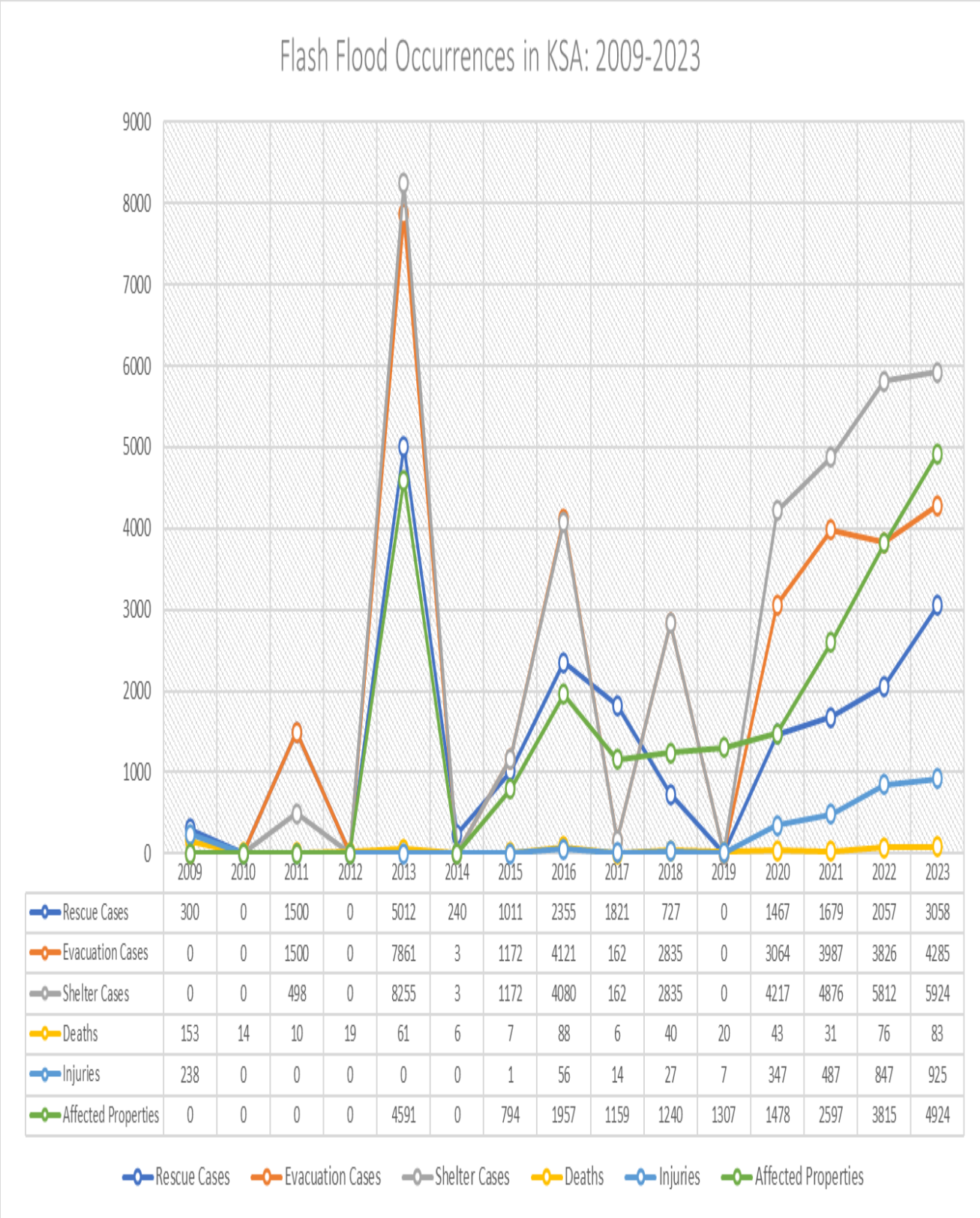
Desert countries experience infrequent but intense rainfall events. When storms do strike, the lack of vegetation to absorb water and the hard, compacted soil can lead to rapid surface runoff, preventing water from infiltrating the soil efficiently and making desert regions susceptible to devastating flash floods not only to humans but also to the environment, property, and infrastructure. Rainfall intensity in mm/hr exceeds infiltration capacity (also in mm/hr) in flash floods, leading to instantaneous runoff. In recent years, flash floods like the

Derna flash flood in September 2023 in Libya have underscored the shocking vulnerability of desert countries to sudden and intense rainfall.

According to the United Nations, Daniel's winds and rain on September 10 and 11, 2023, caused significant damage throughout eastern Libya, with the coastal city of Derna, home to over 100,000 residents, suffering the most severe impact. While 170 people died in other eastern Libyan cities due to rising waters, thousands perished in Derna after the long-neglected Abu Mansour and Derna (Belad) dams failed. The collapse released nearly 7.9 billion gallons (30 million cubic meters) of water downstream along the Wadi Derna River, which divides the city. A 23-foot (7-meter) high wave of reddish mud struck in the middle of the night, demolishing houses, sweeping away the lower floors of high-rises, and carrying people, vehicles, and debris into the sea. Estimates suggest that the deluge destroyed or severely damaged at least a quarter of Derna city, burying about 400 buildings in thick mud. The disastrous flooding resulted in more than 4,000 deaths and around 10,000 missing people in Derna city (Ashoor & Eladawy, 2024). The KSA is a desert country, like Libya.

The KSA consists of the largest area and population of the countries of the Arabian Peninsula in Western Asia, with a total area of approximately 2.25 million km2, of which about 38% are desert lands (World Bank, 2020). The KSA's population is around 35 million inhabitants (World Bank, 2020). The KSA has a hot and dry desert climate. According to Köppen and Geiger classification, this climate is classified as a hot desert climate (BWH) (World Bank, 2020). Although the KSA climate is a hot and dry desert overall, the country faces frequent annual flash floods, which increasingly impact most cities (Mohamed, 2017; Chen et al., 2018; Bashawri, 2019). In the previous ten years, these flash floods have led to thousands of injuries and hundreds of deaths, as well as harm to residences, vehicles, and

other property damage (Youssef et al., 2016; Abdalla, 2018), as shown in the examples presented in Figure 1.1.



	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Rescue Cases	300	0	1500	0	5012	240	1011	2355	1821	727	0	1467	1679	2057	3058
Evacuation Cases	0	0	1500	0	7861	3	1172	4121	162	2835	0	3064	3987	3826	4285
Shelter Cases	0	0	498	0	8255	3	1172	4080	162	2835	0	4217	4876	5812	5924
Deaths	153	14	10	19	61	6	7	88	6	40	20	43	31	76	83
Injuries	238	0	0	0	0	0	1	56	14	27	7	347	487	847	925
Affected Properties	0	0	0	0	4591	0	794	1957	1159	1240	1307	1478	2597	3815	4924

Figure 1.1. Frequency of Flash Floods in the KSA from 2009-2023 (GDCD, 2023)

The emergency planning for responding to flash floods varies significantly from country to country. Regarding the KSA, Momani and Fadil's (2010) research highlighted the limits of the current approach to emergency planning. The authors found insufficient planning to manage potential emergencies, which reduced the effectiveness of the flash flood response. Moreover, they found that the ability to investigate the causal factors relating to gaps in the planning for the response to flash floods is inadequate. Furthermore, Abosuliman et al. (2013) pointed out that although emergency planning is developed concerning such a response, it is a reactive rather than a proactive process that might be due to a lack of preparedness. Almari (2010) also found that emergency planning may be less prepared for future flash floods.

Generally, flash floods have severely impacted the KSA, as they have caused significant loss of life, property, and damage to the environment. Therefore, this thesis aims to verify the General Directorate of Civil Defence's (GDCD) officers' perceptions towards the emergency planning requirements for responding to flash floods in the KSA. Consequently, the problems highlighted both here and throughout the rest of the thesis support the rationale for the research.

1.4 Research Aim and Objectives

The primary aim of this thesis is to extend existing work on emergency planning for responding to flash floods in the KSA, beyond exploration and description into assessing to develop a sound flash flood response. The following objectives are designed to examine the research problem and to fulfil the research's primary aim:

1. To explore the current approaches in emergency planning for responding to flash floods.
2. To identify the current state of emergency planning for responding to flash floods.

3. To verify and validate Saudi Civil Defence officers' perceptions of the emergency planning requirements for responding to flash floods.
4. To explore the perceived challenges of emergency planning for responding to flash floods.

1.5 Research Questions

Following the research's aim and objectives, its primary research question seeks to understand how to assess emergency planning for responding to flash floods in the KSA. Therefore, this thesis aims to address the research questions below, which were formulated to maintain focus and guide the work to be carried out:

1. What emergency planning approach for responding to flash floods is currently being used?
2. What is the current state of emergency planning for responding to flash floods?
3. What are Saudi Civil Defence officers' perceptions of the emergency planning requirements for responding to flash floods?
4. What are the perceived challenges of emergency planning for responding to flash floods?

1.6 Research Assumptions

Based on the research problem, aim, objectives, and questions previously mentioned, this thesis is founded on a basic assumption that risk perception will be an effective method for evaluating emergency planning for responding to flash floods in the study area. The perceptions of practitioners are vital for assessing the effectiveness of emergency planning due to their expertise and practical experience. Practitioners, including emergency responders, planners, and coordinators, possess substantial direct experience and specialized knowledge in managing emergencies. Their expertise allows them to evaluate

the practical functionality and operational success of emergency plans, providing insights beyond theoretical models or simulations. Practitioners can identify practical challenges and issues not apparent in controlled environments, uncovering gaps that may hinder plan effectiveness during actual incidents.

Additionally, the adaptability of emergency plans to varying scenarios often depends on practitioners' assessments. Their evaluations determine the flexibility and robustness of these plans under diverse conditions. Effective emergency planning also relies on seamless communication and coordination among various agencies and stakeholders, which practitioners are well-positioned to evaluate. They ensure that resources such as equipment, personnel, and facilities are adequate and appropriately allocated, and their evaluations facilitate the effective utilization of these resources.

Furthermore, practitioners' feedback supports the continuous improvement of emergency planning, helping to update and refine plans to address emerging challenges, incorporate best practices, and comply with evolving standards. Moreover, they validate the assumptions underlying emergency plans, providing evidence-based recommendations to enhance their accuracy and reliability. Thus, practitioners' insights are essential for a comprehensive assessment of emergency planning and response strategies, serving as a critical component in evaluating and enhancing the effectiveness of emergency planning.

Therefore, the researcher assumes that the captured perceptions are somewhat correct and accurate since there is no absolute truth, despite the possibility of contradictions between perceptions and documents. In this research, perceptions about emergency planning, its requirements and challenges are examined by employing the cultural theory of risk to develop an effective response to flash floods. Therefore, it is assumed that if a participant realises an issue, then there is a reasonable reason for this perception. Since the KSA encounters flash flood risks annually that include deaths, injuries, environmental

damage, and economic losses, it is assumed that participants are able to assess emergency planning to design an effective flash flood response.

1.7 Research Stages Diagram

A comprehensive and accurate process will be adopted to assess the emergency planning requirements for responding to flash floods in the KSA. Figure 1.2 shows the various stages of the research process required to accomplish the research objectives and answer the research questions, as illustrated in Sections 1.4 and 1.5, respectively:

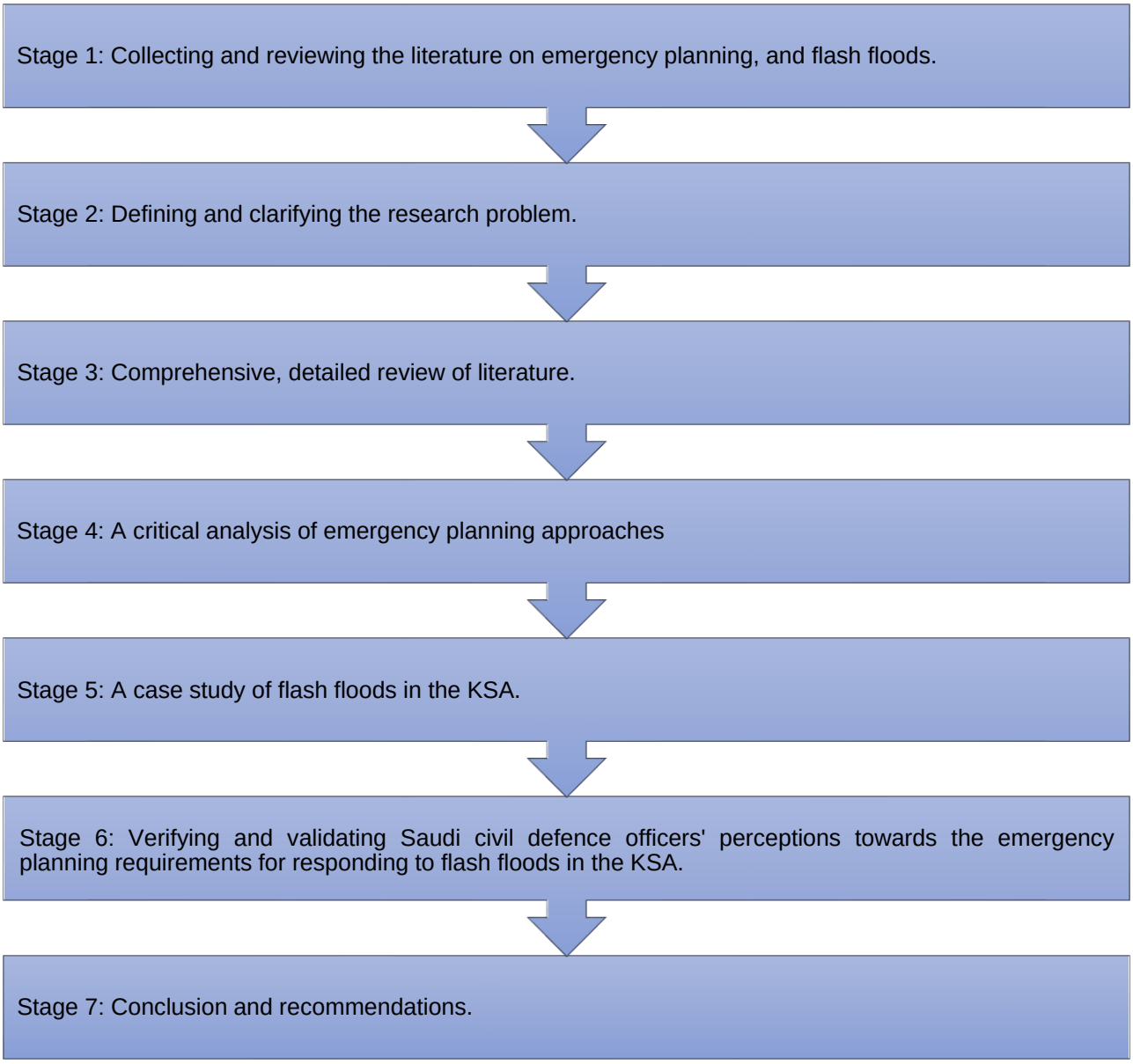


Figure 1.2. The Research Stages Diagram

1.8 Research Contribution and Importance

From the discussion in the introduction and when stating the research problem, it is clear that assessing the emergency planning for responding to flash floods in the KSA can contribute to knowledge, particularly to the preparedness and response phases. As this research seeks to provide more understanding of flash floods and planning requirements to respond to them, it examines previous literature on emergency planning and flash floods. A comprehensive and critical examination of issues related to emergency planning for responding to flash floods is conducted through primary and secondary data sources, which leads to increased awareness of the topic and a focus on the importance of emergency planning. In addition, this research provides a deep understanding of flash floods – which are more challenging to deal with than most other disasters due to their nature, extent, and direction to escalate in scope and severity – particularly those that occur in the KSA.

While the importance of this contribution to knowledge is undeniable in the academic field of emergency planning and flash flood response, identifying and assessing emergency planning requirements for responding to flash floods in the KSA is the hallmark of the current thesis. Based on the above, this thesis contributes to knowledge by clarifying the emergency planning requirements for flash flood response and the need for better understanding, identification, and assessment of such requirements. Consequently, this thesis promotes knowledge and practice in emergency planning and flash flood response, focusing on the link between emergency planning requirements and flash flood response.

1.9 Research Scope and Limitations

The scope of the research depends upon the problem addressed as well as the objectives set; in this case, emergency planning requirements for responding to flash floods in the KSA. Furthermore, the thesis seeks to assess these requirements in terms of a plan for flash flood response to officers at the GDCD. The research structure identified previously also shows

the research standards in identifying and exploring the emergency planning requirements that contribute to an effective response to flash floods.

Moreover, the research scope includes literature, policies, legislation, regulations, plans for flash floods, and other documentary sources related to theoretical and practical emergency planning and flash floods in the KSA. In contrast, while reference materials and cases for the study were chosen with an emphasis on the KSA as the context, broader knowledge is drawn from global sources.

In addition, the participants in the research conducted have experience in emergency planning and flash flood response in the KSA; the principal agency in the KSA responsible for organising and providing responders for responding to flash floods is the GDCD. Therefore, focusing on this agency may help not only in gathering relevant, valid and quality data, but also to ensure the relevance and utility of the information to assess the emergency planning requirements for responding to flash floods in the KSA. However, the research is limited by the time allowed and the availability of other resources to the researcher.

1.10 Thesis Structure and Content

This thesis assesses the emergency planning requirements for responding to flash floods in the KSA, and the work conducted for this research is presented systematically throughout this thesis. A clear research structure is essential for ensuring that the research remains within a defined scope and is practical to implement. The thesis contains six chapters, and an outline of each is provided below:

Chapter One. Introduction: This chapter outlines the main features of the research, including the research background, the research problem, the research aim, objectives, questions, and assumptions. Moreover, it discusses the research's significance and scope and how it contributes to knowledge in the field.

Chapter Two. Literature Review on Emergency Planning and Flash Floods: The chapter reviews relevant literature, for example, emergency planning, approaches, requirements, challenges, and issues in emergency planning. It also presents a discussion about the flash floods to which the KSA is frequently exposed. It then evaluates a case study of recent flash floods in the KSA. It uses a range of journal articles, books, data from studies, and reports, before identifying gaps that require further exploration. It also provides a critical examination and analysis of the research's context, thus providing a rationale for selecting the research topic.

Chapter Three. Methodology: This chapter reviews the methodology applied to conduct the research and explains the methods. A discussion of the research philosophy is given, as well as the research approaches, strategies, and relevant ethical considerations. The research uses a qualitative method, as the most appropriate choice for assessing the emergency planning requirements for responding to flash floods in the KSA. The research design is covered in relation to a sample selection, as well as techniques for gathering data – which ensures validity and reliability in the research instrument – and how the data is recorded and analysed.

Chapter Four. Data Analysis and Results: This chapter presents the findings related to the pilot and main study, then the verification and validation of the officers' perceptions of emergency planning requirements for responding to flash floods in the KSA. The process is carried out in detail by using semi-structured interviews as an instrument to collect the data. Finally, the data is analysed via content analysis, and the results generated are contributed to the assessment.

Chapter Five. Discussion of Results: This chapter is a discussion of the findings of this study. It presents and discusses the results obtained from primary and secondary

data. In addition, the discussion provides answers to the main research questions according to the findings of the thesis in light of the previous literature.

Chapter Six. Conclusions and Recommendations: The concluding chapter summarises the thesis's work, emphasising the main findings of the research. The chapter also discusses how the research has contributed to knowledge, as well as comments on the limitations of the work. On this basis, recommendations to improve emergency planning for responding to flash floods in the KSA are offered. Finally, suggestions are given for further related research.

1.11 Chapter Summary

The first chapter has discussed the research background and context. A justification for the research has also been provided, along with a summary of the aim, objectives, questions, and assumptions, as well as clarifying the research contribution and importance. The research's scope has been identified, along with the constraints of that scope, and setting out how the research will be presented through the structure of this thesis.

A review of existing literature is essential for examining and explaining the topic, and to this end, Chapter Two will now provide an extensive review of current work relevant to the research topic and scope.

Chapter Two: Literature Review on Emergency Planning and Flash Floods

2.1 Introduction to Chapter

This chapter presents a systematic review of the literature on emergency planning and flash floods. The chapter begins by introducing the theoretical framework that is relevant to the research. Then it moves on to emergency planning, its requirements, and challenges hindering its effectiveness. The chapter also discusses flash floods and managing their risks, focusing on flash floods in the KSA, before evaluating them as a case study. Finally, gaps not covered in the literature and the study area are also outlined.

2.2 Methodology of Literature Review

Levy and Ellis (2006) stated that a review of existing literature leads to the achievement of a range of goals, such as helping the researcher understand what has previously been known on the topic, presenting a clear theoretical base for the proposed research, proving the existence of both the research problem itself and any gaps in the literature, and verifying that the research presented will add to knowledge.

Methodology experts stated that there are two types of literature review: a narrative review and a systematic review. Due to the research topic, a systematic review was used to achieve the aim and objectives of this thesis. It is defined as “a replicable, scientific, and transparent process […] that aims to minimise bias through exhaustive literature searches of published and unpublished studies and by providing an audit trail of the reviewer’s decisions, procedures and conclusions” (Bryman, 2016, p.99). In other words, it is a review of the literature which focuses on a clearly formulated question and that uses systematic and explicit methods to identify, select and critically appraise relevant secondary data, as well as to extract and analyse data from the studies that are included in the review (Khan et al., 2001).

Advocates of systematic reviews argue that it is more effective in generating unbiased and thorough descriptions of the literature, especially in disciplines where the goal is to determine if a particular intervention would have clear benefits (Bryman, 2016). Due to this, certain criteria were considered before the review of the literature was undertaken:

- Quality: the researcher selected only studies and reports from credible organisations, peer-reviewed articles or papers, and journals that had been reviewed for validation.
- Relevance to the topic: this included choosing local governmental or international studies, and publications by organisations such as United Nations (UN) organisations or emergency agencies that provide reports or studies about emergency planning and flash floods.
- The fields of concentrated concern: this included emergency planning, its approaches, requirements, challenges, and flash floods, specifically those in the KSA.

The literature review for this thesis was performed on separate databases such as Google Scholar and Scopus since each database has different functionality. Furthermore, the research scope was expanded to include online database articles using keywords related to emergency planning and flash flood response.

The literature review considered the state of previous literature of both English and Arabic publications and was primarily taken from four major types of publications: books; peer-reviewed journals, articles, or papers; government documents; and national and international organisations' publications, including documents and statistics from the GDCD. However, the key source was journal articles offering scientific data and analysis, derived from various fields represented by journals that illustrate the significance of emergency planning for responding to flash floods.

Moreover, each paper was evaluated on the basis of its link with flash floods and the phases of flash flood management: each was reviewed and analysed for examples of flash floods that occurred in the KSA, and any mention of emergency planning, its approaches, requirements, and challenges were identified and explored.

The findings from the literature review were evaluated using the analysis data steps suggested by Bryman (2016), and the themes of emergency planning, its approaches, requirements, challenges, and flash floods were processed and analysed. Therefore, the research objectives were partially achieved through a systematic review of the literature, and the research questions were somewhat answered.

2.3 Theoretical Orientation for the Study

This section explains how the theoretical framework was presented. The section begins by outlining the rationale for the theoretical framework provided in this thesis, followed by a discussion of the main issues that need to be addressed. The construction of the theoretical framework was then explored in terms of the main concepts, interrelationships, and boundaries. The researcher selected a theoretical framework in order to provide an academic context for the thesis. A theoretical framework may be conceived as a conceptual structure that supports research. In other words, a theoretical framework helps the researcher understand the link between many variables identified as being relevant to the topic (Sekaran & Bougie, 2019).

2.3.1 The Importance of a Theoretical Framework

As described by Miles and Huberman (1994), a theoretical framework is a visual or written result that "describes, either graphically or in narrative form, the principal items to be examined; the essential components, ideas, or variables; and the hypothesised relationships among them" (p.18). So, when it comes to conducting research, the theoretical

framework of a thesis on emergency planning for responding to flash floods should be considered a critical component.

Moreover, according to Maxwell (2013), a theoretical framework is a collection of ideas, theories, conceptions, beliefs, and assumptions on a research topic. To this end, Yin (2017) pointed out that by conceptualising a phenomenon, the researcher may demonstrate the research's key ideas and the boundaries to which the concepts and interrelationships apply. Thus, adopting a theoretical framework assists the researcher in understanding and relating to the research problem, objectives, and questions, and facilitates the design of the research.

Furthermore, Maxwell (2013) stated that by using a theoretical framework, the researcher may acquire a better knowledge of what needs to be studied, what issues are occurring, and why they are important. In addition, Maxwell further pointed out that the most critical aspect of understanding a theoretical framework is that it serves as a foundation for assessing and refining the research objectives; developing realistic and relevant research questions; selecting appropriate research methods; and identifying any potential validity to the findings.

Following on from this, Maxwell also stated that a theoretical framework for research can be built from four sources: (i) experiential knowledge of the researcher; (ii) previous theories and research; (iii) experiments; and (iv) exploratory and pilot research. So, a theoretical framework that represents how the researcher conceptualises their research is essential for that research to be fruitfully created. Therefore, based on the sources outlined above, the researcher has adopted existing theories as a theoretical framework for this research.

2.3.2 Choosing the Theoretical Framework

Relevant theoretical foundations can serve as the orientation for a research's investigation, allowing the researcher to focus on its issue and answer its questions clearly and concisely. Since emergency planning is a subset of emergency management and no dedicated theoretical framework exists, the framework for the cultural theory of risk perception is the most appropriate place to start. Thus, based on this thesis' research objectives and questions, the researcher considers the previous theory appropriate to reveal GDCD officers' perceptions towards the emergency planning requirements for responding to flash floods.

The theory on which the research for this thesis was based emerged through a literature review. As this thesis will assess the emergency planning requirements for responding to flash floods from officers' perspectives at the GDCD in the KSA, the researcher has adopted the cultural theory of risk perception to serve as the lens through which to interpret the empirical research. The theory presented an integrated theoretical framework for understanding and studying emergency management leaders' perspectives on emergency planning, its requirements, and challenges.

2.3.3 Cultural Theory of Risk Perception

The theory related to the theoretical framework of this thesis is the cultural theory of risk perception. It is used in this research to explore the emergency management GDCD officers' perceptions of emergency planning requirements for responding to flash floods in the KSA. The cultural theory of risk perception assumes that public or organizational perception of risk can be influenced by variables such as collective consciousness and cultural construct (Wehbe, 2014).

The researcher employs a qualitative study approach using a social constructivist lens and cultural theory of risk perception to examine organisational perceptions of planning and determine the perceived effectiveness of flash flood response and emergency planning. The constructivist theory originates from interpretivism, further influenced by sociology and postmodern qualitative research (Andrews, 2012).

The cultural theory of risk perception is similar to the constructivist's view that perception is derived from lived experience. This framework can assist in determining how each individual within a shared community perceives risk. For example, it can be assumed that individuals and organisations within professional communities will share similar perceptions of risk depending on the shared variables (King, 2012).

Social constructivists argue that the nature of reality is objective and subjective (Maxwell, 2013), and constructivist researchers want to study participants within their natural work environment (Creswell, 2013). So, understanding how participants perceive flash flood preparedness and emergency planning can provide a look inside the overall perception of the response to flash floods. From Maxwell's interpretation of the social constructivist lens, emergency preparedness planners have a constructed perception that they use as a frame of reference for dealing internally within GDCD and externally with other flash flood response community members. Understanding these perceptions may provide insight into members of the GDCD and may identify strengths and weaknesses in the emergency plan.

The study approach aligned with the research questions in this study. The underlying conceptual basis for this study was Maxwell's interpretation of social constructivism, which asserts that perception is derived from reality. However, limited studies addressed perception as a method for assessing emergency planning in the KSA, and even fewer studies discussed the effectiveness of flash flood planning.

This study addresses the GDCD officers' perceptions towards the emergency planning requirements for responding to flash floods. This study leverages a social constructivism perspective and cultural theory of risk perception to explore the emergency planning requirements for responding to flash floods from officers' perspectives at the GDCD in the KSA. This study interviews participants regarding their risk perceptions concerning flash floods preparedness, response, and emergency planning. In addition, their perceptions are surveyed regarding the community's ability to plan a flash flood response. The interview questions elicit participants' feelings regarding area emergency planning and flash flood response based on their lived experiences and shared cultural experiences in the emergency planning field.

The following section focuses on emergency planning as the cornerstone of the preparedness phase.

2.4 Emergency Planning as the Cornerstone of the Preparedness Phase

The concept of planning varies according to the field in which it functions. Generally, Davidoff and Reiner (1962) defined planning as "a process for determining future action through a sequence of choices" (p.103). Moreover, Dynes (2003) indicated that the concept of emergency planning is well-established within the existing literature. Other 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) stated 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.

Zhao et al. (2017) stated that emergency planning before an event occurs can effectively minimise harm; in other words, response planning is key for effective emergency

management. Although not all hazards can be avoided, their severe effects can be reduced by proper emergency planning and preparation (Quarantelli, 1999). Admittedly, emergency response costs can be significantly higher than event planning and preparation costs (Phaup & Kirschner, 2010).

Planning inefficiencies can quickly contribute to death, injury or damage that should have been prevented. Therefore, planning for response is a moral obligation – and potentially a lawful responsibility – for all those dealing with hazards and risks. However, which type of hazard response planning is needed will differ dramatically according to the kind of community in which it is implemented and the kind of economic growth it underpins (Alexander, 2002). Additionally, hazard response planning is not only about creating a plan but should also be viewed as a learning process: the aftermath of each hazard should be examined to determine how effective the response actually was (Fearn-Banks, 2016). In other words, emergency planning is a process rather than a static aim. Therefore, it should be constantly and increasingly exercised, as plans should evolve and respond to changing situations (Alexander, 2002).

Emergency planning covers various activities and tasks, including business continuity management planning, preparedness planning, preparations and practices, and response and recovery planning (Norman et al., 2006). Thus, the result of emergency planning is the implementation of plans for a range of emergency cases. Lee (2015) conducted a review of various literature and found that although many discussed emergency preparedness, not many addressed emergency planning. A multisectoral emergency planning approach is necessary since hazards have such broad consequences. Therefore, more research on emergency planning is needed. Section 2.4 describes the various approaches to emergency planning.

2.5 Approaches in Emergency Planning

Simply put, the approaches to emergency planning discuss how planning should be performed and who should be doing it. However, no approach to emergency planning has been widely accepted; numerous descriptive and normative approaches have been developed as emergency planning has developed. The inability to establish a generalised planning approach arises from differences between theorists' and practitioners' viewpoints (Kiernan, 1983). In general, two different viewpoints have been established over the last decades: the 'community-based' and the 'dominant'. The two separate approaches will now be explored in more detail, with the dominant approach being outlined in the following subsection.

2.5.1 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. Friedmann (2020); and Giddens (2013) both stated that based on the original bureaucracy theory by Max Weber, this dominant approach stresses practical and numerical analyses that are separate of controversy connected with community involvement methods. Therefore, the dominant approach has become the main choice of governments, companies, and leaders (Weber et al., 2010).

Sabatier (1978) indicated that in this approach, information is characterised by its compliance in terms of technicality and applicability of strict science methods. From another perspective, information involves using statistical data collected by qualified experts on the scope of the issue being discussed, the possible effects of proposed strategy decisions and the effects of previous findings. Strictly speaking, the dominant approach's information is, therefore, without emotion and is not person-based. Additionally, Brody (2003a) stated that

the use of objectivity in a rational, structured method makes it possible for planners to professionalise their art; offers a sound foundation for making decisions; confirms they do the correct work; and provides a way to make plans justifiable and identical.

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 tends to concentrate on infrastructure strategies such as flash flood dams and technological solutions to control the hazard. A dominant ‘top-down’ strategy may also suggest, for instance, moving individuals to neighbouring safer areas to avoid the flash flood threat (Fleming, 2002).

However, several studies have criticised the 'top-down' tendency for emergency planning (Fordham, 1999; Handmer, 2000; Jain, 2000). For example, Innes (1998) argued that a significant obstacle to scientific, rational decision-making is that experts and specialised professionals have somewhat different perceptions of knowledge and decision-making methods than policymakers and the rest of the community have.

Weber et al. (2010) indicated that using the dominant approach could lead to negative consequences, making it difficult for organisations with minimal resources to grasp the process, conduct the analysis and coordinate the outcome in a manner that is beneficial for all decisions, including for basic issues. Furthermore, Rosenfeld et al. (2009) stated that the dominant approach is constrained and the data sources for information should be accurate, credible, usable and adaptive, and in order for decision-makers to successfully perform the dominant approach, sufficient time and training are required; but it is likely that those tools are not available in the majority of situations.

Such difficulties and shortcomings of the dominant planning approach prompted planning thinkers to seriously investigate other decision-making methods and encourage community participation practices to be undertaken within the community and organised by

planning practitioners (Innes, 1996; Buckle et al., 2003). The following subsection highlights the community-based approach.

2.5.2 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. Consequently, 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 (Innes, 2004), and enhances cooperation and coordination between decision-makers and impacted communities during the planning stage (Koontz & Johnson, 2004).

Giddens (2013) indicated 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. Thus, the community-based planning approach is intrinsically collaborative, consultative, and participative.

The literature review conducted indicates that evidence for widespread engagement of stakeholders is well-established. For example, a study by Burby (2003) revealed a positive association between the stakeholders engaging in hazard reduction planning and the implementation level of plans in 60 communities in the USA. In addition, he noted that engagement in activities of planning by some groups of stakeholders was an essential factor in achieving effective results. These results include a strongly associated between community planners' involvement in planning issues and the grade of planned risk reduction actions; however, their engagement was not highly correlated to the efficiency of the ideas implemented.

Furthermore, Brody (2003b) measured the importance of getting a wide variety of partners engaged in the planning process for 30 areas in Florida. He stated that participation in the planning phases from a wide variety of stakeholders was not strongly linked to the plan's efficiency. Brody argued that this could be because of bureaucratic constraints for integrating different viewpoints; challenges in finding a consensus on options for planning; and consensus on planning solutions that do not increase the plan's efficiency. To enhance the plan's flexibility, the participation of particular categories of the main participants – such as non-governmental organisations (NGOs) and business organisations – in the planning phases seems to be more important than the number of participants.

Lavell (2003a) further illustrated that a community-based approach could be best able to provide the emergency planning of the effects of possible hazards, based on how often they occur, as well as their capacity to inflict harm or destruction. Additionally, Lavell (2003b) explained that with the community's participation, it is easier to observe how potential threats fit in with other stresses faced; for example, the need to be closer to potential jobs or work, which will improve the livelihood of individuals.

Furthermore, Dietz and Stern (2008) noted that the extensive participation of stakeholders and partners has continuously been described as being a leading factor to the progress of the planning through expertise, credibility and efficiency. Additionally, Wassen et al. (2011) showed proof that increased stakeholder participation has been positively linked to education through discussion and information sharing with decision-makers and stakeholders. The engagement can also improve the potential to move the ways of planning in organisations from one way to a more comprehensive way of decision-making, whereby stakeholders have more ability to engage directly in the technical fields of planning (Hildebrand, 2009).

Although the community-based approach's importance is widely acknowledged by many influential community foundations, other members are likely to underestimate 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, 2002). The following subsection discusses the possibility of combining a "top-down" approach with a "bottom-up" approach.

2.5.3 Combining 'Top-Down' with 'Bottom-Up' Approaches

Despite advances towards a community-based approach for emergency planning, there are many limitations on what could be accomplished by identifying and analysing the hazards and risks – as well as potential solutions – at a community level. For instance, when identifying and analysing potential hazards and risks, communities may not put an adequate focus on those they have not yet encountered, like dormant volcanoes or threats associated with climate change as flash floods.

Fischer (2003) argued that the community-based approach has been effective in engaging community members in planning and decision-making. Nevertheless, stakeholder engagement has its obstacles and has also been shown to make planning activities worthless when performed poorly (Dietz & Stern, 2008). In addition, when many stakeholders are engaged in the planning process, the time taken to make decisions increases as participants may lack the patience and time to negotiate with one another (Rogers, 1992).

Furthermore, participatory planning activities encounter many obstacles due to minimal resources (Hoard et al., 2005). They can also be obstructed because of governmental or authority protocols, and participants may sometimes behave incorrectly

(Flyvbjerg, 1998). Additionally, disagreements linked with different points of view can generate a potential for conflict between participants (Ambruster, 2008).

Consequently, it can be concluded that a mixture of 'top-down' and 'bottom-up' approaches is the most effective method for emergency planning, with data moving mostly upwards and resources flowing downwards (UNDP, 2004). However, for emergency planners to be able to carry out emergency planning effectively, several requirements must be met, which are discussed in the following section.

2.6 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, recognise 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; assess options and strategies for decision-makers who want a way to proceed to achieve results; examine the planning findings to produce new data; and following the steps iteratively starting with the first stage. In the emergency planning tasks context, Alexander (2017) stated that the main tasks of emergency planning are (a) to match available resources with urgent needs generated by the emergency, (b) in doing so to create and share the common operating picture in order to ensure adequate situational awareness, and (c) to procure and apply additional resources according to needs assessments.

The National Plan for Natural Disaster Risk Reduction (GDCD, 2020a) divided the management of emergencies into three distinct stages: before, during, and after. Preparedness lies within the pre-emergency phase and thus includes response planning. The plan establishes six requirements for this:

First, studies must be conducted that show potential hazards and risks, their locations, and their implications. Secondly, appropriate measures must be taken that reduce the possible causes of hazards 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. Thirdly, public awareness should be increased through the media concerning the preventative measures that must be taken to reduce the hazard's effects. Fourthly, appropriate emergency plans must be prepared to deal with hazards and risks, including human capabilities and any available equipment, and identifying 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 hazards occur, in accordance with the plans that have been prepared. Lastly, executing virtual field experiments of the prepared plans, checking 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) addressed emergency planning in the KSA. A survey was carried out before, during and after floods which occurred in 2009 and 2011 in Jeddah by interviewing Saudi decision-makers. Participants were largely in consensus on the top four priorities for emergency planning: training of emergency responders; identification and coordination of responsibilities and roles of the agencies; community education; and preparedness. In addition, mapping was deemed essential as it allows decision-makers to consider patterns of the hazards and can assist with adequate risk prevention and preparation. Similarly, Youssef et al. (2016) stated that mapping can help emergency planning in this area, which is useful for all involved parties and decision-makers.

Moreover, one of the most critical requirements of emergency planning is the extent of the ability for training planning. Al-Amin et al. (2019) found evidence that there is a shortfall

of training for responding to emergencies in Makkah and Jeddah, for which it is observed that present emergency responders training for this area are insufficient in handling current and future emergencies. Natural hazards can have economic, social, and environmental consequences such as fatalities, injuries, diseases, the destruction of property, loss of livelihoods, disturbance of the social and economic hierarchy, or damage to the environment. Accordingly, for future responses to be as effective and efficient as possible, improved training programmes and capabilities are needed for each level. 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 emergency planning.

2.7 Challenges and Issues in Emergency Planning

With a specific focus on those in the KSA, in a recent study, Ledraa and Al-Ghamdi (2020) pointed out that the challenges facing emergency planning include: how the authority responsible for dealing with disasters in the KSA is organised; 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 floods; and the paucity of coordination among government agencies and stakeholders. Furthermore, Bin Ottai (2017) revealed that the emergency planning training programmes within the KSA have many shortcomings, and they do not address training needs, especially in flash floods.

Additionally, Momani and Fadil's (2010) study highlighted a lack of emergency planning in government agencies, especially the governmental bureaucracy. Furthermore, the lack of an advanced early warning system meant that the population of the city were not informed in a timely manner, plus there were delays in detecting those who were missing, as the use of modern technology was limited. The lessons learnt here dictated the need for more preventative measures, as well as for improved mechanisms to report and deal with

the flash flood in a timely manner. Therefore, policy alteration is essential for developing emergency planning for future flash floods.

Moreover, Alharbi (2013) indicated that emergency planning in the KSA remains inadequate to what is needed due to: poor general culture; strategic leadership; the lack of the administrative units required for strategic planning; poor coordination among existing layers in emergency planning for activation of procedures; and the ineffective control and follow-up systems.

In the first part of this literature review, a systematic review of emergency planning, its approaches, requirements, and challenges was conducted, focusing on the KSA as a study area. Thus, the following section presents a systematic review of flash floods, which is the second variable of this research.

2.8 Flash Floods as a Hazard

Flash floods are one of the most natural hazards affecting people (based on the number of fatalities and individuals affected), properties, and the environment in most countries. As many as 85% of all flooding incidents are caused by flash floods, which also have the greatest fatality rate: each year over 5,000 people are killed by flash floods (WMO, 2020). The main reason for this is: flash floods occur more frequently. According to NOAA (2010), these occurrences seldom make headlines but can seriously harm a country's development.

Flash floods are defined as being "floods of short duration with a relatively high peak discharge" (Neussner, 2009). They may arise due to storms, heavy rain in mountainous regions and basins, or severe water flows and run-offs created by rainstorms (CRED, 2014). This is dangerous as a rapid rise in water levels poses hazards to individuals in the area who are exposed, leaving them with little time for an appropriate – and life-saving – response (Norbiato et al., 2008).

Damage from flash floods has steadily increased over the last few decades. The rising frequency of heavy precipitation, changes in land use, and an ever-growing concentration of people and assets in flash flood-prone areas are all factors that contribute to this trend (Abdelkhalek, 2011), and the lack of emergency planning for flash floods can worsen this (WMO, 2020). In addition, landslides and debris flows are frequently triggered by flash floods, which lead to extensive property damage and even fatalities and casualties. Thus, flash flood prevention is a worldwide challenge because of the difficulty of flash flood formation and the uncertainty of severe rain.

Flash floods are different from other types of floods in that they tend to form at the same time and in the same place as the rainstorm that caused them, which enables only brief warnings to be sent out sometimes – this can be any time between a few minutes and a few hours. In addition, since more people and infrastructure are now concentrated in flash flood-prone areas due to urbanisation and population expansion, the risk of flash floods has increased significantly (Davis, 2001).

Flash floods are formed due to several factors, which include rain characteristics – intensity, duration, amount, and time-space distribution – and physical and hydrological watershed characteristics – area, length, slopes, shape, type of soil and land use, vegetation, and antecedent conditions (Rozalis et al., 2010). However, even though so many different factors can cause flash floods, it is not easy to make accurate predictions about their occurrence. The ability to predict flash floods is therefore limited and is dependent on numerous factors: the availability of rainfall data, its accuracy and spatiotemporal resolution, the estimation of soil moisture, surface parameters, and the ability of hydrological models to represent the complex processes involved in flash flood generation (Yatheendradas et al., 2008).

There is increasing evidence that severe rainfall events are more often a result of global warming (Alpert et al., 2002 & 2004; Hussain, Yassin, Abba, Lawal, Hussein, Teo, Mustaffa, & Aljundi, 2023). Climate change, primarily driven by global warming, is significantly altering weather patterns and intensifying the frequency and severity of extreme weather events, such as flash floods. This phenomenon, characterized by rising global temperatures and altered precipitation patterns, is posited to exacerbate flood events (Prein et al., 2017). As a long-term shift in the Earth's climate, climate change is a critical global concern. It predominantly refers to the increase in global average temperatures caused by anthropogenic activities, including the combustion of fossil fuels, deforestation, and industrial processes (Sovacool et al., 2021; Perera & Nadeau, 2022; Hoegh-Guldberg et al., 2019; Skendžić et al., 2021; Nordhaus, 2019). These activities emit greenhouse gases (GHGs) into the atmosphere, which trap heat and lead to the greenhouse effect (Soeder, 2021). Consequently, the planet is experiencing a range of impacts, including more frequent and severe weather conditions such as increased temperatures, storms, and flash floods (Perera et al., 2020; Moazami et al., 2019).

Rainfall intensity and patterns are directly influenced by climate change and the rise in global temperatures (Tarawneh & Chowdhury, 2018). The increase in mean temperatures enables the atmosphere to hold more moisture, thereby intensifying rainfall events over short periods. Additionally, rainfall patterns become more irregular, with some regions experiencing prolonged droughts followed by intense rainfall, potentially leading to flash floods (Burt et al., 2016; Miranda et al., 2011). Thus, it is evident that climate change has profound effects on global weather patterns, increasing the likelihood and impact of flash flood events (El-Rawy et al., 2023; Hussain et al., 2023).

Lastly, flash flood risk usually refers to the severity and frequency of the hazard, the number of people and properties at risk, and their vulnerability and exposure to any damage.

The Global Assessment Report on Disaster Risk Reduction has classified flash floods as one of the more common hazards, characterised by frequent, and linked to localised and recurring hazards (UNDRR, 2020). The following section focuses on flash flood risk management.

2.9 Flash Flood Risk Management

Flash flood risk management (FFRM) is an approach based on the idea that risks cannot be eliminated entirely, only partly, and often at the expense of other societal goals or the continuous and holistic societal analysis, assessment, and mitigation of flash flood risks (Klijn, 2009). Therefore, FFRM is defined as the process of making decisions and taking measures to better understand, analyse, assess, mitigate, prepare for, and reduce flash flood risk (Schanze et al., 2007). As a result, risk analysis, assessment, and reduction are essential parts of FFRM (Sayers et al., 2013).

FFRM seeks to reduce the damage and losses caused by flash floods by preventing them from occurring in the first place, plus protecting the people and properties most exposed to this type of hazard (Vis et al., 2003). In other words, it focuses on flash flood risks and the probability of flash floods occurring, as well as efforts to reduce the vulnerability of certain communities (Klijn, 2009). However, in order for FFRM to be effectively carried out, a long-term strategy must be developed that balances current requirements with future sustainability. Therefore, the use of both structural and non-structural approaches is often required in an integrated strategy (Jha et al., 2012).

Structural approaches are engineering actions that aim to improve stream channels by, for example, building and repairing dams. In contrast, non-structural approaches focus on loss-sharing measures – which include disaster relief, aid, and insurance – as well as loss reduction measures – for example, preparedness, emergency planning, and mitigation (Smith & Ward, 1998).

In the KSA, structural approaches – for example, rainwater drainage systems and dam construction – have often been conducted with the absence of consideration for non-structural approaches. As a result, these approaches have not yielded meaningful results. Therefore, structural approaches need to be integrated with non-structural approaches.

This research will employ one such non-structural approach by assessing the emergency planning requirements for responding to flash floods. The non-structural approach to assessing emergency planning requirements for responding to flash floods emphasizes the importance of preparedness, planning, and community involvement. By focusing on risk assessment, early warning systems, emergency plans, public education, and supportive policies, communities can enhance their resilience to flash floods without relying solely on physical infrastructure. This approach promotes sustainable and adaptive flood risk management practices that are crucial in the face of increasing climate variability and extreme weather events.

2.10 Flash Floods in the KSA

The KSA is exposed to various natural hazards, such as earthquakes, volcano eruptions, landslides, slope collapses, and flash floods (Lam et al., 2016). Other common natural hazards in this arid country include drought, erosion, sand dune shifting, dust storms, and salinisation, all of which lead to the decline of agricultural areas (Al-Bassam et al., 2014). However, flash floods caused by intense, continuous rainfall are the most common type of natural hazard in the KSA (Theilen-Willige & Wenzel, 2019). Flash floods have been the most common hazard documented in the EM-DAT during the previous few decades (CRED, 2021). Statistics from the GDCD indicated that between 2000 and 2023, over 1000 people lost their lives in the whole KSA due to flash floods, and they caused an economic loss amounting to billions of US dollars (GDCD, 2023).

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. As a result, its climate is characterised by fluctuating low rainfall. The average annual rainfall in most parts of the country is below 150 mm throughout the year except the southwestern part where the rainfall occurs between 400 – 600 mm annually (Ministry of Higher Education, 2015; climateknowledgeportal.worldbank.org, 2024).Moreover, even though it has no rivers, the country is not immune to increasingly frequent and severe flash flooding.

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 (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; Alkhalaf & Basset, 2013; Haggag & El-Badry, 2013). Furthermore, in 2011, a wave of torrential rain (50mm in four hours) resulted in 11 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 & Al-Ghamdi, 2014). Following on from this, in Jeddah in the last week of November 2015, 22mm of torrential rain totally disrupted life in the city, disturbing businesses, closing schools and universities, and forcing people to stay indoors (Gulf News, 2015). The aforementioned flash floods – as well as further examples – are displayed in Table 2.1.

Table 2.1. Cases of Flash Floods in the KSA (GDCD, 2023)

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 130,000km^2 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 100,000km^2, 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 6m, 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 centre 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 few hours, which killed 163 people, and displaced more than 10,000 others. Further damages occurred to 11,849 properties and 10,913 cars, as well as financial damage of 3 billion riyals.

Floods	Descriptions
Jeddah Flood in 2011	At least 11 people died in this flood, with 3 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 northwestern 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.
Riyadh. Jeddah, Tabuk, Medina, Makkah, and Qassim Floods in 2021	Heavy rains across these regions caused floods that resulted in the deaths of 31 people, injured 487 others, and damaged the properties and infrastructure.
Jeddah, Medina, Asir, Najran, Makkah, Jizan, Tabuk, Riyadh, and Arar Floods in 2022	Heavy rains across these regions caused floods that resulted in the deaths of 76 people, injured 847 others, and damaged the properties and infrastructure.

Floods	Descriptions
Jeddah, Riyadh, Qassim, Hail, Tabuk, Medina, Makkah, Taif, Jizan, Najran, and Asir Floods in 2023	Heavy rains across these regions caused floods that resulted in the deaths of 83 people, injured 925 others, and damaged the properties and infrastructure.

As shown in Table 2.1, not only were flash floods the most prevalent natural hazards 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, as well as loss of life, resources, properties, and infrastructure. These events indicated that cities and emergency agencies in the KSA are not yet adequately prepared in terms of emergency planning and flash flood response (Ledraa & Al-Ghamdi, 2020).

Therefore, emergency planning for responding to flash floods in the KSA will continue to be an important research subject since:

- they are the predominant type of natural hazard in the country
- their occurrences appear to have increased lately at an unprecedented pace (Ledraa & Al-Ghamdi, 2020).
- they cause many casualties, whether deaths or injuries
- they cause both severe devastations to properties and severe disruptions to economic activities.

The following section analyses the aforementioned Jeddah flash floods in 2009 and 2011 as a case study. Figure 2.1 illustrates the location of Jeddah city on the map.

Figure 2.1. Location of Jeddah City Within the Map of the KSA (GDCD, 2020)

2.11 Jeddah Flash Floods as a Case Study

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 & Ali, 2019). As a result, flash floods hit multiple areas across Jeddah at noon, with poorer neighbourhoods in the south of the city being most affected (Abosuliman et al., 2014). Almost two years later, on 26th January 2011, the city suffered from more heavy rainfall, this time 111mm within just 3 three hours (Ameur, 2016). Azeez et al. (2020) stated 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 properties were severely affected. Figure 2.2 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.

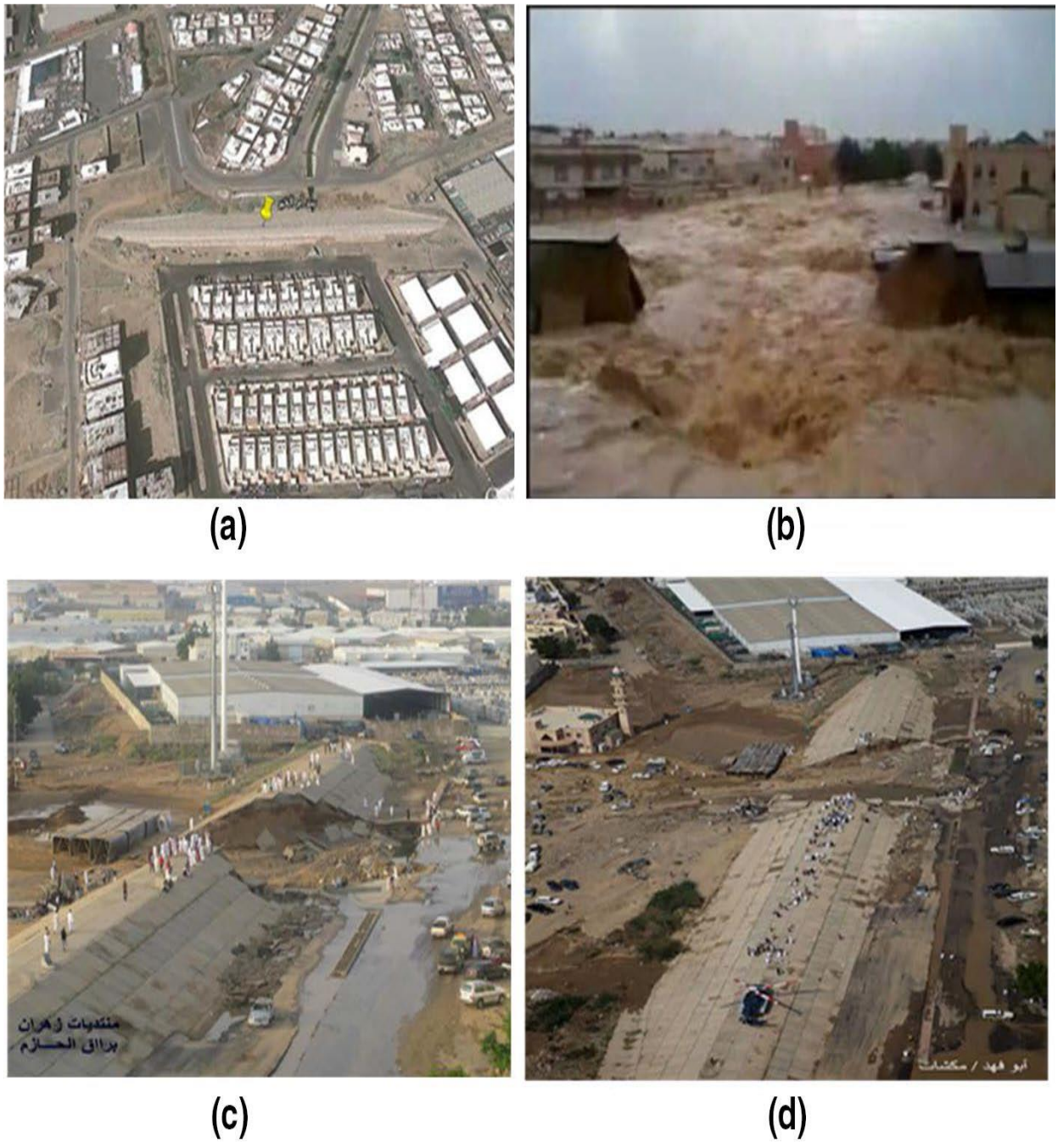


Figure 2.2. Satellite Images of the Um al-Khair Dam Before, During, and After the Collapse (Azeez et al., 2020)

Information gathered from multiple journal articles indicates that the damage from both floods was vast, and 163 people lost their lives in the first occurrence, with a further 11 dying in 2011 (Youssef et al., 2016). Furthermore, 8,000 homes and over 7,000 vehicles were damaged (Abosuliman et al., 2014), plus the sum of economic damages totalled approximately US$1 billion, and the reimbursement for those impacted was projected at a further US$2 billion (Ameur, 2016). In addition, the floodwater washed across 80% of the city, including highways, sidewalks, and structures, covering around 400–600km^2 (Azzam & Ali, 2019). Some of the damage is shown in Figures 2.3 and 2.4.

Figure 2.3. Flood of Jeddah – November 2009 (Azeez et al., 2020)

Figure 2.4. Flood of Jeddah – January 2011 (Azeez et al., 2020)

The flash flood effects have led to the Saudi government and people condemning organisations responsible for flood management, such as GDCD, wastewater control, and the municipality (Al Saud, 2015). Therefore, the primary objective of the investigation into these Jeddah flash floods is to determine how they were treated and planned and handled by the GDCD. Firstly, there were a lack of data on forecasting, mitigating, and emergency planning activities (Al Saud, 2015). An ineffective warning system and emergency relief plan were also noted, and one of the fundamental reasons for this inefficiency is thought to be

the centralised aspect of the current emergency management system (Abosuliman et al., 2014). Secondly, 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 (Ameur, 2016). Thirdly, the lack of a Master Flood Management Plan was also an important underlying reason (Azzam & Ali, 2019). Lastly, there was not any professionally qualified team or special emergency response training at the city or national levels (Azeez et al., 2020).

2.12 Gaps in Literature and The Need for Further Research

A few issues have emerged as a result of the gaps in the literature which have previously been identified. For example, as previously mentioned, the frequency of flash floods occurring across the KSA has steadily increased in recent years, causing harm to people, communities, the environment, and the overall way of life (Bashawri, 2019). In these situations, emergency planning for responding to flash floods is often ineffective and inefficient, which can lead to improvised, hasty decision-making during the event, consequently resulting in a wrong response to the flash flood and, subsequently, a failure in rescuing victims (Ali and Ameur, 2018).

Additionally, emergency planning in the KSA has greatly improved compared to some of its neighbouring countries. However, the main focus still seems to be to handle existing flash floods reactively, rather than planning for possible future flash floods (Alamri, 2010). Flash flood planning, therefore, requires a proactive approach, especially concerning key priorities, such as response planning.

Therefore, it can be concluded that emergency planning currently in place for the KSA should be assessed to ensure that the response to any flash floods that might occur is efficiently and effectively implemented. Many emergency agencies in the KSA are involved in emergency planning for responding to flash floods, but the main agency is the GDCD,

which coordinates with all agencies involved in responding to flash floods. Thus, it is necessary to assess emergency planning for responding to flash floods, which will be done by verifying the GDCD officers' perceptions. To the researcher's knowledge, no research has specifically discussed assessing the emergency planning for responding to flash floods in the KSA.

2.13 Chapter Summary

This chapter used a systematic review of existing literature on emergency planning and flash floods. First, the cultural theory of risk perception was discussed as the theoretical framework chosen for this thesis. The chapter then clarified emergency planning was discussed, the term was explained, and the various approaches were demonstrated. In addition, the systematic review revealed the requirements and challenges of emergency planning.

This was followed by a discussion of flash floods as a hazard, and then flash flood risk management was explored. Furthermore, the chapter then discussed the most common natural hazards found in the KSA. It became clear that flash floods are the most common and frequent. Due to this, a case study of the flash floods that struck Jeddah in 2009 and 2011 was presented.

Consequently, this literature review has helped identify the gaps in the existing emergency planning for responding to flash floods in the KSA, as well as highlighting areas on this topic that require further investigation.

The following chapter will outline the methodology used in this research to achieve its aim and objectives.

Chapter Three: Research Methodology

3.1 Introduction to Chapter

This chapter discusses the methodology employed in achieving the research aim and objectives and how to answer its questions. Therefore, the research onion model was adopted (Saunders et al., 2016). Accordingly, it was structured in sections to illustrate the philosophy, approach, strategy, design choices, time horizon, techniques, and procedures employed throughout. In addition, population, sample, and data collection methods were discussed, as well as how the data was analysed.

3.2 Research Methodological Framework

A central aim of this research is to assess existing emergency planning requirements for responding to flash floods in the KSA. Emergency planning for responding to flash floods is an applied area of research in relation to various subjects, such as social sciences, management, and the humanities. As documented in the previous chapter, the literature review gave the researcher a broad understanding of emergency planning for responding to flash floods, which in turn was crucial in guiding the methodology.

Research may be described as rigorous and systematised processes that aim to give descriptions of a certain topic or phenomenon, which develop and test theories and ideas designed to help build knowledge (Bowling, 2014). One popular research method is the aforementioned “research onion”, which can be used to explain the reasons for the choice of the methodology presented here (Saunders et al., 2016). It is crucial to recognise and incorporate the various components of, and relationships between, each method used in the most effective way to improve data validity, reliability and performance (Kagioglou et al., 2000). For this reason, the research onion was adopted because of its detailed method and

its ability to connect one layer to the next (see Figure 3.1). Furthermore, in order to contribute to correct and accurate data collection.

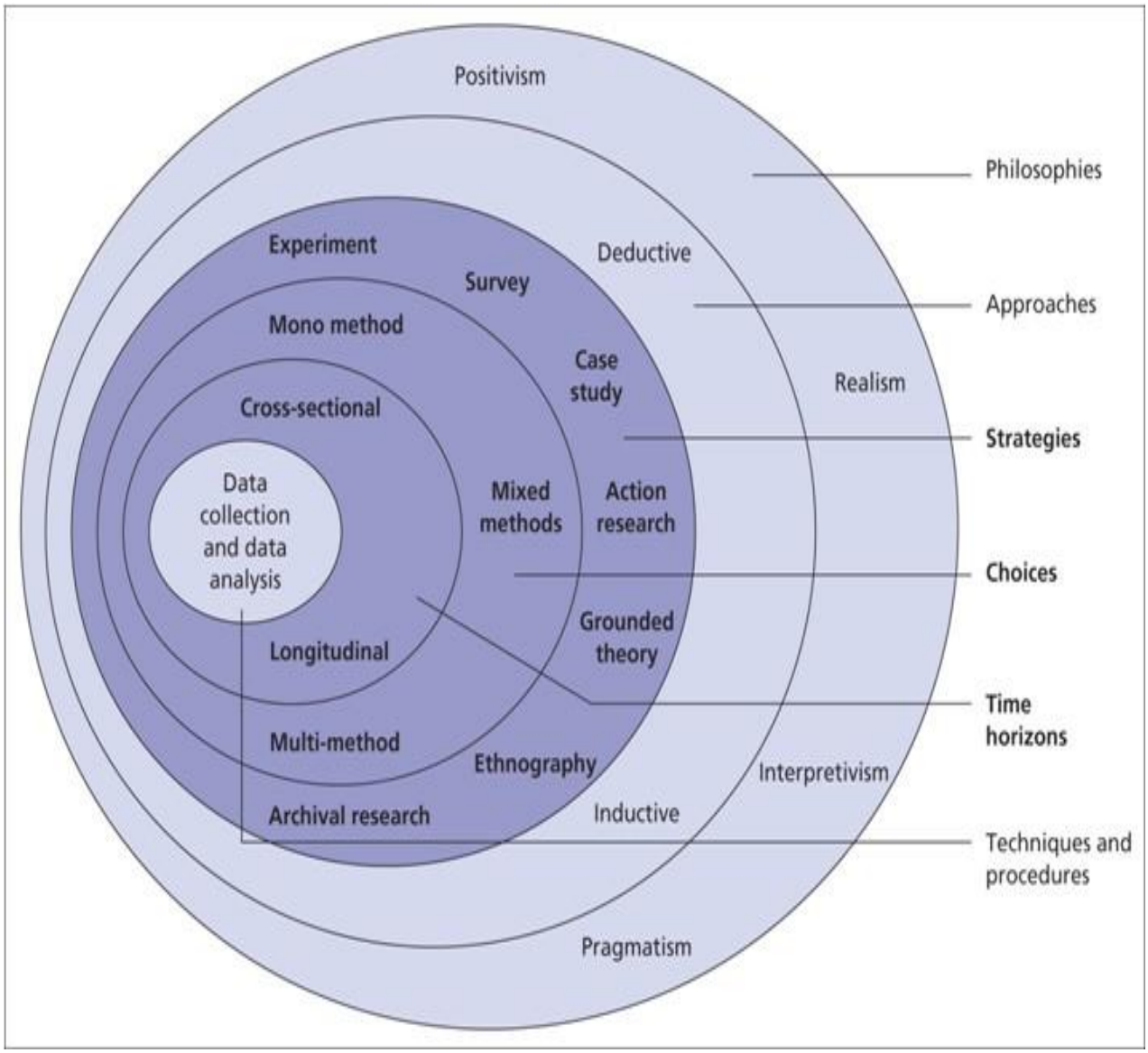


Figure 3.1. The Research Onion (Saunders et al., 2016)

As shown above, the research onion comprises six layers (Saunders et al., 2016). The first layer of the research onion model is the research philosophy. Research is profoundly affected by the philosophical research assumptions named epistemology, ontology, and axiology. These philosophical assumptions were further discussed in the following section.

3.3 Research Philosophy

Research philosophy characterises the way in which knowledge is gathered and how that knowledge is used, and is founded on certain philosophical assumptions: epistemological, ontological, and axiological (Saunders et al., 2016). These assumptions guided the research philosophy, strategy and approach (Bryman, 2016).

The adopted research philosophy was clarified regarding epistemology, ontology, and axiology, as shown in Figure 3.2.

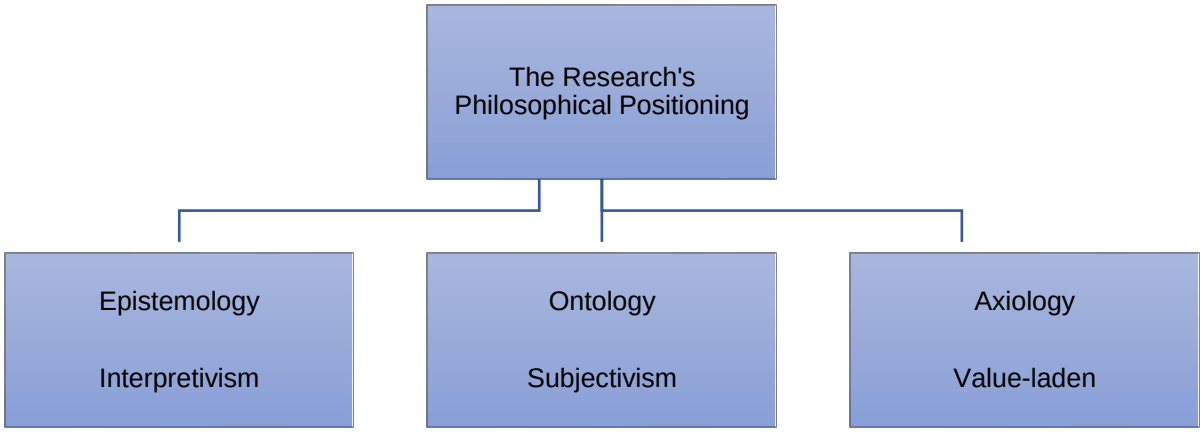


Figure 3.2. The Research's Philosophical Positioning

Epistemology can be defined as focusing on the assumptions researchers might have about the origin of knowledge (reality), how the knowledge is accepted in their field of research, and the subsequent relationship between the researcher and this knowledge (Gray, 2017). Epistemology also addresses the issue of what constitutes or should constitute acceptable knowledge in a certain field (Easterby-Smith et al., 2012; Collis and Hussey, 2013; Bryman, 2016). The knowledge that led the research of this thesis was related to emergency planning for responding to flash floods, particularly in the KSA. The epistemological position consequently stemmed from this field, and here, emergency planning related to flash flood response was considered "knowledge needing to be created" instead of "knowledge which exists". This philosophy made the assumption that emergency

planning for responding to flash floods does not exist. Hence, research focused on comprehending GDCD officers' perceptions of emergency planning, interpretivism was found to best fit this research form. Accordingly, the epistemology assumption lies in interpretivism.

Ontology is a philosophical field that studies ideas such as reality (Bryman, 2016). In other words, ontology is a view of the nature of reality. Ontological assumptions that address the essence of truth allow the researcher to investigate how reality functions (Brown & Baker, 2007). Furthermore, ontological assumptions impact how the researcher interprets subjects like organisations, management, the working life of individuals, and organisational activities (Saunders et al., 2016). The current state of emergency planning related to flash flooding needs to be critically reviewed systematically. In addressing this, the meaning given to emergency planning and how it relates to flash flooding was highly subjective. Therefore, the intended research was positioned towards the subjectivism aspect of ontology because it dealt with the meanings that individuals attach to the way that emergency planning functions in flash flood preparedness and how that affects the response to flash floods. Furthermore, the design of this research was justified by the gap between emergency planning and the assumption of how effective it would be in boosting the overall flash flood response.

Axiology refers to values and ethics in research (Saunders et al., 2016). It drives the researcher towards an understanding and consideration of what part could be played by beliefs, views, and other interpretations within the process of collecting data (Heron, 1996). Furthermore, Heron (1996) asserted that the ability of a researcher to express their values is evidence of their axiological skill and serves as the foundation for all of their behaviour. The researcher was part of the data collection process; there was great importance on data

collected, and individuals' perceptions were subjective and biased. Hence, the axiological assumption position was value-laden.

3.4 Research Approach

The second layer of the research onion represents the approach used to understand and examine the data collection and analysis (Saunders et al., 2016). This approach depends on the reasoning adopted by the researcher (Ketokivi & Mantere, 2010).

This research adopted the inductive approach. Saunders et al. (2016) stated that the inductive approach generates theory by collecting data and then analysing that data to build a theory. Collis and Hussey (2013) asserted that the inductive approach generates theory from the observation of empirical reality; hence, broad inferences are derived from specific instances. It is described as moving from the particular to the general because it includes moving from a specific observation to a general conclusion about a pattern or rule (Ketokivi & Mantere, 2010).

For the current research, the adoption of an inductive approach to achieve the research's aim, objectives, and questions was motivated by the researcher's philosophical assumptions, beginning with a literature review on flash floods and their impacts and investigating emergency planning for responding to flash floods. Based on this, the researcher explored emergency planning for responding to flash floods. Then, he analysed data, looking for patterns. A theory was then developed to figure out an explanation for these patterns. Therefore, the researcher moved from data to theory or from specific to general. Consequently, it was an inductive approach, as shown in Figure 3.3.

Figure 3.3. The Adopted Research Approach (Inductive Approach)

3.5 Research Strategy

The third layer of the “research onion” concerns the strategy for the research. Saunders et al. (2016) defined a research strategy as “a plan of how a researcher answered the research questions.” Therefore, choosing the appropriate research strategy depended on the previous research layers, i.e., the research philosophy and approach. Denzin and Lincoln (2011) stated that research strategy is the methodological link between the research philosophy and subsequent data collection methods. It is clear that no one research strategy is inherently better or inferior to another. Saunders et al. (2016) pointed out that the most crucial consideration is whether it helps the researcher to answer the research questions and achieve the research aim and objectives. Furthermore, Yin (2017) asserted that research strategies are not exclusive, and each strategy can, therefore, be employed in descriptive, explanatory, or exploratory research.

In general, exploratory research focuses on thinking, understanding, meaning, and generating a theory or model on a specific topic (Bryman, 2016). Thus, it can be argued that this research, as it attempts to understand and explore GDCD officers' perceptions of emergency planning for responding to flash floods, is exploratory. Hence, research is often conducted using a variety of strategies; therefore, it was worth clarifying the reasons for selecting the current research strategy.

The researcher found that a case study strategy and an in-depth descriptive survey strategy were the most appropriate strategies for collecting data. A case study strategy is typically employed to examine contemporary events and relies on observation of the participants who participated in the research (Yin, 2017). Therefore, this strategy was used by studying the case of the flash floods that hit the KSA, specifically the city of Jeddah in 2009 and 2011, in addition to studying the case of the National Plan for Natural Disaster Risk Reduction and the GDCD.

According to Bryman (2016, p.54), “survey research comprises a cross-sectional design in relation to which data is collected predominantly by questionnaire or by a structured or semi-structured interview on a sample of cases drawn from a wider population and at a single point in time in order to collect a body of quantitative or qualitative data in connection with a number of variables (usually many more than two), which are then examined to detect patterns of association”. The survey strategy provides quantitative or qualitative descriptions related to various views, attitudes, and tendencies among a certain population, in which a selected sample is surveyed, generally using questionnaires or interviews to collect the data (Creswell, 2013). The descriptive survey seeks to answer the questions "who," "how many," "what," "when," and "where." In addition, it calculates the number of participants who have feelings, thoughts, or attitudes about a topic that is to be examined to compare or demonstrate future trends (Naoum, 2012). An in-depth surveys seek to obtain in-depth data from a limited number of participants across a series of interviews Remenyi et al., 1998).

Thus, the researcher found that a case study strategy and an in-depth descriptive survey strategy were the most appropriate strategies for addressing the aim and objectives of the research. Therefore, this research employed them to understand GDCD officers’ perceptions of emergency planning for responding to flash floods. The research strategy links to the research methodology choice.

3.6 Research Methodology Choice

The fourth layer of the “research onion” model focuses on methodology choice. Saunders et al. (2016) stated that it could be used to design research and collect data. Based on epistemological (interpretivism), ontological (subjectivism), axiological (value-laden) considerations, a research approach (inductive), a research strategy (in-depth descriptive survey and case study), and after reviewing the quantitative and qualitative methods, this

research fell under the classification of qualitative research. Hence, it was decided that a qualitative method was the most appropriate method for achieving the research aim and objectives.

This research focused on words on emergency planning for responding to flash floods and its requirements and challenges rather than quantification in the data collection and analysis. It focused on how participants understand emergency planning and flash flood response. It represented a perception of emergency planning as a continually evolving emergent feature that used participants' thoughts. Furthermore, as this research adopted the qualitative method, it dealt with non-numerical data such as words (Fellows and Liu, 2021). Thus, interviews were used to collect data, and content analysis was employed to analyse data to produce non-numerical information. In other words, this research used the qualitative method to understand and interpret emergency planning for responding to flash floods in the KSA rather than measure them (Saunders et al., 2016).

3.7 Research Time Horizon

The fifth layer of the "research onion" is the time horizon (Saunders et al., 2016). The time frame – or horizon – for research is a significant factor that influences the consistency and quality of the data collected, which can significantly affect the successful completion of the research (Levy and Lemeshow, 2013). The "research onion" revealed two-time horizon types: a cross-sectional study – a research procedure covering a short period – or a longitudinal study – which is performed across a longer duration and focuses on multiple samples (Saunders et al., 2016).

This research does not aim to investigate the occurrence of flash floods and their impact variations, or to compare emergency planning for responding to flash floods in the KSA over multiple periods. Therefore, a cross-sectional study is deemed more suitable for this research, considering the complexity of the research, the objectives, and the

examination process, as well as being more compatible with the research scope and the resources available.

3.8 Research Techniques and Procedures

The final layer of the “research onion” relates to techniques and procedures for collecting the data. Various ways of doing this include interviews, observation, questionnaires, and archival content (Collis & Hussey, 2013). In the prospect of not having a single technique that suits all research, this research’s philosophy, approach, strategy, and method guided it to choose and use the most appropriate technique.

The techniques employed in this research are a literature review to explore emergency planning and flash floods with a focus on the KSA as a case study, along with interviews to verify selected expert GDCD officers' thoughts and perceptions on the research topic. Consequently, this research employed the literature review as a secondary data source and the interviews as a primary data source. The following subsections detail the techniques and procedures used for data collection and analysis.

3.8.1 Literature Review

It was discussed in detail in Chapter Two of the thesis (see Section 2.2). Literature reviews were the cornerstone for designing interviews, as the information gathered helped the researcher to form relevant questions and to decide what further information was needed from the participants. Thus, the second data collection technique used for this thesis was interviews.

3.8.2 Semi-Structured Interviews

The second technique used for data collection was an interview. They are the most common tool for data collection in qualitative research because they can provide an in-depth understanding of the subject being examined, assisting researchers in collecting valid and

reliable data relevant to the research questions and objectives (Saunders et al., 2016). Interviews can be classified as structured, semi-structured, and unstructured (in-depth) interviews (Bryman, 2016).

This research adopted semi-structured interviews. Qualitative research interviews are commonly referred to as semi-structured interviews (Bryman, 2016). Semi-structured interviews were informal and conversational, and provided open answers from the interviewees (Longhurst, 2003). The researcher had a list of themes and perhaps some essential questions to cover during such interviews. These interviews were valuable for exploring the research to figure out what was happening and comprehend the situation (Bryman, 2016). Thus, in this research, semi-structured interviews were used to accomplish the research objectives.

The stages for designing and implementing interviews included (i) interview preparation; (ii) designing effective and valuable interview questions; (iii) conducting the interviews; and (iv) interpreting the data. Each stage was explored in the following subsections (Creswell (2013).

3.8.2.1 Interview Preparation

The preparation stage was critical for keeping a clear focus on how the interviews are conducted in order to achieve the most advantage to this research (McNamara, 2009). The preparation included (i) identifying suitable candidates for the interviews based on the non-probability sampling technique used for collecting data from selected participants with expertise and experience relevant to the research objectives; and (ii) conducting a pilot test in which the researcher sought to prove if there are errors, limitations, or shortcomings in the interview design, which allowed required adjustments to be made prior to the research's implementation (Turner, 2010).

3.8.2.2 Designing Effective and Valuable Interview Questions

One of the most critical aspects of interview design was the creation of useful interview questions (Turner, 2010). In this research, semi-structured, face-to-face interviews were designed to verify the opinions and perceptions of expert officers at the GDCD on emergency planning for responding to flash floods.

In semi-structured interviews, a number of specific questions were covered for discussion. However, the interviews were not rigidly structured, which led to some topics being briefly explored while others were discussed in more detail. Furthermore, instead of using leading questions, open-ended questions were asked, allowing participants to provide in-depth answers and for the interviewer to probe deeper and ask further questions.

For this research, the interview questions were created according to the research objectives and literature review. These questions were developed within themes to collect critical data regarding emergency planning for responding to flash floods. A sample of interview questions was included in Appendix (7).

The first section of the interview questions included personal information such as name, rank, region, email, qualifications, and relevant experience. The second section included questions based on the four main themes shown below:

- The current emergency planning approach used in the KSA.
- The current state of emergency planning in the KSA.
- Expert perceptions of the emergency planning requirements in the KSA.
- The challenges perceived for emergency planning in the KSA.

3.8.2.3 Conducting the Interviews

The researcher contacted potential participants via phone or email prior to the interview (see Appendix 4 for a copy of the letter). Following this, each participant received interview

materials such as a participant information sheet (Appendix 5), as well as a participant consent form (Appendix 6). They also provided with information about the research, its objectives, and the interview's structure and ethics.

Each participant was then asked to sign the consent form and give their approval for the interview to be recorded. The contact information of the researcher was provided in case the participants have any additional questions or concerns about the research so that they could be addressed before the interview begins. A mutually agreed date, time, and location were then set for each interview. Each interview lasted between 45 minutes and one hour. The interviews were recorded, edited, translated from Arabic to English, and reviewed by the researcher and interviewees.

3.8.2.4 Interpreting the Data

The interpretation of the data collected during the interview was the last stage in the interview design process. According to Creswell (2013), at this stage, the researcher must "make meaning" of what he has discovered and organise the data into sections or groups of information, often known as themes or codes. The transcripts of the interviews were analysed using Microsoft Word. Each interview was read and examined, and groups of questions and answers relevant to the research objectives were identified, copied, and collated separately. Thus, any similarities between various answers were identified. Other opinions, perspectives, and views related to the interview themes were also noted and cited. Quotes and information from each interview were presented anonymously, with no names or personal information about any of the participants being included.

3.8.2.5 Pilot Study

A pilot study is a small one that takes place before the main interview and is used informally (Ghauri et al., 2020). According to Yin (2017), a pilot study is necessary to check that the

research questions are clear and that the participants are able to engage in the study. A pilot study is also important for determining the research direction and improving the study's quality by identifying its deficiencies (Bryman, 2016). Generally, as Sampson (2004) points out, a pilot study can help to enhance the entire research.

A pilot study was regarded as necessary in this research to assess the validity of the research methods and design. The pilot study relied on five semi-structured interviews with senior officers at the GDCD who were experts on the topic; their seniority and expertise meant that their perceptions and opinions were strongly valid, reliable, and trustworthy.

The pilot study was conducted to test the interview form's usability and to help with the familiarisation of the interview process. In addition, it helped the researcher to check whether:

- The interviewees fully understood the questions and were able to provide meaningful answers.
- The interview questions were appropriate for all interviewees and did not exceed their expertise or knowledge.
- The answers given provided high-level, exploratory data on the research topic.
- Any questions that need to be added or removed.

All of the pilot study interviews were carried out face-to-face and the duration did not exceed one hour. With the consent of the participants, audio recordings of each interview were made using a digital audio recorder, which was transcribed afterwards for analysis. During the interviews, the researcher also made handwritten notes as an extra measure in case the audio recorder did not catch everything the interviewee said.

3.9 Population and Sample

3.9.1 Population

Bryman (2016, p.174) defined the population as “the universe of units from which the sample is to be selected”. For example, the population who are being sampled could be people, animals, countries, cities, places, companies, etc. In this research, the population consisted of current officers within the GDCD in the KSA. This included all officers located in all cities across the KSA, in all ranks from lieutenant to major-general who were “in service”.

GDCD officers in the KSA were chosen as the population for this research for several reasons:

i. The GDCD is the agency responsible for preparedness and emergency planning for responding to flash floods in the KSA.
ii. The GDCD officers are professionals in the field of emergency planning and flash flood response.
iii. They have extensive knowledge and experience with regard to flash flood response and emergency planning.
iv. They have passed many training courses in emergency planning and flash flood response.
v. They have been involved in the preparedness, planning, and response to many flash floods in the KSA.

3.9.2 Sampling

The sample is described as “the segment of the population that is selected for investigation; therefore, it is a subset of the population” (Bryman, 2016, p.174). In other words, sampling means selecting part of the research population in order to reach a judgement, conclusion, or opinion about the entire study population (Kothari, 2004). The chosen sample should

accurately represent the population so that it is a microcosm of it, and it should be represented in a way that can be justified (Bryman, 2016). Sampling is an acceptable alternative to using a census when data collection from the entire population is impractical due to research funding constraints and time limitations (Saunders et al., 2016). Non-probability sampling is used in qualitative research when the research focuses on exploring rather than testing a hypothesis (Bryman, 2016).

This research assesses emergency planning for responding to flash floods. Therefore, it seeks particular participants who have the expertise, experience, and knowledge of the research objectives. As a result, non-probability (purposive) sampling was the most appropriate sampling technique to use to achieve the research aim and objectives.

Purposive sampling was a non-probability or non-random sampling technique in which participants in this research were selected for a particular reason. This helped the researcher to acquire a more comprehensive and in-depth understanding of the chosen topic (Neuman, 2000). Purposive sampling required the researcher to use his judgement to choose participants to answer the research questions and achieve the research objectives (Saunders et al., 2016). Furthermore, this method was based on the idea that concentrating on a limited number of participants provides the most useful information (Denscombe, 2017). The data provided by these selected participants strengthened the validity of the data collected through the literature.

Thus, purposive sampling was adopted in this research because the desired participants needed specific characteristics and knowledge to provide the most meaningful data for the research topic. For example, the participants needed to be more familiar, knowledgeable, and experienced with emergency planning and flash floods than any other group.

Accordingly, data was collected to achieve the research objectives via semi-structured interviews with experts. These experts were top management officers at the GDCD with extensive experience in emergency planning and flash flood response and access to high-level data. They were, therefore, able to assess emergency planning for responding to flash floods in the KSA.

The KSA is divided into 13 provinces. A GDCD department exists in each province. As a result, the manager of each department was selected as an expert in the field to participate in the interview, meaning that there were 13 participants taking part in the interviews. The above are summarised in Table 3.1.

Table 3.1. Summary of the Type and Sample of Interviews

Type of Interview	Interviewees	Interview Method
Semi-structured interviews	13 top management officers within the GDCD	Face to face (one-to-one)

3.10 Data Analysis

Data analysis is part of the techniques and procedures layer of the “research onion”. It is the process of examining, coding, classifying, and tabulating collected data with the aim of making a conclusion (Bryman, 2016). Qualitative data analysis enabled the researcher to create theories from the data (Plas & Kvale, 1996; Saunders et al., 2016). In this research, qualitative data analysis began as soon as the data was collected. Since data analysis techniques can render whole data findings meaningless, inaccurate, or biased (Davies & Dodd, 2002), so care was taken from the start of this research to identify and choose techniques that would improve data validity and reliability.

These insights of data analysis led the researcher to employ qualitative analysis technique. The secondary data was textual and qualitative in nature and derived from published literature and documents, which were analysed using content analysis. Similarly,

the primary data collected from interviews were analysed using content analysis. Content analysis was explored in the following subsection.

3.10.1 Content Analysis

Content analysis is a technique used for systematically classifying words, phrases, sentences, and other text units into a sequence of relevant categories, whether written, spoken, or visual (Kalof et al., 2008, p.105). In other words, content analysis is a technique of methodically analysing text into variables (Collis & Hussey, 2013) to establish reproducible and valid inferences from texts into the contexts in which they are employed (Krippendorff, 2009). As such, the categorisation of words or phrases and the coding of any themes relevant to the research field are possible through content analysis (Saunders et al., 2016).

These aspects justified the use of content analysis in this research because emergency planning for responding to flash floods was needed to examined and verified. All themes collected from this process were inductively analysed. Hence, content analysis was used to match the transcribed words from the interviews to the main themes. Data from the interviews were transcribed electronically into a Microsoft Word document. The context was then carefully examined in order to reveal the key themes.

As previously mentioned, content analysis was used to analyse collected and transcribed data (White, 2017). This process was divided into four stages:

- **Stage 1:** Data categorisation and coding to ensure that similar information related to each objective and research question was placed together under the appropriate theme.

- **Stage 2:** The themes were interpreted to ensure that all answers and data under each theme were thoroughly examined and evaluated in order to identify any related themes.
- **Stage 3:** The themes that had been interpreted were then analysed.
- **Stage 4:** This produced a generalisation of the analysed themes in order to formulate the research findings and determine any new themes that emerged throughout the research process and which may contribute to knowledge.

These stages were highly beneficial when dealing with data (Krippendorff, 2009). Additionally, these four stages helped the researcher to identify answer patterns, themes, and the relevance of any findings concerning the research objectives (Punch, 2013).

NVivo software programme version 11.04 for Windows was used in this research to further analyse the data of the semi-structured interviews. This software was among the most used for analysing qualitative data. The reasons for selecting NVivo software were based on its benefits, including the import of data, the coding of textual data, and the modification of the text without impacting the coding (Jackson and Bazeley, 2019). It also helped certain words on emergency planning for responding to flash floods to be searched for within the text itself, plus it divided the data into subclasses, both of which made it easier to spot emergent themes. Furthermore, it was also more secure concerning data backup (Jackson and Bazeley, 2019). Lastly, NVivo software also helped the text analysis process by allowing valid and reliable inductions and inferences to be drawn from the collected data. As a result, it was used to categorise the themes of emergency planning, its requirements and challenges and display them using nodes. In the next section, data validity and reliability were outlined.

3.11 Validity and Reliability

Validity and reliability are terms employed to assess the quality of the research. For the current qualitative research, validity and reliability indicate that data collection and analysis may be repeated with the same results (Yin, 2017). Therefore, tests to prove the validity and reliability of data for this qualitative research were important in determining the data's stability, credibility, and quality (Riege, 2003).

3.11.1 Validity

The term validity herein refers to "the extent to which measures and research findings provide an accurate representation of the things they are supposed to be describing" (Easterby-Smith et al., 2012, p.347). It is all about the integrity of the research conclusions (Bryman, 2016). In other words, it is about determining whether the study findings reflect the examined topic (Collis & Hussey, 2013; Robson & McCartan, 2016). In this research, multiple methods were employed to confirm the validity of the results, such as evaluating in light of the cultural theory of risk perception and comparing the research results to the previously published literature on emergency planning, its requirements and challenges and flash flood response to determine how they fit into the current body of knowledge.

3.11.2 Reliability

The term reliability refers to a measure's constancy (Bryman, 2016). Therefore, reliability relates to whether data collection and analysis techniques would provide consistent results if conducted in another situation or by a different researcher (Saunders et al., 2016). In other words, it is "a question of whether repeated investigations of the same phenomenon give the same result" (Kvale, 1989, p.79). The aim of reliability, therefore, is to keep mistakes and biases to a minimum during the data collection process (Amaratunga et al., 2002). Thus,

a reliable research instrument can provide the same results if conducted using the same procedures (Golafshani, 2003).

In this research, multiple sources of evidence were used to enhance reliability. For example, the reliability was evaluated by conducting a pilot study on a group of experts in the field of civil defence in the KSA. In addition, the reliability was also carried out by asking similar questions to the participants in different ways, listening to the recorded interviews several times, going through various transcriptions of each recorded interview, and by a precise analysis of the interviews in order to understand the accurate meaning of the participants' responses so that logical results were obtained. The ethics of this research were explored in the following section.

3.12 Ethical Approval

According to University College London (UCL) policy, any research conducted using human subjects, data or content must be formally and ethically assessed and approved before the research can begin. For this thesis, ethical approval was obtained from GDCD (Appendix 1), UCL's "Ethical Approval Committee" (Appendix 2), as well as UCL Risk Assessment Authorised (Appendix 3).

3.13 Chapter Summary

This chapter presented and explained the research methodology adopted to address the research aim, objectives, and questions. Accordingly, the research adopted interpretivism, subjectivism, value-laden as philosophical assumptions, an inductive approach, an in-depth descriptive survey, a qualitative method, a cross-sectional study, and a literature review and semi-structured interviews for data collection. The research population consisted of all officers at the GDCD who were on the job. A purposive sampling technique was adopted; hence, 13 participants were selected as an expert in the field to participate in the interview.

The research used the content analysis technique to analyse the primary and secondary data. Multiple methods were employed to confirm the validity of the results, such as evaluating in light of the cultural theory of risk perception and comparing the research results to the previously published literature on emergency planning, its requirements and challenges and flash flood response. In contrast, the reliability was evaluated by conducting a pilot study. Having appointed the research methodology in this chapter, the following Chapter Four included data analysis and results.

Chapter Four: Data Analysis and Results

4.1 Introduction to Chapter

The research aim, objectives, and questions were defined in the first chapter of this thesis. The main issues and the theoretical framework relating to the research topic were discussed in the second chapter. This was followed in the third chapter by an explanation of how the research would be conducted. The current chapter seeks to analyse the data and present the results that were generated through the chosen qualitative research method. To achieve this, this chapter will present a description and analysis of the case study, which includes a detailed description of the General Directorate of Civil Defence (GDCD) in the KSA and the National Plan for Natural Disaster Risk Reduction. Following this, the interview data will be analysed using the content analysis technique, and as a result, the themes and sub-themes will be revealed relating to emergency planning for responding to flash floods in the KSA.

The chapter is divided into four sections: the first section introduces the case studies; the second section presents the qualitative analysis of the interview data; the third section shows the results; and the fourth section provides evidence of the trustworthiness of the data analysis and results.

4.2 Case Study: The General Directorate of Civil Defence in the KSA

4.2.1 Establishment and Developmental Stages

The establishment of the Saudi Civil Defence began on 1st July 1927, when Royal Decree No. 133 was issued, which included the municipality system and the formation of the first fire brigade in Makkah. Then, in 1947 the fire brigade was separated from the municipality and joined the police department. After this, a fire brigade was established in Medina. After that, in 1948, two fire brigades were established in Jeddah and Riyadh. Subsequently, in 1956, the fire brigade department was created within the public security sector. Its tasks

were defined so that it would fight fires and take preventive measures to prohibit their outbreak and limit their effects.

In 1960, the fire brigade department was separated from the public security sector and joined the Ministry of Interior with an independent budget. It was renamed as the General Directorate of Fire Brigades, and a branch was established in each city in the KSA. In 1962 the KSA joined the International Civil Defence Organization (ICDO). After that, in 1965, the Secretary of the ICDO visited the KSA and was briefed on the structure and functions of the General Directorate of Fire Brigades. One of the results of that visit was that the ICDO proposed changing the name of the General Directorate of Fire Brigades to the General Directorate of Civil Defence. Accordingly, the Royal Decree No. 6858 of 1965 was issued, which approved the name change. The newly-formed GDCD's tasks included firefighting, rescue, dealing with all hazards – whether natural or human-made – and mitigating, preparing for, and responding to all disasters, as well as being at the forefront of the recovery operations from them.

In 1986, Royal Decree No. M/10 was issued, which included approval of the legislation of the GDCD. The legislation defined the GDCD's tasks, responsibilities, and objectives. In addition, the tasks and responsibilities of each ministry were also defined for implementing civil defence measures and actions in emergencies and disasters. By that time, a GDCD department had been established in each Province of the KSA, totalling 13 Directorates. Thus, it can be concluded that the Saudi Civil Defence is within the military sector and is directly linked to the Ministry of Interior (GDCD, 2020b).

4.2.2 Responsibilities of the General Directorate of Civil Defence

The Saudi Civil Defence Legislation defined the concept of civil defence as a set of procedures and actions necessary to protect the population and public and private property from the risks of fires, other natural disasters, wars, and various accidents, as well as provide

relief for the afflicted, ensure the safety of transportation, communication, and workflow in public facilities, and protect all national resources (1986, p.15).

The Saudi Civil Defence consists of the following:

- The Civil Defence Council.
- The GDCD.
- The Civil Defence Committees.

The main departments of the GDCD are:

- The Fire and Rescue Department.
- The Civilian Protection Department.
- The Safety Department.
- The Studies, Research, and Information Department.

These departments perform the tasks and responsibilities of civil defence in cooperation with stakeholders such as ministries, government sectors, companies, business owners, Civil Defence forces, internal security forces, the National Guard, the armed forces, and civil defence volunteers (GDCD, 2020b).

The Saudi Civil Defence Legislation (GDCD, 2020b) has defined the GDCD's tasks, responsibilities, and duties as the following:

- Preparing for hazards, risks, and disasters.
- Mitigating hazards, risks, and disasters.
- Responding to hazards, risks, and disasters.
- Rescue, firefighting, evacuation, relief, and recovery services.
- Monitoring potential hazards and risks.
- Training and education.

- Structuring civil defence.
- Leading and managing civil defence.

4.2.3 The National Plan for Natural Disaster Risk Reduction

An extensive search was carried out for disaster management plans which focus on flash floods in the KSA, but the documents were not attainable. Possible reasons for this include: i) the military structure of the GDCD, which could prohibit the publication or circulation of such official documents, or ii) there is a lack of planning in this area. It is probable that both of these reasons led to this result. However, once the search was extended, The National Plan for Natural Disasters Risk Reduction was found (GDCD, 2020a). It focuses on all types of natural hazards rather than just flash floods.

The National Plan for Natural Disaster Risk Reduction relies on several pieces of royal legislation, namely:

1. The Royal Decree No. (4689), dated 1986, which includes forming committees from all ministries to make plans for public contingencies in the country.
2. The Civil Defence System announced through Royal Decree No. (M/10), dated 1986, and its executive regulations for the tasks and responsibilities of ministries and government agencies that were issued by Ministerial Decree No. (9/T/W/4), dated 1987.
3. Royal Decree No. (300/8) of 1998, which includes creating effective mechanisms to deal with disasters.
4. Royal Decree No. (7/B/15424), dated 2000, which includes the approval of preparing a comprehensive strategy to deal with disasters and prepare effective rescue teams.
5. Cabinet Decree No. (151) of 2007, which includes recommendations of the committee to study damage made by heavy rainfall and reduce the risk of flash floods.

6. Royal Decree No. (1455/M/B) of 2011, is similar to the above, and includes the study of the aforementioned damages, focusing on the needs of all Saudi cities, as well as of government agencies.

The plan aims to take proper action to preserve lives from all-natural hazards and protect public and private property in all Saudi cities by following the best methods and ensuring effective coordination between all of the authorities concerned with the implementation of the plans, so as to confront what may happen from the assumptions contained in this plan with efficiency and competence. It also indicates several potential disasters that may occur in the KSA, such as heavy rainfall, flash floods, strong winds or storms, earthquakes, volcano eruptions, hurricanes, landslides, building collapses, dam collapses, the spread of epidemics or deadly diseases, as well as any other cases that could require the implementation of civil defence measures.

In addition, the document notes the need for each of the relevant bodies to coordinate activities as efficiently as possible during emergency planning for responding to disasters. However, it did not specify how the parties could decide on an appropriate response. Moreover, all participants in emergency planning are government agencies, and it did not involve the local community. More limitations are discussed in the following subsection.

4.2.3.1 Evaluation of National Plan for Natural Disaster Risk Reduction

The above GDCD plan shows that there is already work being carried out regarding emergency planning for responding to disasters in the KSA, as well as coordination between all government agencies involved in the implementation of the plan. However, the document did not indicate what the requirements for emergency planning are and how they are identified and assessed, nor how the decision-makers can ensure that the plan fulfils the role for which it was designed. Furthermore, although the plan relies on legislation specific to flash floods and the GDCD system, it is a general plan which focuses on all types of

natural hazards, as previously indicated. Therefore, it can be concluded that the GDCD does not have a flash flood-specific emergency response plan in place and are unable to appropriately identify and assess the emergency planning requirements.

Moreover, as the plan was developed after the 2009 and 2011 Jeddah flash floods, it would be more beneficial to focus on flash flood planning. In addition, the plan limits the roles of all government agencies involved in its implementation and makes the GDCD responsible for the coordination of all government agencies; plus, it ignores the role of the local community and does not include them in the emergency planning phase.

Based on the above, the researcher considers that the minimal information provided in the plan is insufficient for emergency planning for responding to flash floods, which instead would need more precise and specific instruction and information. For this reason, it is necessary to explore the GDCD officers' perceptions of this plan.

4.3 Qualitative Data Analysis

This section explains the data collection method used.

4.3.1 Semi-Structured Interviews

In this section, the data collected through the semi-structured interviews are analysed. The semi-structured interviews aimed to verify: i) the current emergency planning approach for responding to flash floods used in the KSA; ii) the current state of emergency planning for responding to flash floods in the KSA; iii) expert perceptions of emergency planning requirements for responding to flash floods; and iv) the perceived challenges of emergency planning for responding to flash floods.

A systematic process was adopted to prepare for the interviews, as follows :

i. The technique of non-probability sampling, particularly purposive sampling, was employed to select the participants who are experts in the field of emergency planning

and flash flood response and have experience and knowledge related to the research objectives.

ii. A pilot study was conducted to find out whether there were deficiencies, weaknesses, or limitations in the interview design.

iii. An opportunity to make any necessary adjustments and revisions to the interview form before carrying out the main study was provided.

4.3.2 The Pilot Study

A pilot study was conducted to test the data collection instrument and ensure that the data collected would support the research objectives prior to implementing the main study. For this, the researcher developed an interview form (see Appendix 7), which included a list of research questions and themes to be covered. Initially, the researcher consulted his thesis supervisors, Prof David Alexander and Dr Gianluca Pescaroli, who are experts in this field. The researcher requested feedback and advice on the form's relevance and scope in order to improve it. Thus, the interview form was adjusted based on the feedback given.

Afterwards, the researcher travelled to the KSA at the start of September 2022 to conduct the pilot study in preparation for the main study. The accuracy of the research tool in answering the research questions was examined in order to increase its reliability and validity. The researcher also sought to determine how long the interview process would take.

As such, five pilot interviews were conducted to investigate whether: i) the interview questions were designed to collect useful, valuable, and relevant data; ii) the answers given provided high-level, exploratory data on the research topic; iii) whether any questions needed to be added or removed; and iv) whether the data achieved the objectives of the study.

The pilot study consisted of five semi-structured face-to-face interviews with voluntary officers from the GDCD who held leadership roles in emergency planning and flash flood response or who had relevant experience to contribute critical insights in this field. Each participant had at least 20 years of professional experience in emergency planning and flash flood response. The researcher noticed that the interviewees were highly eager to participate in the study because they were aware of its importance due to the recent flash floods in the KSA.

In order to protect the participants' privacy and anonymity, the interview participants were coded as "Officer"; for example, participants 1, 2, 3, 4, and 5 were coded as Officer_01, Officer_02, Officer_03, Officer_04, and Officer_05, respectively. All interviewees who participated in the pilot study were excluded from the main study. A main strength of the pilot study is that the participants were all from diverse backgrounds and worked in different provinces of the KSA. For more details on the pilot study interviewees, see Appendix 8.

All participants received an individual invitation to take part in the study. They were given a brief explanation of the study and then signed a consent form before the interview began. Each interview was no more than an hour long. All interviews were conducted in Arabic and then translated into English. With the consent of each participant, all interviews were recorded using a digital audio recorder, and these recordings were later transcribed for analysis. Handwritten notes were also taken during the interviews in order to collect additional information, particularly elements that may not be easily recorded by the audio recorder, such as the interviewee's accent and body language. It took around four weeks to complete the data collection for the pilot study. Interviews ceased once data saturation was reached. This happened when the researcher noticed that the pilot study accomplished its objectives and no new information about the interview form and questions was provided.

Data analysis was carried out a few days after the interviews were completed. Initially, the researcher repeatedly listened to the recorded interviews in order to become familiar with the general perceptions and opinions of the participants. Then, the researcher read and reread the transcripts to become familiar with the content of the interviews. Next, a content analysis technique was used to analyse the data. After becoming familiar with the data content, coding was the next step. Two coding techniques were used: descriptive coding and NVivo coding.

Descriptive coding, often called topic coding, is one of the most common types of coding in qualitative research. It involves assigning a single word or phrase to represent the central idea in a passage of qualitative data (Saldaña, 2013, p.83). In contrast, NVivo coding, also known as literal, verbatim, or inductive coding, involves using a word or short phrase directly taken from the participants' words (Saldaña, 2013, p.91).

The data were coded to identify any emerging themes which would provide answers to the research questions. The coding was conducted by comparing the answers of all participants, summarising and describing the data, exploring the meaning of the answers, investigating the relationship between the various sorts of data, and clarifying the similarities and differences between them. The resulting thematic codes were then grouped, regrouped, and ultimately integrated into more general thematic categories and redefined using new codes as appropriate. See Appendix 8 for more details on the results of the pilot study and a summary of the data analysis.

The interview form was adjusted based on the feedback and comments from the interviewees. Some questions were slightly modified to improve clarity and avoid confusion, while others were left unchanged. The interviewees commented on the questions to make the sentences more grammatically correct and to avoid confounding the participants of the main study. Most of the interview questions were straightforward in terms of language, with

the exception of a few terminologies which needed to be clarified, particularly in the Saudi context. The suggestions and comments from the interviewees significantly improved the interview form.

According to the voluntary officers' feedback, it would be easier for participants to understand the questions if they were of a higher rank, such as colonel, brigadier, or major general. Therefore, the voluntary officers emphasised the need to select the interview sample based on rank. They also provided advice on how to conduct the interviews so that participants would provide more in-depth and rich information, especially with regards to the questions about their individual opinions and experiences of the strengths and weaknesses of the current state and approach of emergency planning. Consequently, the researcher revised and updated the interview questions in light of the voluntary officers' comments.

Following the analysis of these pilot study interviews and the implementation of the suggestions and improvements, the researcher considered the updated version to be a trustworthy and reliable tool for collecting data from the participants of the main study. The final version adopted for the main study can be seen in Appendix 9. Thus, the data collection tool was ready to be used in the main study by October 2022.

4.3.3 The Main Study

The researcher travelled to the KSA at the start of October 2022 to conduct the interviews for the main study. The main study was administered in the same way as the pilot study. Face-to-face interviews were conducted at the most convenient time and location for each interviewee. Each interviewee was given the interview guidelines, which included the interview invitation letter, the participant information sheet, the consent form, and a list of the interview questions. Furthermore, all personal information provided by the interviewees was treated with discretion and each participant remained anonymous. Each interview

lasted between 60 to 90 minutes. All interviews were conducted without any difficulties, and everything went as planned.

The time spent collecting data for the main study took about two months. The saturation point was reached at the end of November 2022, after the researcher had conducted all 13 interviews. Once data collecting was finished, the next step was to analyse the data. The exact procedures stated in Sub-section 4.3.2 of this chapter were used to conduct the interviews and collect and analyse the data.

Consequently, data were collected for the main study via semi-structured interviews with experts on the topic to achieve the research objectives. These experts are top management officers in the GDCD who have extensive experience in emergency planning and flash flood response and who have access to high-level data. Therefore, they can explain and assess emergency planning for responding to flash floods in the KSA.

Figure 4.1. Map of the KSA Showing the 13 Provinces (https://www.vecteezy.com/vector-art/20804029-saudi-arabia).

The KSA is divided into 13 provinces, as shown in Figure 4.1. Thus, a GDCD department exists in each province. The manager of each GDCD department was selected to participate in the interviews, leading to a total of 13 participants. Each interviewee is identified and described in Table 4.1.

Table 4.1. Participant Demographics.

Question	Options	Number of Participants
Gender	Male	13
Organisation	General Directorate of Civil Defence in the KSA (GDCD)	13
Rank	Major General	12
	Brigadier	1
Years of Experience	Over 30 years	13
Qualification	Bachelor's	3
	Master's	4
	Doctorate	6
Job Title	Manager of the Civil Defence Directorate in their province	13

The delimitations of the participants of this study included: a) gender; b) organisation; c) rank; d) years of experience; e) qualifications; and f) job title. The targeted participants used in this study were high-ranking officers in the GDCD in the KSA. It was clear that all participants were males since there are currently no females in leadership positions in the GDCD in the KSA. Out of the 13 participants, 12 were major generals, and one was a brigadier. After collecting the data and analysing the participants' responses regarding their years of experience in emergency planning and flash flood response, it was apparent that they all have over 30 years of experience in this field. All participants mentioned their post-college education. This includes continuous training on emergency planning and flash flood response, which the GDCD imposes. Six of the 13 participants had earned doctoral degrees

from an accredited university, four had obtained master's degrees, and three had completed only bachelor's degrees.

In order to protect the participants' privacy and anonymity, the interview participants were coded as "Expert". These participants were represented using the codes shown in Table 4.2.

Table 4.2. Coding the Interview Participants.

Interviewee	Code
Participant_1	Expert_1
Participant_2	Expert_2
Participant_3	Expert_3
Participant_4	Expert_4
Participant_5	Expert_5
Participant_6	Expert_6
Participant_7	Expert_7
Participant_8	Expert_8
Participant_9	Expert_9
Participant_10	Expert_10
Participant_11	Expert_11
Participant_12	Expert_12
Participant_13	Expert_13

The interview data were analysed using NVivo software. The interviews were conducted to verify themes, which were named nodes in NVivo. The following section presents the results of the interviews.

4.4. Results

The results of the study were organised according to emerging themes that have been named, categorised, and arranged according to their relation to the research questions. Table 4.3 presents the main themes and sub-themes that emerged during the interview and data analysis stages. These themes focus on assessing the emergency planning for responding to flash floods currently in place in the KSA from the perspectives of expert officers at the GDCD. See Appendix 10 for more details on the results of the main study and a summary of the data analysis.

Table 4.3. Data Analysis Results of the Expert Officers' Interviews: Themes and Sub-Themes.

Main Themes	Sub-Themes
Theme 1. The current emergency planning approach used,	1. The emergency planning approach currently used,
Theme 2. The current state of emergency planning for responding to flash floods.	1. The current state of emergency planning.
Theme 3. Expert perceptions of emergency planning requirements for responding to flash floods.	1. Emergency planning requirements for responding to flash floods. 2. The National Plan for Natural Disaster Risk Reduction. 3. Rebalancing emergency planning with a focus on the community.
Theme 4. The perceived challenges and deficiencies.	1. The perceived challenges and deficiencies.

4.4.1 Theme 1: The Current Emergency Planning Approach Used

The first theme that emerged from the interviews addressed the current emergency planning approach used in the KSA. All 13 participants discussed their perceptions on this theme. The theme was coded in NVivo. The result of the interviews is presented in the following.

Participants presented similar responses when answering the question about the emergency planning approach currently used for responding to flash floods in the KSA. All participants consented that the emergency planning approach used is the dominant top-down approach. For example, Expert_3 mentioned,

> *"It uses the dominant approach, from top to bottom, because community members do not have the information or data for flash flood response planning that emergency agencies have."*

Furthermore, Expert_5 illustrated that the reason is that community members do not have relevant experience or sufficient information:

> *"It uses the dominant approach, from top to bottom, because community members and civil society organisations do not have the relevant information or experience required in emergency planning for responding to flash floods."*

Additionally, Expert_9 explained that the military nature of the Saudi Civil Defence directed it to use the dominant approach:

> *"It uses the dominant approach, from top to bottom, due to the Saudi Civil Defence's military nature and the military chain of command followed in the Saudi Civil Defence."*

Although Expert_4 agreed that the emergency planning approach currently being used is the dominant top-down approach, he added that emergency planning in cities differs from that in villages:

> *"In urban areas and cities, the dominant approach is used in coordination with the relevant agencies, while in villages the opinion of community members such as volunteers is considered in emergency planning for responding to flash floods."*

In addition, Expert_7 said that in some cases of flash flood response planning, community members are consulted:

> *"It uses the dominant approach, from top to bottom. However, in some cases, information about flash flood risks is collected from individuals."*

4.4.2 Theme 2: The Current State of Emergency Planning for Responding to Flash Floods

The second theme that emerged from the interviews explored the current state of emergency planning for responding to flash floods in the KSA. The results of this theme were coded in NVivo. The full results of this part of the interviews are presented below.

The participants were asked about the current state of emergency planning for responding to flash floods. All participants reported being somewhat satisfied with the current state of emergency planning, with an urgent need to develop and improve deficiencies.

One participant (Expert_4) mentioned that emergency planning was scientifically designed:

> *"Because the emergency planning for responding to flash floods in the KSA is based on a solid scientific background and represents a roadmap for updating and improving the emergency plans.*"

Some, such as Expert_11 and Expert_13 justified their response by stating that the current emergency planning decreases damages:

> *"Because it responds appropriately to flash floods and reduces human and economic losses.*"

Another participant (Expert_9) expressed that:

> *"However, it still needs to be improved, updated, and developed further – for example, by strengthening cooperation and coordination among all stakeholders.*"

Expert_8 mentioned that it is necessary to take advantage of modern technology in enhancing emergency planning for responding to flash floods:

> *"The emergency planning for responding to flash floods is sufficiently in place. However, it needs to be constantly updated, developed, and improved and modern technology must be introduced in this field."*

However, some, such as Experts 1 and 7, addressed how implementation and adherence can be challenging:

> *"The emergency planning for responding to flash floods is adequately in place, but implementation and adherence are challenging."*

Similarly, Expert_3 stated that,

> *"However, there tends to be a delay in implementation by the relevant agencies."*

Experts_2, 4, 10, and 13 added that the emergency planning for responding to flash floods must constantly be updated, developed, and improved:

> *"The emergency planning for responding to flash floods is not sufficiently available, so it needs a thorough review and update."* (Expert_2.)

> *"However, the current emergency planning for responding to flash floods is insufficient and must be developed further."* (Expert_4.)

> *"The current emergency planning for responding to flash floods is in place, but they need to be updated, developed, and improved upon."* (Expert_10.)

> *"The current emergency planning for responding to flash floods is currently used well because it reduces the risk of flash floods. However, it should be constantly developed, updated, and improved upon."* (Expert_13.)

It can therefore be concluded that the current state of emergency planning for responding to flash floods is adequate. However, it needs to be supported by modern technology; there needs to be more coordination among the relevant agencies, as well as better commitment to implementation; and it needs to be constantly improved and developed.

4.4.3 Theme 3: Expert Perceptions of Emergency Planning Requirements for Responding to Flash Floods

The third theme that emerged from the interviews relates to their perceptions of emergency planning requirements for responding to flash floods. The theme was broken down into three further sub-themes: emergency planning requirements for responding to flash floods, the National Plan for Natural Disaster Risk Reduction, and rebalancing emergency planning with a focus on the community. The perspectives of the interviewees on these sub-themes are presented and analysed in the following three sub-sections. The third theme and its sub-themes were also coded in NVivo.

4.4.3.1 Emergency Planning Requirements for Responding to Flash Floods

The first sub-theme that became apparent in this category focuses on the emergency planning requirements for responding to flash floods. The following requirements became evident: administrative requirements; equipment and technical requirements; human resources (i.e., trained staff and specialists); identifying, analysing, and evaluating the risks; and updated databases.

Firstly, Expert_1 divided them into three main requirements:

> *“Administrative requirements such as regulations and legislation, technical requirements (which includes equipment), and human resources.”*

In more detail, Expert_3 mentioned that they include,

“Qualified leadership and management; an updated database; recruiting the experts; knowledge gained from international experiences; determining goals; availability of sufficient financial resources; [and] completed infrastructure.”

Others, such as Experts_2, 4, 6, 8, 9, 10, 11, and 12, stated that they include,

“Identifying, analysing, and evaluating flash flood risks.”

On the other hand, Expert_5 pointed out that they include,

“Determining the tasks and responsibilities of the relevant agencies, determining the chain of command at national and local levels, and determining the staffing and technical capabilities for responding to flash floods.”

Similarly, Experts_2 and 13 added that they would include,

“Training and practice.”

Furthermore, Expert_7 explained that,

“Studies, research, and reports are an important part of the emergency planning requirements.”

In addition, Expert_13 stated that one of the most important aspects was,

“Coordination and cooperation among stakeholders.”

To conclude, a summary of the emergency planning requirements that must be met in order to achieve an effective flash flood response are presented in Table 4.4.

Table 4.4. Emergency Planning Requirements for Responding to Flash Floods.

No.	Emergency Planning Requirements for Responding to Flash Floods
1	Administrative requirements, including regulations and legislation.
2	Technical requirements (which includes equipment).
3	Human resources (staff, responders, stakeholders).
4	Identifying, analysing, and evaluating flash flood risks.
5	Determining the tasks and responsibilities of the relevant agencies.
6	Qualified leadership and management.
7	Determining the chain of command at national and local levels.
8	Determining the human resources and technical capabilities for responding to flash floods.
9	Coordination and cooperation among stakeholders.
10	Recruiting the experts.
11	Knowledge gained from international experiences.
12	Updated databases.
13	Availability of sufficient financial resources.
14	Completed infrastructure.
15	Studies, research, and reports.
16	Training and practice.

4.4.3.2 The National Plan for Natural Disaster Risk Reduction

The second sub-theme that was revealed in this category aimed to explore the participants' views on the National Plan for Natural Disaster Risk Reduction. They were asked two questions: what is your opinion of the Plan? Are there any aspects of the Plan that require improvement? The majority of the participants expressed the opinion that the Plan is somewhat acceptable; however, it is obvious that it needs updating and further development and refinement.

Firstly, Expert_1 stated that,

"…its implementation by respondents is problematic…it should be updated, especially with regard to the organisational, coordination, administrative, and technical aspects."

Similarly, Expert_2 mentioned that,

"However it needs a comprehensive update where the natural hazards are identified, assessed, and analysed. This means that it needs to be rewritten entirely by a team of experts specialising in the field."

Furthermore, Expert_3 pointed out that,

"it must be constantly updated and evaluated in order to align with the Kingdom's Vision 2030, as well as the issues posed by climate change."

Moreover, Expert_4 reported that,

"it should be constantly reviewed and updated according to changing circumstances and situations because each emergency plan should be reviewed after its implementation."

Additionally, Expert_5 stated that,

"it clarifies the tasks, responsibilities, and roles of the stakeholders related to implementing flash flood response activities. However, it should be updated, plus the Plan should be evaluated each time it is implemented."

Similarly, Expert_6 indicated that,

"it defines the roles, tasks, and responsibilities of the stakeholders related to implementing flash flood response activities. It also includes identifying, analysing, and evaluating the risks of flash floods. However, it needs to be constantly updated, plus it should employ modern technologies. Additionally, many aspects of the

National Plan require updating and improvement, such as: amending the names and tasks of some governmental agencies related to flash flood response; involving individuals and civil society organisations in planning for the flash flood response; and employing modern technologies when responding to the flash floods."

Furthermore, Expert_7 said that,

"the problem lies with the actual response, as the flash flood response plan is not being implemented as planned. So, many aspects of the National Plan require updating and improvement, but it should first be applied to identify its deficiencies and weaknesses."

In addition, Expert_8 commented that,

"it needs continuous evaluation, updating, improvement, and development based on the latest information and data about flash floods and their risks."

Moreover, Expert_9 mentioned that,

"It is adequate if carried out professionally and accurately… [however], the stakeholders implementing the Plan are the weakness."

Similarly, Expert_10 mentioned that,

"It is reasonable because all detailed flash flood response plans in the KSA are based on it. However, it can be improved upon by updating the roles and tasks of the government agencies related to implementing the flash flood response plan."

Additionally, Expert_11 explained that,

"it includes the essential elements required for responding to flash floods and their risks. However, it should be reviewed annually and updated and developed."

Lastly, Experts_12 and 13 outlined that,

“it was written by experts and specialists in the field of emergency planning and flash flood response. However, all aspects of the Plan need to be updated and improved annually.”

It can therefore be concluded that the National Plan for Natural Disaster Risk Reduction is well-written, reasonable, and practical, and can be implemented because it achieves a beneficial response to flash floods and reduces human and economic losses. Table 4.5 summarises these suggested essential aspects of an effective flash flood response plan.

Table 4.5. Aspects of an Effective Flash Flood Response Plan

No.	Aspects of an Effective Flash Flood Response Plan
1	Clear and specific goals.
2	Written in an easy and simple language.
3	Identifying, analysing, and evaluating hazards and risks.
4	Identifying the tasks, responsibilities, and roles of each stakeholder.
5	Employing modern technologies.
6	Involving individuals and non-governmental organisations (NGOs).
7	Training, practice, and implementation.
8	Updated data and information.
9	Coordination and collaboration among stakeholders.
10	Annual review and evaluation.

4.4.3.3 Rebalancing Emergency Planning with a Focus on the Community

The third and final sub-theme that arose in this category centres on rebalancing emergency planning with a focus on the community. Participants were asked the research question: can the biggest improvement to the flash flood response in the KSA be achieved by rebalancing emergency planning so that it focuses as much on achieving the community-based approach as it does on the dominant approach? The majority of participants reported that it

is more appropriate to rebalance emergency planning so that it focuses on both approaches equally.

Firstly, Experts_2, 4, 5, 6, 9, and 10 explained that rebalancing the two approaches in emergency planning could provide more reliable information and experiences regarding flash floods and their risks. However, the circumstances accompanying each emergency, the geographical nature of each city, and the cultural and educational differences between community members should first be considered:

> *"Yes, a balance between a dominant approach and a community-based approach is best for emergency planning. However, it should not be used in all emergencies, but should vary from one emergency to another."* (Expert_2.)

> *"Yes, combining the dominant and community-based planning approaches would be better for emergency planning for responding to flash floods in Saudi Arabia because information and experiences are mixed with each other."* (Expert_5.)

> *"Yes, combining the dominant and community-based planning approaches would be better for emergency planning for responding to flash floods in Saudi Arabia. It would undoubtedly be better to involve individuals and civil society organisations in the planning of the flash flood response because this will lead to more effective planning as reliable information about the flash floods and their risks will be provided."* (Expert_6.)

> *"Yes, I think so. It is better to integrate the two approaches because this would provide more information, data, and experience for emergency planning and responding to flash floods. However, the level of integration between the two approaches will vary from one city to another according to the geographical nature of each city and according to the cultural and educational level of the population."* (Expert_9.)

"Yes, I think so. It is better to integrate the two approaches because this would provide more information, data, and experience for emergency planning and responding to flash floods." (Expert_10.)

In connection to this, Experts_1 and 3 mentioned that they support rebalancing the two approaches in emergency planning. However, this should not be the case in all emergencies, plus community members should only be involved if they are specialists in the field:

"Yes, but community-based planning cannot be completely relied upon. The dominant planning approach is the basis because it has the data, information, and resources required." (Expert_1.)

"Yes, I support the participation of community members and civil society organisations in flash flood response planning, but only if they are specialists in emergency planning." (Expert_3.)

Furthermore, Expert_12 pointed out that the dominant approach provides resources, and the community-based approach provides information, so they should be balanced in emergency planning:

"Yes, I believe that flash flood response planning would be of great benefit if the dominant approach is combined with the community-based approach, because a combination would take advantage of the resources provided by the dominant approach and the information provided by the community-based approach."

Similarly, Expert_13 stated that integrating the two approaches in emergency planning is beneficial in discussing lessons learned:

"Yes, I believe that flash flood response planning would greatly benefit if the dominant approach was combined with the community-based approach because individuals,

civil society organisations, and emergency agencies would be able to provide the required information about flash flood risks and lessons learned from previous flash flood disasters."

On the other hand, three participants (Experts_7, 8, and 11) declined to balance the two approaches in emergency planning for several reasons, including a lack of information and experience among the community members and a lack of specialist NGOs:

"No, because of the lack of experience and insufficient information among individuals and the absence of civil society organisations specialising in emergency and flash flood planning." (Expert_7.)

"No, because individuals and civil society organisations do not have enough information about emergency planning or flash flood plans and their risks." (Expert_8.)

"No, because civil society organisations and individuals do not have sufficient information or experience in identifying, analysing, and evaluating flash flood risks." (Expert_11.)

To conclude, a summary of the acceptance and rejection justifications for rebalancing between the community-based approach and the dominant approach in emergency planning for responding to flash floods is shown in Table 4.6.

Table 4.6. Acceptance and Rejection Justifications for Rebalancing the Community-Based Approach with The Dominant Approach.

No.	Acceptance Justifications	Rejection Justifications
1	Provides the integration of information and experience	Lack of experience of community members
2	Leads to more reliable information	Community members have insufficient information
3	Provides resources and support	Absence of NGOs
4	Provides a broader view of lessons learned	

4.4.4 Theme 4: The Perceived Challenges and Deficiencies

The fourth and final theme that emerged during the interviews addressed the perceived challenges and deficiencies. The perspective of the interviewees was taken through the research question: are there any particular challenges, deficiencies, difficulties, or issues that come to mind in the field of emergency planning for responding to flash floods? As a result, the following challenges, deficiencies, and issues arose: a) changes to flash flood pathways; b) climate change issues; c) inadequate human and equipment resources; d) lack of coordination and cooperation among stakeholders; e) lack of flash flood risk databases; f) poor or incomplete infrastructure; and g) poor training. This fourth theme was coded in NVivo.

The participants' responses revealed that emergency planning for responding to flash floods in the KSA indeed faces a range of difficulties, challenges, and deficiencies. For example, Expert_1 mentioned that,

> *"Yes, there are many challenges such as climate change; the lack of equipment and technical tools; poor training and readiness; and lack of rescue skills."*

Climate change contributes to the unpredictability and severity of flash floods. It increases the frequency and severity of extreme weather events. Experts such as 1, 2, and 8 cited the difficulty in accurately predicting climate patterns as a core challenge. This is exacerbated by global warming, regional and global climate changes, and inadequate local climate modeling capabilities. There is inadequate investment in climate modeling and adaptation strategies. So, there is a need to emphasize adaptive capacity in climate change management, highlighting the importance of local adaptation strategies.

Furthermore, Expert_2 stated that they include four challenges:

> *"Poor infrastructure; unavailability of a database for previous flash floods; lack of accurate prediction of climate change; and lack of identification, analysis, and assessment of flash flood risks."*

Additionally, Expert_5 agreed with Expert_2 that *"incomplete infrastructure"* was a significant threat to emergency planning for responding to flash floods.

The infrastructure in place, such as flash flood defences and drainage systems, is often not resilient enough to handle severe flash floods. Expert_2 and Expert_5 highlighted incomplete or inadequate infrastructure as a significant threat. This is typically a result of historical underfunding of infrastructure projects, a focus on short-term rather than long-term infrastructural development, and a lack of emphasis on resilient construction standards. So, the concept of resilient infrastructure emphasises the need to design infrastructure that can withstand and quickly recover from flash floods.

Similarly, Experts_6, 7, 10, 11, and 12 also agree with Expert_2 that there is a[n],

> *"Lack of a comprehensive national database for flash flood risks."* (Expert_6.)

> *"Lack of a comprehensive database for flash flood risks."* (Expert_7.)

> *"Absence of a database on flash floods and their risks."* (Experts_10 and 11.)

“Lack of information on the risks of flash floods and previous flash flood disasters.” (Expert_12.)

A recurring theme was the absence of a comprehensive database on past flash floods and associated risks, as noted by Experts 6, 7, 10, 11, and 12. This deficiency is due to inadequate investment in data collection and its management systems, such as Geographic Information Systems, which hampers effective risk assessment and emergency planning. So, the Disaster Risk Reduction frameworks by the United Nations advocate for robust data collection and risk assessment mechanisms to enhance preparedness and emergency planning.

Moreover, Expert_3 added four more challenges:

“Poor preparedness; delay in decision-making; lack of participation by all stakeholders in decision-making; and poor training.”

Several experts, such as Experts 1 and 3, pointed out the lack of simulation exercises and inadequate training programs for emergency responders. This stems from a neglect of continuous education and professional development for emergency personnel. So, the emergency management cycle highlights the importance of emergency planning, which includes training and exercises.

However, Expert_6 stated that the most critical issue that impedes emergency planning for responding to flash floods is,

“An encroachment on the channels and pathways of flash floods.”

The encroachment on flash flood channels and pathways is a significant immediate issue. As highlighted by Expert_6, this often results from unregulated construction and urbanization in areas prone to flooding. The underlying cause is a lack of strict enforcement of land-use policies and insufficient urban planning regulations. Unregulated construction and

urbanization in flood-prone areas lead to obstruction of flash flood pathways. The lack of rigorous environmental impact assessments exacerbates this issue, allowing for development projects that ignore hydrological patterns. So, emergency planning must integrate environmental considerations to enhance resilience against flash floods.

In addition, Expert_7 added that,

> *"Paying attention to the commercial aspect at the expense of staving off the risks of flash floods through building houses in flash flood pathways."*

Furthermore, Expert_8 pointed out that emergency planning for responding to flash floods encountered four difficulties:

> *"Inadequate human and equipment resources; climate change issues; and lack of awareness among residents about flash flood risks."*

A shortage of trained emergency responders and a lack of advanced equipment are significant barriers. Expert_1 and Expert_8 emphasized the lack of technical tools and poor training. This stems from both budgetary constraints and prioritization issues within government emergency agencies. Also, there is a limited focus on capacity building and continuous professional development. So, the capability maturity model can be applied to evaluate and improve organizational capabilities in emergency management.

On the other hand, Experts_9 and 13 agreed that *"lack of coordination and cooperation among stakeholders"* is the most significant obstacle facing emergency planning for responding to flash floods.

Experts 9 and 13 identified poor coordination as a critical issue. This often results from fragmented governance structures, the absence of integrated communication channels among various agencies and stakeholders, fragmented governance and communication gaps among agencies, and the absence of a unified command structure and integrated

communication systems. So, effective emergency management requires a networked approach, where inter-agency collaboration and information sharing are crucial.

Other challenges and deficiencies mentioned by the participants included:

> *"Failure to involve all stakeholders in emergency planning for responding to flash floods, particularly individuals and civil society organisations."* (Expert_6.)

Expert_3 and Expert_6 mentioned the lack of stakeholder participation in emergency planning and decision-making processes. This is rooted in a top-down approach where community and civil society engagement is minimal. It also marginalizes local participation and lacks inclusivity. So, it is crucial to involve a broad range of stakeholders to enhance the legitimacy and effectiveness of emergency planning.

> *"Lack of automation implementation in all emergency planning processes and activities."* (Expert_4.)

> *"Lack of experts and specialists in emergency planning and flash flood response."* (Expert_10.)

It can therefore be concluded that emergency planning for responding to flash floods in the KSA faces a variety of challenges and deficiencies, all of which are summarised in Table 4.7.

Table 4.7. Challenges and Deficiencies of Emergency Planning for Responding to Flash Floods.

No.	Challenges and Deficiencies of Emergency Planning for Responding to Flash Floods
1	Encroachment on the channels and pathways of flash floods.
2	Climate change issues.
3	Poor or incomplete infrastructure.
4	Lack of database for flash floods and their risks.
5	Lack of coordination and cooperation among stakeholders.
6	Failure to involve all stakeholders in emergency planning for responding to flash floods.
7	Lack of equipment, technical tools, and human resources.
8	Lack of training.
9	Delay in decision-making.
10	Lack of experts and specialists in emergency planning and flash flood response.
11	Lack of automation implementation in all emergency planning processes and activities.
12	Lack of awareness among community members on flash flood risks.

Despite these challenges, there have been notable successes in emergency planning for responding to flash floods in the KSA, reflecting progress in certain areas. For example, establishing early warning systems using meteorological data and flood prediction models has improved the ability to predict and alert communities before flash floods occur and respond to them. The Saudi Meteorological and Environmental Protection Authority has developed warning systems that integrate satellite data and weather forecasts, though further refinement is needed (Al-Wathinani, Barten, Borowska-Stefańska, Gołda, AlDulijan, Alhallaf, Samarkandi, Almuhaidly, Goniewicz, Samarkandi, & et al., 2023).

Moreover, formulating national response frameworks, such as civil defence decrees and regulations and establishing the Saudi National Risk Council, have clarified roles and responsibilities, enhancing coordination among various agencies before and during emergencies. The GDCD coordinates emergency planning and response activities across

different government agencies (Hussain Shah, Yassin, Abba, Lawal, Hussein Al-Qadami, Teo, Mustaffa, & Aljundi, 2023).

Furthermore, while infrastructure remains challenging, significant investments have been made in upgrading flood defences, such as levees and drainage systems in urban areas. For example, major cities like Jeddah have seen extensive drainage projects to mitigate flash flood risks (Sofia, Yang, Shen, Mitu, Patlakas, Chaniotis, Kallos, Alomari, Alzahrani, Christidis, & Anagnostou, 2023).

Also, efforts and campaigns to educate individuals and raise public awareness about flash flood risks and preparedness measures have increased community awareness and resilience. For example, the GDCD conducts regular outreach programs and drills to prepare residents for emergencies (AlQahtany & Abubakar, 2020; Tammar, Abosuliman, & Rahaman, 2020).

Overall, while there are still areas that need improvement, these efforts reflect significant progress in the KSA's approach to emergency planning, managing flash flood risks, and enhancing overall emergency preparedness and response capabilities.

Comparing these challenges with other countries reveals similar issues but also highlights different approaches and solutions. For example, Japan's comprehensive approach includes robust early warning systems, community-based flood management practices, and advanced technological solutions (Fan & Huang, 2020; CAO, Vu Quynh, Anh Nakamura, Shinichiro, Otsuyama, Kensuke, Namba, Miki, Yoshimura, & Kei, 2024). Implementing regular flood drills and integrating community-based management practices could enhance preparedness in the KSA.

In contrast, FEMA's flood risk management strategies in the USA include extensive use of floodplain mapping, strict building codes, and strong inter-agency collaboration (Andrew,

Brandon, & Garrett, 2021). Adopting similar floodplain mapping and building code enforcement, along with fostering inter-agency cooperation, could improve emergency planning and resilience in the KSA.

Another example is that the Netherlands excels in innovative water management and sustainable land use planning. Their proactive flood prevention measures, such as dikes and controlled flooding zones, set a global standard(Janssen, Ramos, Linderhof, Polman, Laspidou, Fokkinga, & de Mesquita, 2020). Investing in similar proactive and preventive measures, such as improved water management infrastructure, could significantly reduce flash flood risks in the KSA.

By comparing the KSA's emergency planning strategy to those of these countries, it becomes evident that addressing the identified challenges requires a multifaceted approach involving technological advancement, regulatory reforms, increased investment in training and resources, and enhanced stakeholder engagement. Integrating successful elements from other countries' experiences could significantly improve the emergency planning and effectiveness of flash flood response in the KSA.

4.5 Evidence of Trustworthiness

This section addresses the study results' credibility, transferability, dependability, and confirmability.

4.5.1 Credibility

In qualitative research, credibility is the equivalent of internal validity and is concerned with the issue of truth value. It is the confidence that the results are accurate. Credibility indicates that the results are derived from the participants' opinions and accurately reflect their perceptions. The best methods to achieve credibility are prolonged engagement, persistent observation, triangulation, and a participant review (Korstjens & Moser, 2018).

In this study, semi-structured interviews using face-to-face open-ended questions were conducted to collect the data. In addition, data were collected from other sources such as documents, reports, and previously published studies. So, it can be stated that triangulation was used to validate this study. A qualitative researcher can use triangulation to lessen the possibility of bias in the data analysis (Guion et al., 2011).

Once the face-to-face interviews had been completed with the participants, the responses were then transcribed. The researcher then met the participants again, provided them with a copy of his responses, and asked them to review the transcript relating to their interview to ensure that the transcribed responses accurately reflected their opinions and perceptions.

4.5.2 Transferability

The transferability of a study's results refers to its applicability in various settings and studies. Therefore, it is synonymous with or a substitute for external validity and generalisability. Understanding the target audience is crucial when thinking about transferability (Burchett et al., 2011). The researcher commenced examining the transferability of the results when he verified that all of the participants were experts in the field of emergency planning and flash flood response. All of them had educational qualifications related to the research subject and were all top management officers in the GDCD who had extensive experience in emergency planning and flash flood response and had access to high-level data. Therefore, they could assess emergency planning for responding to flash floods. The KSA is divided into 13 Provinces, and a GDCD department exists in each Province. Therefore, the manager of each GDCD department was selected to participate in the interviews, leading to a total of 13 participants.

As the study focused on emergency planning for responding to flash floods, it is therefore expected that the results could be generalised to other organisations inside or outside of the KSA that also engage in emergency planning and flash flood response.

4.5.3 Dependability

Dependability relates to the consistency and reliability of the study's results, as well as the extent to which research procedures are documented, enabling a third party to review, examine, and evaluate the research process (Moon et al., 2016). Therefore, the researcher should thoroughly document the methodology, research design, and implementation, especially the research strategy, methods used, and data collection and analysis details.

This study aimed to assess emergency planning for responding to flash floods from expert officers' perspectives at the GDCD in the KSA. In light of this, data was collected from a variety of sources, such as documents, reports, previously published studies, and face-to-face semi-structured interviews. The participants were selected purposefully for the data collection because of their extensive experience in emergency planning and flash flood response. Once the data were collected, it was analysed using the qualitative content analysis technique. Then the themes were coded using NVivo software.

To prove dependability, the researcher transcribed the interviews and then asked each participant to review their responses to ensure that they accurately and correctly reflected their perceptions. All data acquired (such as the literature review, other documents, the interviews, and field notes) should be stored securely to ensure its safety and reliability (Yin, 2015).

For this study, the researcher saved all of the data collected – which included the literature review, various reports and documents, the transcripts of the interviews, and the field notes – in a secure database created solely as a place to store the study's data.

4.5.4 Confirmability

Confirmability aims to demonstrate that the study's results and interpretation are accurately derived from the data, not the researcher's imagination. Confirmability is concerned with the neutrality aspect. An audit trail can be used as a technique for proving confirmability (Korstjens & Moser, 2018).

The researcher made an effort to keep a critical eye on the research process. However, he was also well aware of the impact of his bias on the results. Therefore, analytical notes were used after each interview to write down the researcher's impressions, feelings, perceptions, biases, and personal thoughts related to each interview. In this study, the researcher was a passive interviewer. During the interview, the researcher listened to the participant's response and asked clarifying questions only if the reply required further clarification. Follow-up interviews were conducted to clarify any unclear responses and to ensure that the participant's perceptions, opinions, and thoughts were accurately captured.

4.6 Chapter Summary

This chapter presented the results of the data collected on emergency planning for responding to flash floods in the KSA in order to achieve the research objectives. It contained four main sections: the case study, qualitative data analysis, results, and evidence of trustworthiness.

The first section introduced a case study on the GDCD in the KSA, followed by a critical review of the National Plan for Natural Disaster Risk Reduction. The section also examined the establishment and development stages of the Saudi Civil Defence from 1927 to the present day. It was found that the Saudi Civil Defence consists of three parts: the Civil Defence Council, the GDCD, and the Civil Defence Committees. Then the section explored the responsibilities of the GDCD and it was found that they include the following: preparing

for, mitigating, and responding to hazards, risks, and disasters such as flash floods. After that, the National Plan for Natural Disaster Risk Reduction was reviewed. It was noted that it relied on several royal legislations and aimed to take proper actions to preserve lives from all-natural hazards and protect public and private property in all Saudi cities by following the best methods and ensuring effective coordination among all authorities.

The second section addressed qualitative data analysis. The primary data were collected for the main study to achieve the research objectives via semi-structured interviews with 13 experts from the GDCD on emergency planning for responding to flash floods. Data from the interviews were analysed using the content analysis technique.

The third section presented the study's results derived from the analysis of the data from the semi-structured interviews. Through the qualitative content analysis of the interviews, the following themes and sub-themes became evident:

1 The current emergency planning approach used.
2 The current state of emergency planning for responding to flash floods.
3 Expert perceptions of emergency planning requirements for responding to flash floods: a) emergency planning requirements for responding to flash floods; b) the National Plan for Natural Disaster Risk Reduction; c) rebalancing emergency planning with a focus on the community.
4 The perceived challenges and deficiencies.

The fourth and final section discussed evidence of the trustworthiness of the data analysis and results. It included the study results' credibility, transferability, dependability, and confirmability. The credibility of the study was verified by triangulation. Face-to-face semi-structured interviews using open-ended questions were conducted to collect the data. In addition, data were collected from other sources such as documents, reports, and previously published studies. The results' transferability was verified by proving that the

participants were all experts at the GDCD in the field of emergency planning and flash flood response.

Furthermore, the dependability was proved by the interviews being transcribed and then the researcher asking each participant to review their responses to ensure that they accurately and correctly reflected their perceptions. Lastly, the confirmability was demonstrated through the interviewer being passive during the interviews. He listened to the participant's response and asked questions only if the response required further clarification. In addition, follow-up interviews were conducted to clarify any unclear responses and to ensure that the participant's perceptions, opinions, and thoughts were accurately captured.

The next chapter will discuss the results of the study further and provide an interpretation of the aforementioned themes.

Chapter Five: Discussion of Results

5.1 Introduction to Chapter

This chapter discusses the results of the qualitative study in light of the relevant literature. The study aims to assess emergency planning for responding to flash floods in the KSA. The study sought to answer the following research questions: 1) What emergency planning approach for responding to flash floods is currently being used? 2) What is the current state of emergency planning for responding to flash floods? 3) What are Saudi Civil Defence officers' perceptions of the emergency planning requirements for responding to flash floods? 4) What are the perceived challenges of emergency planning for responding to flash floods? This qualitative study collected data from multiple sources, such as: a) the Saudi Civil Defence Act; b) various legislations, regulations, documents, plans, and reports; c) a literature review; and d) face-to-face semi-structured interviews.

Four key themes emerged from the data analysis:

- Theme 1) The emergency planning approach used.
- Theme 2) The current state of emergency planning.
- Theme 3) Expert perceptions of emergency planning requirements.
- Theme 4) The perceived challenges and deficiencies.

Accordingly, this chapter includes a summary of the results, an evaluation of the results from the perspective of the theoretical framework, a discussion and interpretation of the results in light of previous studies, and a summary of the chapter. This chapter was further divided into the following three sections: the first section presents an overview of the results; the second section evaluates the results from the perspective of the theoretical framework; and finally, the third section discusses and interprets the results in light of previous studies. The following section presents a summary of the study results.

5.2 Summary of the Results

This section summarises the results of the study. Chapter Four presented the participants' responses and the themes and sub-themes that emerged in detail. The research questions explored the emergency planning approaches for responding to flash floods in the KSA. This qualitative study generated valuable data and presented insights into the expert officers' perceptions at the GDCD in the KSA on the research topic. While some of the results were consistent with previously published literature, others revealed new perspectives on the subject. The following is a summary of the results.

Theme 1. The emergency planning approach used. All participants confirmed that the emergency planning approach currently used in the KSA is the dominant top-down approach. The participants illustrated that the military nature of the Saudi Civil Defence led it to use the dominant approach. In addition, many community members do not have relevant experience or sufficient knowledge in order to act. However, a few participants highlighted that in some cases, community members are actually consulted. They also stated that emergency planning varies depending on whether the area is rural or urban.

Theme 2. The current state of emergency planning. All participants expressed a somewhat positive attitude towards the current state of emergency planning in the KSA because they believe it to be well-designed and reduce human and economic losses. However, more coordination among stakeholders and more collaboration among the relevant agencies are still required; plus, it needs to be supported by modern technology, constantly updated, improved, and developed, and there needs to be a better commitment to its implementation.

Theme 3. Expert perceptions of emergency planning requirements. This theme was further broken down into three sub-themes: emergency planning requirements for

responding to flash floods; the National Plan for Natural Disaster Risk Reduction; and rebalancing emergency planning with a focus on the community.

The participants stated that the emergency planning requirements that need to be met in order to achieve an effective flash flood response are: administrative requirements such as regulations and legislation; technical requirements such as equipment, devices, and tools; human resources; identifying, analysing, and evaluating flash flood risks; determining the tasks and responsibilities of the relevant agencies; qualified leadership and management; determining the chain of command at national and local levels; determining staffing and technical capabilities; coordination and cooperation among all stakeholders; recruiting experts in the field; knowledge gained from local and international experiences; an updated database; availability of sufficient financial resources; completed infrastructure; conducting studies and research; and better training and practice.

Most participants assessed the National Plan for Natural Disaster Risk Reduction is somewhat acceptable, efficient, well-written, reasonable, and practical and that it could be implemented as it is because it reduces human and economic losses. However, it needs to be further updated, developed and improved. They also added that an effective emergency plan should have clear objectives and be written in simple, understandable language. In addition, it should identify, analyse, and evaluate the hazards and risks; identify the tasks, responsibilities, and roles of each stakeholder and ensure better coordination and collaboration among them; employ modern technologies; involve individuals and non-governmental organisations (NGOs); offer better training, practice, and implementation; use updated data and information; and be reviewed and evaluated annually.

The majority of participants reported that the biggest improvement to the flash flood response in the KSA could be achieved by rebalancing emergency planning so that it focuses as much on achieving the community-based approach as it does on the dominant

approach. Therefore, it is more appropriate to rebalance emergency planning so that it focuses on both approaches equally. Furthermore, the results showed that the justifications for accepting the rebalancing between the two approaches in emergency planning for responding to flash floods included: it provides an integration of the knowledge available with previous experience, which leads to more reliable information on how to handle future events; it provides better resources and support; and it provides a broader view of lessons learned. On the other hand, the justifications for rejection included the lack of experience and knowledge of community members, and the absence of NGOs.

Theme 4. The perceived challenges and deficiencies. The participants' responses showed that emergency planning for responding to flash floods in the KSA faces a number of difficulties, challenges, and deficiencies, such as encroachment on the channels and pathways of flash floods; climate change issues; poor or incomplete infrastructure; lack of a database; lack of coordination and cooperation among stakeholders; failure to involve all stakeholders; lack of equipment, technical tools, and human resources; lack of training; delays in decision-making; lack of experts and specialists; lack of automation implementation; and lack of awareness among community members.

5.3 Discussion and Interpretation of the Results

The results of this study will be discussed and interpreted in this section. Firstly, the results will be evaluated in the context of the selected theory. Secondly, the results of this study will be compared to those of previous studies.

5.3.1 Results in Light of the Theory

This study used a qualitative descriptive case study to assess emergency planning for responding to flash floods in the KSA by analysing the perceptions of expert officers in the GDCD towards emergency planning, its requirements, and challenges. The study's guiding

theory was the cultural theory of hazard and risk (See section 2.2.3). Using this theory, a researcher may study hazard and risk perceptions and ascertain how each member of a shared community evaluates hazards and risks (Cope, 2014). This allows a researcher to presume that members of the same professional community will have comparable hazard and risk assessments if certain factors are met (King, 2012). The participants in this study have training and experience in emergency planning and flash flood response. Considering their links to the broader KSA emergency management community, learning about their perspectives on hazards and risks might shed light on how to better plan for and respond to flash floods in the country.

Similar research conducted in the KSA revealed gaps in emergency planning and flash flood response based on an evaluation of perceived preparedness, plans, and responses. According to the cultural theory of hazard and risk, it stands to reason that those working in emergency planning and management roles will have a common understanding of what “preparedness and planning” mean when responding to a flash flood. Thus, this study was guided by the following research questions: 1) What emergency planning approach for responding to flash floods is currently being used? 2) What is the current state of emergency planning for responding to flash floods? 3) What are Saudi civil Defence officers’ perceptions of the emergency planning requirements for responding to flash floods? 4) What are the perceived challenges of emergency planning for responding to flash floods?

The results that emerged from the data analysis revealed that the current emergency planning approach used in the KSA is the dominant top-down approach. The results also showed that the current state of emergency planning is somewhat acceptable because it achieves the GDCD’s goals and reduces human and economic losses. The results also illustrated that the emergency planning requirements for responding to flash floods in the KSA include: administrative requirements such as regulations and legislation; technical

requirements such as equipment; human resources such as staff; identifying, analysing, and evaluating the flash flood risks; determining the tasks and responsibilities of the relevant agencies; qualified leadership and management; determining the chain of command at national and local levels; determining the staffing and technical capabilities for responding to flash floods; coordination and cooperation among stakeholders; recruiting the experts; knowledge gained from international experiences; an updated database; the availability of sufficient financial resources; completed infrastructure; conducting studies and research; and training and practice. These results were consistent with previous findings in Chapter Two of this study (Momani & Fadil, 2010; Alharbi, 2013; Abosuliman et al., 2014; Youssef et al., 2016; Bin Ottai, 2017; Al-Amin et al., 2019; GDCD, 2020a; Ledraa & Al-Ghamdi, 2020), and it's clear that the KSA's policymakers and emergency planners have made substantial efforts to address these issues. Due to these considerations, using the cultural theory of hazard and risk in emergency planning for responding to flash floods is a relevant explanation.

In general, it was proved that employing the cultural theory of hazard and risk in the field of emergency planning for responding to flash floods is extremely useful, especially for employees in emergency agencies such as Civil Defence. All of the Civil Defence experts interviewed had high experience and academic qualifications in emergency planning and flash flood response; for example, it was apparent that they all have over 30 years of experience in this field. In addition, they had completed extensive training courses in emergency planning and flash flood response. Six of the 13 participants had earned doctoral degrees from an accredited university, four had obtained master's degrees, and three had completed bachelor's degrees, which provided them with sufficient knowledge of appropriate ideas that apply to the topic.

The bottom line is that all civil defence experts interviewed were knowledgeable of the emergency planning requirements needed for responding to flash floods, such as the relationship between climate change and flash floods; hydrological, meteorological, and climatological studies; identifying, analysing, and evaluating flash flood risks; cooperation and coordination among stakeholders; employing modern technologies; the availability of technical equipment; the availability of well-trained and qualified responders; the National Plan for Natural Disaster Risk Reduction, which needs to be constantly updated and developed; continuously monitored and evaluated emergency plans; education of the community; and increased projects for preventing flash flood risks, such as constructing dams and drainage channels. In addition, the majority of these requirements were available in the provinces where the participants work.

The civil defence experts also found that the challenges and deficiencies in emergency planning, such as changes to flash flood pathways; climate change issues; inadequate human and equipment resources; lack of coordination and cooperation among stakeholders; lack of updated databases; poor or incomplete infrastructure; and insufficient training – were not attributed to the size of the province or the priority assigned to emergency planning, but to a lack of knowledge, awareness, and resources.

5.3.2 Comparison of Results with Previous Literature

Previous studies on emergency planning and flash flood response related to the KSA are scarce. This study was the first to assess emergency planning for responding to flash floods in the KSA. All previous studies on emergency planning have either focused on international or regional levels or have specialised in the medicine, trade, information technology, industry, finance, or business sectors.

However, research studies that validated the results of this study were found in a review of the literature. Consequently, this study found that the perceptions of research

participants and the previous literature on emergency planning for responding to flash floods in the KSA were consistent with one another. Therefore, these results should be considered to completely comprehend what may be required of the organisations in charge of planning for emergencies, especially with regard to flash flood response planning.

The studies by Momani and Fadil (2010), which was on the topic of changing public policy after Jeddah experienced flash floods, and Ledraa and Al-Ghamdi (2020), which explored the planning and management issues and challenges of flash floods in Riyadh, were the closest to the subject of this research. Nevertheless, aspects of this research were also addressed by other studies, such as Alamri (2010); Abosuliman et al. (2013; 2014); Ameur (2016); Rahman et al. (2016); Youssef et al. (2016); Bashawri (2019); Alyami et al. (2020); and Azeez et al. (2020).

The following four research questions directed this results discussion section:

1. What emergency planning approach for responding to flash floods is currently being used?
2. What is the current state of emergency planning for responding to flash floods?
3. What are Saudi Civil Defence officers' perceptions of the emergency planning requirements for responding to flash floods?
4. What are the perceived challenges of emergency planning for responding to flash floods?

Thus, the themes that were identified through data analysis were categorised under these four questions.

As previously stated, four key themes emerged from the data analysis: Theme 1) The emergency planning approach used; Theme 2) The current state of emergency planning; Theme 3) Expert perceptions of emergency planning requirements; Theme 4) The perceived

challenges and deficiencies. The themes and sub-themes of the discussion chapter follow the same structure as the results chapter.

5.3.2.1 The First Research Question: What Emergency Planning Approach for Responding to Flash Floods Is Currently Being Used?

The theme that emerged from this research question relates to the current emergency planning approach used in the KSA. There was a consensus of 100% of the participants that the emergency planning approach currently used for responding to flash floods in the KSA is the dominant top-down approach. The participants attributed this finding to the fact that the military nature of the GDCD directed it to use the dominant approach.

This result is in line with the results of previous studies. For example, Ledraa and Al-Ghamdi (2020) revealed that the GDCD is the authority responsible for dealing with disaster management in the KSA. Its responsibility includes legislation, regulations, coordination with various government institutions, and implementation. In each of the 13 administrative regions of the country, there is a Local Civil Defence Department and a Local Emergency Committee, whose main objective is to implement the provisions and rules of the Civil Defence system whenever a disaster occurs. The Local Emergency Committee convenes whenever it is necessary to deal with an emergency. However, such meetings are not held regularly.

Furthermore, Ledraa and Al-Ghamdi found that being a military organisation, the GDCD adopts a top-down approach that is relatively rigid and too centralised regarding the decision-making process and emergency management. They added that the government considers itself the sole guardian of the state, and little room has been given to community participation. Therefore, it has adopted a top-down approach where higher authority levels make planning and decisions. This emergency planning approach is not ideal for some managerial activities involving flexibility, quality attainment, swift coordination, and

effectiveness, such as flash flood planning. For example, the local community may have different and beneficial perceptions about emergency planning.

This centralised top-down approach has constraints in addressing flash flood risks. Therefore, it is critical that they adopt a more decentralised bottom-up planning approach that conforms to the concepts and benchmarks of local engagement, accountability, and quality assurance. It can hence be concluded that employing both top-down and bottom-up approaches in emergency planning for a flash flood response at the GDCD in the KSA will be more appropriate.

From the above, it is clear that The GDCD in the KSA is the primary body responsible for flash flood planning and management. It employs a dominant top-down approach, characterised by centralised decision-making and rigid hierarchical structures typical of military organisations. This method has strengths in command and control but lacks flexibility and community engagement, which are crucial for effective flash flood response. The GDCD's military structure provides strong central control, ensuring uniformity and discipline in responses. This approach can be effective in scenarios requiring quick mobilisation and strict adherence to protocols. While the centralised approach ensures disciplined execution, it falls short in flexibility and adaptability, often leading to delayed responses in dynamic disaster situations like flash floods.

The emergency management system in the KSA was compared and analysed with regional and international emergency systems, such as the emergency management system in the United Arab Emirates (UAE) and the emergency management system in the United States of America (USA). Comparative analysis showed that both the KSA and UAE had centralised emergency management systems with significant government control. The UAE has integrated advanced technology and community engagement into its disaster management practices (Al Blooshi et al., 2023). The UAE's National Emergency Crisis and

Disaster Management Authority emphasises public awareness and community involvement more than the KSA's GDCD. The UAE uses sophisticated early warning systems and geospatial technologies to manage flash floods (Al Kurdi, 2021). These technologies can be transferred to the KSA to enhance its flash flood response capabilities.

The USA employs a federal approach to flood management, combining top-down and bottom-up strategies. Agencies like FEMA coordinate with state and local governments, ensuring both centralised oversight and local flexibility (Tariq, Rashid, & Nick, 2020). The USA approach heavily incorporates community-based flood planning, which has proven effective in managing diverse and frequent floods. Empowering regional and local departments to make decisions based on real-time assessments can mitigate the rigidity of a top-down approach, enhancing responsiveness and adaptability (Tyler, Sadiq, & Noonan, 2019).

Incorporating a community-based approach, as in the USA, can be adapted to the KSA context. This involves integrating local knowledge, enhancing public awareness, and promoting community-led initiatives in emergency planning. Developing local flash flood response teams, conducting public awareness campaigns, and involving community leaders in planning processes can enhance resilience and response efficacy.

The use of advanced early warning systems, big data for risk assessment, and real-time communication technologies, as in the UAE and USA, can significantly improve flash flood response. Investing in and deploying advanced meteorological and hydrological monitoring systems, utilising GIS for flood mapping, and employing social media platforms for real-time communication can enhance the KSA's preparedness and response capabilities. Adopting a more decentralised approach, as in a federal system like the USA, can improve response times and adaptability. Empowering provincial civil defence

departments with decision-making authority based on real-time assessments can mitigate the rigidity of the current top-down approach.

To upscale the emergency management system, the KSA can introduce policy reforms mandating community participation in emergency planning. Establishing legal frameworks that support decentralized decision-making can enhance responsiveness. The KSA can benefit from international cooperation and knowledge exchange programs. Participating in global disaster management forums and partnering with international agencies like the United Nations Office for Disaster Risk Reduction (UNDRR) can provide valuable insights and best practices.

The emergency management system in the KSA, while robust in its centralised control and resource allocation, can significantly benefit from adopting more flexible and community-centric approaches. Learning from regional and global best practices, particularly in community engagement, technological integration, and decentralised decision-making, can enhance the effectiveness of the KSA's emergency planning and flash flood response. By upscaling and integrating these approaches, the KSA can improve its emergency planning, preparedness, response, and resilience to flash floods, ensuring better protection of lives and property.

5.3.2.2 The Second Research Question: What Is the Current State of Emergency Planning for Responding to Flash Floods?

The theme that emerged from this research question relates to the current state of emergency planning for responding to flash floods in the KSA. All participants expressed being somewhat satisfied with the current state of emergency planning for responding to flash floods in the KSA. The participants justified their answers by stating that current emergency planning is based on a solid scientific background and represents a roadmap for updating and improving emergency plans. Additionally, the GDCD plans appropriately for

flash floods, leading to reduced human and economic losses. This finding corresponds with what other studies have found.

For example, Alamri (2010) provided a nuanced understanding of the challenges faced during emergencies and the lessons learned from the 2009 Jeddah flash flood. Alamri's key finding was a noticeable enhancement and evolution in emergency planning and management practices in the KSA following the Jeddah flash flood. The improvements were attributed to the valuable lessons derived from the disaster, emphasizing the adaptability and learning capabilities within the emergency management framework.

Furthermore, another study by Momani and Fadil (2010) delved into the repercussions of the Jeddah flash flood on public policy in the KSA. The researchers highlighted a pivotal shift in public policy as a direct response to the challenges posed by the flash flood. The study emphasized the need for a clear and accountable public policy to address disasters effectively. Momani and Fadil's conclusion underscored the importance of providing decision-makers with a structured framework that enables the development and implementation of policies, procedures, and plans specifically tailored to cope with both natural and human-made disasters. In essence, the research advocated for a proactive approach to disaster management through the establishment of comprehensive public policies that could prepare for risks and enhance resilience in the face of future emergencies in the Kingdom of Saudi Arabia.

Following on from the above, the participants stated that emergency planning for responding to flash floods in the KSA still needs to be supported by the use of modern technology, better coordination among relevant agencies, and a more reasonable commitment to implementation. Furthermore, it needs to be constantly improved and developed. These findings are consistent with the literature.

For example, according to Alamri (2010), the government of the KSA has made significant strides in emergency planning and management in comparison to some of its neighbouring countries. However, it still has trouble proactively managing existing risks and vulnerabilities, much less preparing for future disasters. Alamri states that it may be prudent to spend time and resources now in order to be prepared for such disasters. If we do not learn from our mistakes, it will cost us dearly in terms of human lives and properties.

Similarly, Abosuliman et al. (2013) used an empirical survey method to assess emergency preparedness and management in the KSA. The participants of that study unanimously agreed upon the four most essential categories for flash flood planning and response, which were: training of response teams; the identification and coordination of the organisational responsibilities; community awareness; and planning and preparedness.

Additionally, Alamri (2010) revealed that more must be done to plan for and manage emergencies, particularly flash floods. This may be due to the widespread misconception that flash floods are uncommon and low-impact emergencies. It was found that it was challenging to install drainage systems in a city like Jeddah because of its high population density. In addition, it is necessary for there to be more coordination between the many emergency agencies and organisations supplying infrastructure services like power lines, telephone cables, and drainage pipes, as many roads would have to be stopped for lengthy periods. These considerations, among others, have slowed the search for a remedy to this serious problem. However, the devastating flash floods that hit Jeddah in 2009 prompted policymakers to launch new infrastructure initiatives and speed up current ones. All of these efforts were made in the pursuit of a workable answer that would forestall more flash floods.

Regarding using modern technology, Elkhrachy (2015) found that avoiding the risks of flash floods or preventing them is impossible. However, it is plausible to work on the reduction of their effects and to reduce the losses which they may cause. Using modern

technology such as flash flood mapping to identify sites in high-risk flood zones is one of the most powerful tools available for this purpose. Mapping flash floods would benefit urban and infrastructure planners, risk managers, and emergency services or responders during extreme and intense rainfall events.

In this context, Bashawri (2019) revealed that the government of the KSA has issued guidelines for emergency planning and flash flood response, but they need to be more specific. In addition, they do not provide detailed instructions for responding to flash floods quickly. This lack of proper guidance results in rushed, improvised decisions that confuse emergency agencies, responders, and those directly affected by the flash floods.

This study was unique in revealing that while major cities like Riyadh, Jeddah, Mecca, and Medina benefit from advanced infrastructure and resources, remote villages often struggle with limited access to developed emergency planning and civil defence services. Major cities in the KSA Saudi Arabia have well-developed emergency planning. These cities benefit from advanced infrastructure, such as modern buildings with stringent construction standards designed to withstand natural hazards such as flash floods. Regarding resource allocation, significant financial and human resources are dedicated to emergency planning and response. Advanced technologies, such as GIS and early warning systems, are also used. In addition, protocols are established for inter-agency coordination and public communication during emergencies.

In contrast, remote villages in the KSA face distinct challenges in emergency planning and response to flash floods. For example, many buildings are constructed using traditional methods without modern safety standards, insufficient funding and personnel for comprehensive emergency planning and management, geographic isolation impedes timely response and delivery of aid during emergencies, and lower levels of public awareness and preparedness measures compared to urban areas.

This study was also distinguished in that it demonstrated that access to civil defence services in terms of emergency planning for responding to flash floods varies in urban areas than in rural regions of the KSA. Residents of urban areas have better access to civil defence services, which are characterized by their close location to civil defence stations and emergency facilities, regular public education programs and emergency drills, and reliable communication infrastructure ensuring timely dissemination of information. On the other hand, rural areas face notable deficiencies in civil defence services. These include fewer civil defence stations, longer response times, limited opportunities for community training and preparedness drills, and inadequate communication infrastructure that hinders the effective dissemination of emergency information.

The disparity in emergency planning for responding to flash floods and civil defence protection between major cities and remote villages in the KSA underscores the need for tailored strategies. While urban areas enjoy advanced infrastructure and resources, rural regions require significant investment and capacity building to achieve equitable protection. By addressing these disparities, the KSA can enhance its overall resilience to natural hazards such as flash floods and ensure the safety and well-being of all its residents.

5.3.2.3 The Third Research Question: What Are Saudi Civil Defence Officers' Perceptions of the Emergency Planning Requirements for Responding to Flash Floods?

The themes that emerged from this research question were:

- Emergency planning requirements for responding to flash floods.
- The National Plan for Natural Disaster Risk Reduction.
- Rebalancing emergency planning with a focus on the community.

Emergency Planning Requirements for Responding to Flash Floods

The participants' responses highlighted a variety of emergency planning requirements for responding to flash floods, such as administrative requirements, including regulations and legislation; technical requirements, which include equipment; human resources, which includes staff and responders; identifying, analysing, and evaluating flash flood risks; determining the tasks and responsibilities of the relevant agencies and stakeholders; qualified leadership; determining the chain of command at national and local levels; coordination and cooperation among stakeholders; knowledge gained from local or international experiences; updated databases; the availability of sufficient financial resources; completed infrastructure; and improved training and practice. This result corresponds with what previous studies have found.

One of the key emergency planning requirements is the administrative requirements, which include laws, regulations, and legislation. Rong and Jia (2008) revealed that when an emergency breaks out, quick and effective command assignment is an important means for minimising the losses. Emergency leaders and planners critically depend on relevant policy documents, such as emergency plans, laws, legislation, and regulations, to achieve quick and effective command assignments. There are many kinds of emergencies, and their related policy documents are miscellaneous, so when several emergencies occur simultaneously, a singular particular method has to manage these related documents.

The participants also emphasised that technical requirements, including equipment and tools, are crucial for emergency planning. Reddick (2011) showed that there had been a significant impact of information technology on emergency planning. Information technology has proven to be effective for all phases of emergency management. Numerous technologies are used in emergency planning, ranging from the internet, GIS, and wireless technologies to more advanced hazard analysis models.

In the same context, a study conducted by Lumbroso and Vinet (2012) on tools to improve the production of emergency plans for floods found that tools such as checklists, guidance, and specialised software appear to be used rarely to enhance the effectiveness of emergency planning. An investigation was undertaken with flood managers in England and France. The objective was to establish why tools that can usefully contribute to improving emergency plans for floods are often not being used. They concluded that many flood managers are unaware of the tools available to assist them in formulating emergency plans for floods. Lumbroso and Vinet recommended that there is a need for guidance on the tools and how they can be used to help to improve emergency planning for floods.

Furthermore, the participants also revealed that human resources, including staff and responders, are critical requirements for emergency planning. Chan et al. (2019) support this finding and concluded that a holistic strategy combining technical aspects, such as sustainable urban drainage systems, and non-technical human factors, such as employees and responders working in an emergency agency, is key to effective flood planning in cities.

Identifying, analysing, and evaluating flash flood risks is another requirement the participants mentioned. Hossain and Meng (2020) found that by revealing the population's and buildings' risks and their geographic information, this flood risk assessment could help local governments and communities prepare better to take action against future urban flood events. Therefore, this method of integrating GIS and cartographic analysis in acceptable flooding assessments can also be applied to other urban areas for flood mitigation and risk management.

The participants also stated that determining the relevant agencies' and stakeholders' tasks and responsibilities is essential for emergency planning. Box et al. (2013) examined the perception of the roles and responsibilities of four key stakeholders in flood risk management in Australia. They found that understanding each stakeholder's roles and

responsibilities varied considerably between research participants. In the KSA context, participants stated that there is an urgent need for all stakeholders to familiarise themselves with the critical tasks for flash flood planning in order to understand each other's roles and responsibilities better.

The participants also indicated that coordination and collaboration among stakeholders are significant emergency planning requirements. The literature supports this finding. For example, Ledraa and Al-Ghamdi (2020) concluded that coordination and collaboration among stakeholders can lead to quick decision-making, improves resource mobilisation, and manages emergency processes. Another study by Abosuliman et al. (2014) highlighted the need to identify and coordinate organisational responsibilities among stakeholders.

The participants also mentioned that knowledge gained from local or international experiences is crucial. McEwen and Jones (2012) discussed building local flood knowledge into community flood resilience plans. The study explored the key emerging aspects of this expanded knowledge base, namely relationships between expert and local/lay knowledge, the changing nature of local knowledge of community flood risks, and how attempts were being made to incorporate local knowledge into science, policies, and practice. The study also suggested that sustainable flood knowledge should be integrated into expert, local, and political knowledge to build community flood resilience. The study placed emphasis on scale issues about knowledge types, suggesting that local knowledge can be to an "expert" level in the large-scale mapping of flood processes. It reflected how local flood knowledge can be captured, shared, harnessed, and used, and assimilated into governance structures for flood resilience planning. It concluded that the flood experience has helped generate new understandings of the value of local knowledge and has shown how this knowledge might be successfully used in flood risk management practice.

In connection to this, Acharya and Prakash (2019) argued that local knowledge should not be recognised purely for disseminating flood early warning information but also as a place for knowledge generation on flood forecasting. Moreover, strengthening local knowledge systems on flood forecasting could counterbalance the drawbacks of centralised flood early warning systems. They found that the production and consumption of flood forecasting knowledge need local and scientific communities to work together to reduce knowledge gaps. Likewise, Hartmann and Spit (2016) concluded that flood risk management could profit from past experiences and approaches in spatial planning.

The participants also stated how important it is to keep the database up to date. Williams and Archer (2002) revealed that historical flood data provides a better basis for risk assessment and planning on flood plains through revised flood discharge and depth estimates. Additionally, Barriendos et al. (2014) asserted that the database is suitable for use in multidisciplinary flood analysis techniques, such as meteorological or hydraulic reconstructions.

The participants also expressed that having adequate financial resources is critical for emergency planning. Török (2018) revealed that the adverse effects of flood disasters are often associated with communities with high financial resource vulnerability. Thus, the analysis provided a more comprehensive picture of communities in desperate need of financial resources in order to have the ability to reduce the negative impacts of flood disasters and to provide a more sustainable society.

The participants also emphasised the need for finished infrastructure for emergency planning to respond to flash floods. Crespo et al. (2019) revealed that flood protection is influenced by planning decisions such as housing development in flood-prone locations. This result supports the use of guided planning strategies with regard to future natural disasters, such as the role of natural and built infrastructure in reducing the consequences

of floods and the impact on human health. Similarly, Gaitan et al. (2014) stated that urban areas must continuously observe the weather to reduce the effect of floods. So, data describing rainfall and environmental conditions at high spatio-temporal resolution is vital for responding quickly and avoiding loss. As a result, they suggested a secure, efficient, and inexpensive information and communication technology infrastructure that combines data from all relevant sources, sensors, social media, and user-contributed data into a single, cloud-based interface. The suggested infrastructure would increase the effectiveness of emergency responses to flood events, hence ensuring the community's protection.

Finally, the participants also stressed the importance of training and practice for emergency planning for responding to flash floods. This result supports Rahman et al. (2016), who found that training and practice are essential in planning flash flood mitigation and adaptation strategies. He concluded that higher training and frequent simulation exercises on flash flood management for city residents and government officials are needed to improve the city's preparedness for disaster management.

The National Plan for Natural Disaster Risk Reduction

In order to improve emergency planning and management in the KSA, in 2011, the KSA's government developed and issued the National Plan for Natural Disaster Risk Reduction (GDCD, 2020a), which focused on all types of natural disasters, especially flash floods. The Plan relied on several royal legislative instruments, namely Royal Decree No. (4689); Royal Decree No. (M/10); Royal Decree No. (300/8); Royal Decree No. (7/B/15424); Cabinet Decree No. (151); and Royal Decree No. (1455/M/B).

The Plan aimed to take proper actions to preserve lives from all natural hazards and protect public and private property in all of the KSA's cities by following the best methods and ensuring effective coordination between all of the authorities concerned with the implementation of the Plan so as to confront what may happen from the assumptions

contained in the Plan with efficiency and competence. It also indicated several other potential hazards that could occur in the KSA, such as strong winds or storms, earthquakes, volcano eruptions, hurricanes, landslides, dam collapses, and the spread of deadly diseases, as well as any other cases that could require the implementation of Civil Defence measures. In addition, the Plan noted the need for each of the relevant bodies to coordinate in conducting activities as efficiently as possible before, during, and after all disasters and emergencies.

The participants' views on the National Plan for Natural Disaster Risk Reduction revealed that it is somewhat acceptable. This result is attributed to the fact that it is well-written, reasonable, and practical, and can be implemented because it achieves a beneficial response to flash floods, thus resulting in reduced human and economic losses. However, it is apparent that it needs updating and further development and improvement. The participants added that the effective flash flood response plan should: include clear and specific goals which are written in easy-to-understand and simple language; identify, analyse, and evaluate hazards and risks; specify tasks, responsibilities, and roles of all stakeholders; employ modern technologies; involve individuals and NGOs; include training, practice, and implementation information for all stakeholders; include updated data and information; ensure coordination and collaboration among stakeholders; and be reviewed and evaluated annually. This result is consistent with the literature.

According to a study by Abbas et al. (2016), the effectiveness of a plan depends heavily on the degree to which its aims are prioritised. Governments are responsible for safeguarding their citizens from floods, and they would be well served by adopting a combination of strategies that are at least somewhat consistent. Hence, it is crucial to incorporate the aforementioned strategies into the plan to achieve its objectives. In addition, national and provincial governments, local communities, academic institutions and

researchers, management levels, flood control, and emergency responders can all have roles and boundaries established for them depending on the specifics of the plan and its intended outcomes (Kreibich et al., 2015).

Similarly, Lumbroso et al. (2011) revealed that the effectiveness of an emergency plan is challenging to measure, and end users often stated that this could only be assessed accurately after a plan has already been used. Many emergency planners indicated that a well-defined description of the roles, responsibilities, and necessary communication is essential for a plan to be effective. In addition, other more technical aspects, such as accessibility of roads, evacuation routes and procedures, depiction of the flood disaster, and potential impacts of the floods on critical infrastructure, can be considerably improved. The main challenge for emergency planners is to avoid filling plans with generic text and to provide an appropriate level of specific detail in the plan while ensuring its usability.

Likewise, Rahm and Reddick (2011) emphasised the importance of public awareness, claiming that the most effective plan to prevent disaster risks involves communities in disaster management awareness and education. Additionally, Alyami et al. (2020) added that better coordination and communication among all stakeholders could ensure the effectiveness of disaster management plans, particularly between the higher authorities and the local and regional authorities.

Finally, the current study supports the finding by Lumbroso and Vinet (2012), who found that flood risk managers and emergency planners have the potential to enhance the effectiveness of emergency plans by working more closely together by using all available tools.

Rebalancing Emergency Planning with a Focus on the Community

Most participants stated that it is more appropriate to rebalance emergency planning to focus equally on both the community-based and the dominant approaches. It is better to involve individuals and civil society organisations in planning the flash flood response because this will lead to more effective planning. The dominant approach provides resources, and the community-based approach provides information. However, the circumstances accompanying each emergency, the geographical nature of each city, and the cultural and educational differences between community members should be considered. This result is in line with the results of previous studies.

In the KSA, participation from the local community is not included under the GDCD regulations or legislation concerning emergency planning. The current GDCD regulations only focus on the participation of community members as volunteers during a flash flood response. The absence of community members in the KSA's Local Emergency Committee, which includes representatives from all government agencies such as the military, the police, the Civil Defence, and various ministries, shows how they do not believe community participation is required.

Furthermore, Ledraa and Al-Ghamdi (2020) found that the reason why the GDCD adopts a dominant, top-down approach in emergency planning, where decisions and planning are made at the highest levels of authority, is because it considers itself the sole guardian of protection for people and their possessions. Therefore, no room is given for the participation of community members in emergency planning. This kind of planning does not seem to be appropriate for flash flood response planning activities where flexibility, quality achievement, quick coordination, and effectiveness are most required.

However, the participation of local organisations and communities is essential in emergency planning, particularly flash flood response planning, especially concerning

vulnerable residents. No one is more qualified to respond to questions about the local environment, vulnerable peoples' whereabouts, their needs, and how to reach them than the locals themselves. Therefore, local community members should be effectively engaged in emergency planning.

Moreover, emergency planning is not only the responsibility of government organisations but also the local communities. Because they have dealt with so many flash floods in the past, the local communities have gathered a lot of information and have much expertise in coping with such events. Therefore, it is critical to include local communities in all stages of flash flood response planning, beginning with risk identification, allocating an early warning, establishing action priorities, developing response plans, and implementing and assessing such plans. When it comes to assessing risks and developing effective long-term mitigation strategies, community participation is crucial. Engaging the community in risk identification and emergency planning would increase a feeling of communal responsibility for reducing vulnerability and risk.

In connection to this, according to Atanga (2020), flood disasters are becoming more frequent and have severe effects on cities and countries all over the world. This issue could result from community leaders in flood-prone areas not contributing to developing flood risk management strategies. Conflicts, institutional difficulties, and a lack of technical competence may prevent stakeholders from participating in flood management. However, the study found that community leaders could positively impact flood risk management in their neighbourhoods. It came to the conclusion that leaders from flood-prone communities must actively participate in the development and execution of flood risk management strategies.

Furthermore, Yamada et al. (2011) suggested participatory methods for community-based flood risk communication, utilising the workshops to improve local flood catastrophe

mitigation. The implementation of flood risk communication was shown to be successful in raising people's knowledge of both individual and group activities to reduce the flood risk at a local level.

Similarly, Mehring et al. (2018) revealed that the top-down approach still pervades modern flood risk management despite efforts to shift towards more democratic modes of working that offer an integrated approach to addressing flood risks. It was found that using a one-size-fits-all strategy for engagement fails to recognise how diverse communities are and how knowing a community's social dimensions is necessary for effective participation. A greater understanding of floods may be achieved through social learning and information sharing, which involves time, effort, and the development of trust. This can increase societal connection to flooding and its effects.

This study is unique in that it revealed fundamental differences in stakeholders' roles and interactions in emergency planning for flash floods in urban and rural areas in the KSA. Flash floods pose a significant risk, necessitating comprehensive emergency planning. The dominant top-down approach has prioritized centralized control and resource management, often overlooking the potential benefits of community involvement. Findings suggest that a balanced approach, incorporating both community-based and dominant approaches, can lead to more effective emergency planning and flash flood response. However, it should be taken into account that the roles of stakeholders are different in rural areas than in urban areas. So, it is important to consider geographical, cultural, and educational differences in emergency planning. The fundamental differences between stakeholders in urban and rural areas in the KSA stem from the distinct social, economic, and infrastructural contexts in these regions.

The higher population density and infrastructure complexity in urban areas require a more coordinated and multifaceted approach involving multiple government agencies such

as GDCD, the Ministry of Interior, the Ministry of Municipal and Rural Affairs, the Ministry of Agriculture, Environment and Water, the Ministry of Commerce, the Ministry of Industry, the Ministry of Electricity, the Ministry of Housing, and all military and security sectors. Resources such as emergency services, medical facilities, and technological infrastructure are more readily available in urban settings, allowing quicker and more efficient emergency planning and flash flood response. Urban communities are more diverse and transient, requiring tailored communication strategies to reach different demographic groups effectively.

In contrast, rural areas often have lower population densities and simpler infrastructure, but the vast geographical spread and limited accessibility pose unique challenges. Here, traditional community structures and local knowledge play a more significant role. In rural KSA, tribal leaders and elders hold considerable influence. They are vital in mobilizing community response, coordinating with authorities, and ensuring that traditional knowledge and practices are incorporated into emergency planning and flash flood response strategies. Rural areas may lack immediate access to essential emergency resources, necessitating reliance on local capacities. Rural communities tend to be more homogeneous and stable, with strong traditional leadership structures that can be leveraged for coordinated emergency planning and flash flood response efforts.

Emergency planning for flash floods in the KSA involves stakeholders whose roles and interactions vary significantly between urban and rural areas. While urban areas benefit from more sophisticated infrastructure and resource availability, rural areas rely heavily on localized knowledge. Recognizing and addressing these geographical, cultural, and educational differences among community members is vital for developing effective and inclusive emergency planning and flash flood response plans to the specific needs of each area. Thus, integrating community-based and dominant approaches in emergency planning

for responding to flash floods in the KSA is essential for creating effective and adaptable emergency planning and flash flood response strategies.

5.3.2.4 The Fourth Research Question: What Are the Perceived Challenges of Emergency Planning for Responding to Flash Floods?

The participants' responses showed that emergency planning for responding to flash floods in the KSA faces various difficulties, challenges, and deficiencies. The following were the most significant of these challenges: a) encroachment on the natural channels and pathways of flash floods; b) climate change issues; c) poor or incomplete infrastructure; d) lack of databases; e) lack of coordination and cooperation among stakeholders; f) failure to engage all stakeholders; g) lack of equipment, technical tools, and human resources; h) lack of training; i) delay in decision-making; j) lack of automation implementation; and k) lack of awareness among the local community. These results are consistent with results from the previous literature.

The participants mentioned that encroaching on the natural flash flood channels and pathways is an obstacle to emergency planning. Rahman et al. (2016) examined the vulnerability of flash flooding in Riyadh. A simulated flood was used in the study to calculate, map, and assess the physical vulnerability, social vulnerability, and total composite flash flood vulnerability indices. They found that the ability of channels to drain flash flood waters had been diminished as a result of buildings appearing in the valleys which encroach on flash flood pathways and lead to the loss of life and damage to properties.

The participants also stated that climate change issues might pose a challenge to emergency planning. Almazroui et al. (2017) revealed that although frequent and heavy rainfall is uncommon in the KSA, when it does occur it results in severe and devastating flash floods. The study found that the effects of climate change may limit emergency planning effectiveness for the flash flood response. The results indicated that more

precipitation is expected in the future due to climate change, which requires adopting a more practical approach to the flash flood response.

The participants also pointed out that barriers to emergency planning may come from inadequate or incomplete infrastructure. Momani and Fadil (2010) revealed that incomplete or insufficient infrastructure in Jeddah led to increased human and financial losses from flash floods. Thus, robust and complete infrastructure is essential for supporting emergency planning as it reduces the damage caused by flash floods.

The participants also raised concerns that the lack of a database may hinder emergency planning. According to Moy et al. (2019), the persistent absence of surface flooding data that is required for flood risk assessment and planning is a difficulty for cities seeking to adapt to this expanding flood risk. Additionally, Liu et al. (2012) found that a flood risk database could provide effective support in identifying, analysing, and assessing flood risks and could improve the efficiency of flood planning and response.

The participants also stated that failing to engage all stakeholders, as well as an absence of cooperation and coordination among them, may complicate emergency planning. Similar findings were made by Ledraa and Al-Ghamdi (2020), who found that Riyadh's flash flood risk management faces several obstacles, such as deficient institutional mechanisms to deal with flash floods, a lack of policies for managing flash flood risks, a lack of reliable hydrological data, and a lack of coordination and cooperation among government agencies and stakeholders at government levels. The study concluded that poor coordination and cooperation among these government agencies significantly hinder flash flood planning and response. Moreover, excluding participation from NGOs, local communities, and other stakeholders in emergency planning may make responding to flash floods more challenging. Local communities and NGOs are significantly closer to the

afflicted individuals, making them more trustworthy hence more reliable in emergency planning and flash flood response.

The shortage of supplies, such as a lack of technical tools, human resources, or equipment, was another issue brought up by the participants as something that may make emergency planning for flash flood response more complicated. The current study supports the finding by Momani and Fadil (2010) who revealed that due to a lack of fixed and mobile flash flood warning devices and systems, meteorological services in Jeddah were unable to quickly alert stakeholders and the population to the impending heavy rainfall and were hence unable to use the KSA's telecom system to send alerts to them. Furthermore, it took longer than planned to find all the missing people in Jeddah because the GDCD did not employ modern technology to help rescue them, and there was insufficient equipment to find them. This gap may have existed because GDCD did not have dedicated resources to collect and analyse data or assess Jeddah's vulnerability in the face of potential flash floods.

The participants also raised the issue of a lack of training that may hinder emergency planning for responding to flash floods. Rahman et al. (2016) found that issues of planning, mitigation, adaptation, and resilience to flash floods are significantly inadequate due to a lack of training and prior experience, as well as the lack of capacity of emergency agencies' preparedness and the lack of peoples' ability to respond to flash floods. Therefore, training and frequent simulation exercises on flash flood planning and response are required for both residents and government agencies to increase their city's preparedness for flash flood management. Therefore, enhanced emergency planning by continuous training would be critical in developing flash flood reduction and response strategies.

The participants also stated that a decision-making delay is a potential obstacle to emergency planning for responding to flash floods. In a recent study, Ledraa and Al-Ghamdi (2020) revealed that the GDCD is a military organisation and hence it makes decisions in a

top-down fashion that is both inflexible and overly centralised which hinders quick decision-making. Bottom-up decision-making, flexibility, and delegating authority to other stakeholders are all crucial before and during flash floods. It is not always possible for rescue workers and other stakeholders dealing with a flash flood to wait for decisions to be taken at a central level.

Regarding automation barriers, the participants mentioned that the absence of automation implementation might hinder emergency planning. In this context, Orach et al. (2013) found that the automated disaster emergency planning tool proved to be a reasonably rapid, simple, useful, participative, and affordable method for developing emergency operational plans. However, they revealed that implementing the automated disaster emergency planning tool might be restricted by district personnel's lack of computer skills and understanding of computer programmes in resource-constrained countries.

Finally, the participants pointed out that a lack of awareness among local community members might hamper emergency planning. The current study supports the finding by Ledraa and Al-Ghamdi (2020) that the absence of effort to raise local community awareness may be due to the fact that the GDCD focuses on flash flood response rather than preparedness. Furthermore, Momani and Fadil (2010) revealed that local community members should be educated on planning for a flash flood response and encouraged to participate when developing awareness programmes to reduce the risks associated with heavy rainfall and flooding.

5.4 Chapter Summary

This chapter has discussed the findings of the research, particularly the exploration of emergency planning that can improve the effectiveness of the response to flash floods in the KSA. In addition, the comprehensive discussion in this chapter has illustrated the contribution of each research question in achieving the research objectives.

The GDCD is the authority responsible for dealing with disaster management in the KSA and its responsibilities include legislation, regulations, coordination with various government institutions, and implementation. Being a military organisation, the GDCD adopts a top-down approach that is relatively rigid and too centralised regarding the decision-making process and emergency planning. This emergency planning approach does not appear ideal for some managerial activities involving flexibility, quality, coordination, and effectiveness, such as flash flood planning and response.

The current state of emergency planning is based on a clear and authoritative background and represents a roadmap for updating and improving emergency planning. Furthermore, it responds appropriately to flash floods, reducing human and economic losses. It is clear that emergency planning in the KSA began to improve and develop after the 2009 Jeddah flash flood. Furthermore, in order to improve emergency planning and management in the KSA, in 2011 the KSA's government set and issued the National Plan for Natural Disaster Risk Reduction, which focused on all types of natural disasters, especially flash floods.

The National Plan for Natural Disaster Risk Reduction was somewhat reasonable. It is well-written, valid, and practical and can be implemented because it achieves a beneficial response to flash floods. However, it is apparent that it needs updating and further development and improvement.

Although the information provided by the interviewees indicates that the emergency planning requirements are more or less in place, there is a need for further improvement and development. Specifically, there is a need for a better understanding of the emergency planning requirements for responding to a flash flood.

Furthermore, the study concluded that it is more appropriate to rebalance emergency planning to focus equally on both the community-based and the dominant approaches. It is

better to involve the local community and civil society organisations in planning the flash flood response because this will lead to more effective planning. However, the circumstances accompanying each emergency, the geographical nature of each city, and the cultural and educational differences between community members should be considered.

Emergency planning for responding to flash floods in the KSA faces various difficulties, challenges, and deficiencies. These weaknesses confirm the urgent need for improvement and development through constant education and training.

The following chapter presents the conclusions drawn from the study and provides recommendations by linking the study's objectives with the main research findings regarding emergency planning for responding to flash floods in the KSA.

Chapter Six: Conclusions and Recommendations

6.1 Introduction to Chapter

This thesis aimed to explore and assess emergency planning and its requirements and challenges, with a focus on flash flood response planning in the KSA, from the perspectives of expert officers at the GDCD. This chapter summarises the thesis. It consists of seven sections. The first section discusses the research objectives and reveals to what extent they were achieved and how they were achieved. The second section presents the main findings related to each objective. The third section shows the study's contributions to theory and practice. The fourth section outlines the research limitations and the key issues other researchers should consider while conducting studies in this field. The fifth section highlights the research recommendations. The sixth section suggests areas for future research, and finally, the last section presents a conclusion to this chapter.

6.2 Summary of the Research Aim and Objectives

The primary aim of this research was to explore and assess emergency planning in the KSA in order to develop an effective flash flood response. Consequently, the following objectives were designed and further investigated through a literature review and interviews with the participants:

- To explore the current approaches in emergency planning for responding to flash floods.
- To identify the current state of emergency planning for responding to flash floods.
- To verify and validate Saudi Civil Defence officers' perceptions of the emergency planning requirements for responding to flash floods.
- To explore the perceived challenges of emergency planning for responding to flash floods.

Previous flash flood disasters in the KSA and their effects have led to the researcher conducting this study, which revealed some issues where more explanations and analysis will be needed in the future. However, the investigation has helped accomplish the research aim and objectives within the research scope. Clear findings were derived from the data collected through the literature review and interviews, which were analysed through the content analysis technique. Therefore, the research aim and objectives have been achieved. The following section explores the main research findings.

6.3 Main Findings

The first objective of the study was “to explore the current approaches in emergency planning for responding to flash floods”. The study sought to examine current emergency planning approaches, with a particular emphasis on flash flood response planning in the KSA (Section 2.5).

A literature review showed that numerous descriptive and normative approaches had been developed as emergency planning evolved. Generally, two different viewpoints had been established over the last few decades: the “dominant” approach and the “community-based” approach. Emergency planning tended to be a unidirectional, information-driven process implemented “top-down” by practising specialists in emergency planning. This approach in emergency planning is called the dominant approach. However, the difficulties and shortcomings of this approach prompted planning thinkers to investigate other decision-making methods and encourage the participation of the local community. Due to this, the community-based approach was developed (Section 2.5.1).

The community-based approach is planning that is carried out through all stakeholders and typically stresses democratic and opinion values. There is a heavy dependency on widespread 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 and enhances cooperation and coordination between decision-makers and the impacted communities. However, it was found that although many influential community foundations widely acknowledge the community-based approach's importance, other members still underestimate the role of local communities (Section 2.5.2).

Moreover, despite advances towards a community-based approach for emergency planning, it was found that there are many limitations on what can be accomplished by identifying and analysing the risks and potential solutions at a community level. For instance, when identifying and analysing potential risks, communities may not focus adequately on those they have not yet encountered, such as threats associated with climate change. Additionally, when many organisations or individuals are engaged in the planning process, the time taken to make decisions increases as participants and stakeholders may lack the patience or time to negotiate with one another. Furthermore, participatory planning activities can encounter many obstacles due to minimal resources, and they can also be obstructed because of governmental or authority protocols, or because of participants not behaving correctly. Additionally, disagreements linked with different points of view can generate a potential for conflict between participants. Consequently, it can be concluded that a mixture of top-down and bottom-up approaches is the most effective method for emergency planning, with data mainly moving upwards and resources flowing downwards (Section 2.5.3).

The interview results revealed that the emergency planning approach used at the GDCD in the KSA is the dominant top-down approach. The participants attributed this to the military nature of the organisation. The GDCD is the authority responsible for dealing with disaster management in the KSA. Its responsibilities include legislation, regulations, coordination with various government institutions, and implementation. Accordingly, as a

military organisation, the GDCD adopts a top-down approach that is relatively rigid and too centralised regarding decision-making and emergency management. This emergency planning approach is unsuitable for flash flood response activities which need flexibility, quality attainment, swift coordination, and effectiveness (Section 4.4.1).

Consequently, this centralised top-down approach has constraints. Therefore, the GDCD needs to adopt a more decentralised bottom-up planning approach that conforms to local engagement, accountability, and quality assurance concepts and benchmarks. Hence, it was concluded that employing both top-down and bottom-up approaches in emergency planning for responding to flash floods at the GDCD in the KSA would be more appropriate (Section 5.3.2.1).

The second objective of the research was "to identify the current state of emergency planning for responding to flash floods". The main findings from the literature review showed that the KSA is exposed to many natural disasters, the most common of which were flash floods caused by intense, continuous rainfall. It was found that many cities in the KSA, such as Riyadh, Jeddah, Makkah, Yanbu, Jazan, 'Asir, and Al Madinah, are exposed to flash floods annually. These events cause numerous deaths, injuries, and property and infrastructure damage. These occurrences indicate that emergency agencies in the KSA are not yet adequately prepared regarding emergency planning and flash flood response (Section 2.10).

A case study of Jeddah's recent flash floods revealed an inefficiency in emergency planning. It also showed that not all stakeholders were involved in flash flood response planning, plus there was ineffective communication among emergency agencies and the local community, weak cooperation and coordination among all stakeholders, inadequate training, lack of experience and knowledge in flash flood risk management, and no central database or a way to manage all of the information (Section 2.11).

However, the main findings of the interviews showed that the participants were somewhat satisfied with the current state of emergency planning in the KSA. Nevertheless, it needs to be supported by modern technology; there needs to be more cooperation and coordination among the relevant agencies; there needs to be a better commitment to its implementation; and it needs to be constantly improved and developed (Section 4.4.2).

The third objective of the research was “to verify and validate Saudi Civil Defence officers’ perceptions of the emergency planning requirements for responding to flash floods”. The objective was broken down into three sub-objectives:

- Emergency planning requirements for responding to flash floods.
- The National Plan for Natural Disaster Risk Reduction.
- Rebalancing emergency planning with a focus on the community.

This objective was partially achieved in Chapter Two and then further explored in Chapter Four.

The emergency planning requirements that need to be met in order to achieve an effective flash flood response (Sections 2.6 and 4.4.3.1) are:

- Administrative requirements, including regulations and legislation.
- Technical requirements, including equipment.
- Human resources, including responders and stakeholders.
- Identifying, analysing, and evaluating flash flood risks.
- Determining the tasks and responsibilities of the relevant agencies.
- Qualified leadership and management.
- Determining the chain of command at national and local levels.
- Coordination and cooperation among stakeholders.
- Recruiting experts.

- Knowledge gained from international experiences.
- Updated database.
- Availability of sufficient financial resources.
- Completed infrastructure.
- Conducting studies on emergency planning and flash flood response.
- Improved training and practice.

An extensive search was carried out for disaster management plans focusing on flash floods in the KSA. As a result, **The National Plan for Natural Disaster Risk Reduction** was found. However, it focuses on all types of natural disasters, rather than just flash floods (Section 4.2.3).

The Plan aims to take proper action to preserve lives from all-natural disasters and protect public and private property in all Saudi cities by following the best methods and ensuring effective coordination between all of the authorities concerned with the implementation of the emergency plans so as to confront what may happen from the assumptions contained in the Plan with efficiency and competence.

In addition, the Plan notes the need for each of the relevant bodies to coordinate in conducting activities as efficiently as possible during emergency planning for responding to disasters. However, it does not mention how the parties could decide on an appropriate response. Moreover, all participants in emergency planning mentioned are government agencies, and the Plan did not involve the local community. Furthermore, although the Plan relies on legislation specific to flash floods and the GDCD regulation, it is a general plan which focuses on all types of natural disasters, as previously indicated. Therefore, it can be concluded that the GDCD does not have a flash flood-specific emergency response plan in place.

Despite this, the participants of the study stated that the National Plan for Natural Disasters Risk Reduction is somewhat well-written, reasonable, and practical, and can be implemented because it achieves a beneficial response to flash floods and reduces human and economic losses. However, most stated that it needs updating and further development and improvement. Therefore, the minimal information provided in the Plan is deemed insufficient for emergency planning for responding to flash floods, which requires more precise and specific instruction and information (Section 4.4.3.2).

Regarding **rebalancing emergency planning with a focus on the community**, a mixture of top-down and bottom-up approaches is the most effective method, with information mainly moving upwards and resources mainly flowing downwards (Section 2.5.3). The participants reported that it is more appropriate to rebalance emergency planning to focus on both approaches equally, which leads to the integration of information and experience, providing more reliable data and resources, and presenting a broader vision of the lessons learned from past experiences (Section 4.4.3.3).

The fourth objective of the research was “to explore the perceived challenges of emergency planning for responding to flash floods”. The literature review (Section 2.7) and interview results (Section 4.4.4) revealed **challenges and deficiencies** in emergency planning to flash flood response in the KSA, such as:

- Encroachment on the channels and pathways of flash floods.
- Climate change issues.
- Poor or incomplete infrastructure.
- Lack of an updated database.
- Lack of coordination and cooperation among stakeholders.
- Failure to involve stakeholders.
- Lack of equipment, technical tools, and human resources.

- Lack of training.
- Delay in decision-making.
- Lack of experts and specialists.
- Lack of automation implementation.
- Lack of awareness among community individuals on flash flood risks.

The following section summarises the contribution of this thesis to theory and practice.

6.4 Contribution to Theory and Practice

Despite the research limitations, this thesis endeavours to make a significant contribution to theory and practice in the field of emergency planning for responding to flash floods. The following sub-sections explain this contribution.

6.4.1 Contribution to Theory

This study linked literature from two main fields: emergency planning and its approaches, requirements, and challenges (Sections 2.4, 2.5, 2.6, and 2.7), and flash floods, including flash flood risk management, flash floods in the KSA in general, and a case study of Jeddah's flash floods in particular (Sections 2.8, 2.9, 2.10, and 2.11). In addition, the GDCD and the National Plan for Natural Disasters Risk Reduction were also used as case studies (Sections 4.2 and 4.2.3). By examining these research issues, this study presented a better understanding of emergency planning for responding to flash floods. How this study contributes to the theory in these fields is explained in more depth below.

This study has contributed to the theory by reviewing the emergency planning approaches. The development of the emergency planning approaches was accomplished by reviewing the available literature about (i) the dominant approach, (ii) the community-based approach, and (iii) the combination of these two approaches (Section 2.5). Data was then collected through interviews and combined with the literature review findings. This

development led to building a theory based on emergency planning in relation to the aforementioned approaches (Sections 4.4.1 and 4.4.2).

This study has also contributed to knowledge on the topic by exploring emergency planning requirements for responding to flash floods in the KSA, examining and assessing the National Plan for Natural Disasters Risk Reduction, determining the most appropriate approach to emergency planning in the KSA, and the perceived challenges and deficiencies (Sections 4.4.3 and 4.4.4). Thus, the outcomes of this study contribute to knowledge by improving and developing a better understanding of emergency planning, and flash flood response planning in particular.

Additionally, this research will be an added value to the theory of emergency planning and flash flood response planning for all emergency agencies and countries that deal with such issues. Although these findings focus on emergency planning for responding to flash floods, especially in the KSA, it makes a contribution to a theory that may be applicable in an international context.

6.4.2 Contribution to Practice

The contributions of this study to practice are evident from the findings presented in Chapter Four and the discussion provided in Chapter Five. This study has established that emergency planning is required for dealing effectively with a flash flood response. In addition, the study clarified the emergency planning requirements needed to achieve an effective flash flood response in the KSA as well as countries or emergency agencies with similar emergency planning approaches. Furthermore, the emergency planning requirements in this study guide emergency agencies and local communities in the KSA on how and what they need to develop effective emergency plans for responding to future flash floods.

However, it is worth noting that the discussion in Chapter Five showed that emergency planning should be developed carefully and should consider regulations and legislation for each country. They should also consider the roles and responsibilities of each emergency agency when responding to flash floods. It is also evident that emergency planning should take into consideration the challenges experienced during previous flash floods so that capacity can be developed for controlling or dealing with these challenges. According to this understanding, emergency planning developed, explained, and assessed in this study will be best set to contribute to the practice of emergency planning in the KSA, especially flash flood response planning.

Finally, the contributions made to theory and practice are critical for advancing this aspect of emergency planning and flash flood response, especially in the KSA where there is a need to improve emergency planning due to the frequent occurrence of flash floods. Accordingly, the contributions mentioned above demonstrate the originality of this study, support the rationale for conducting it, and provide motivation for developing this field of study.

6.5 Research Limitations

Although this study achieved all of its objectives, there were still limitations that the researcher had to manage. The first limitation was that the GDCD officers who participated in the interviews were all officers of a military nature, which meant that the researcher had limited access to certain data and information that was considered confidential that could have been useful to the study. However, the researcher addressed this by evaluating case studies of past flash floods and reviewing existing literature in the field.

The second limitation was that there were only 13 participants in the study, which could have limited the ability of the researcher to generate objective findings. Furthermore, due to the sensitivity of the research topic and the participants' military nature, some of the

participants could have refused to answer specific questions. However, this limitation was managed through the researcher's persistence and insistence on achieving the research objectives, which ensured that the study was comprehensively conducted so that the content could be used for future research in this field.

The third limitation relates to the participant's perceptions of the research questions being asked, as it is common for some participants to be biased in their answers, and they could respond to questions deceptively (Zikmund et al., 2013). Similarly, assimilation bias can occur when participants use their understanding of the topic and interpret it to reaffirm their personal views, which could lead to incorrect conclusions being made (O'Sullivan & Emmelhainz, 2014). Lastly, the researcher is also an officer of the GDCD, which could have resulted in a biased conclusion.

However, the process adopted in the literature review and the rigorous data collection and analysis methodology used made it impossible to be biased. Also, the researcher's extensive liaising with his supervisors and other experienced researchers and experts in this field has been crucial in managing these research limitations and retaining focus on how best to achieve the research aim and objectives.

6.6 Research Recommendations

This section provides recommendations drawn from the research findings. They focus on how emergency planning and flash flood response can be improved and developed in the KSA. Therefore, the following recommendations should be carefully taken into consideration.

Recommendation one: The study's results revealed that the emergency planning approach currently used in the KSA is the dominant top-down approach due to the Saudi Civil Defence's military nature. However, the results showed that this approach lacks

efficiency and effectiveness. Therefore, it is recommended that the GDCD rebalances its emergency planning so that it focuses as much on achieving the community-based bottom-up approach as it does on the dominant top-down approach. Combining these two approaches would provide better resources, more reliable information, and a broader view of past experiences and lessons learned regarding emergency planning and flash floods and their risks. However, the circumstances accompanying each emergency, the geographical nature of each city, and the cultural and educational differences between community members should be taken into consideration.

Recommendation two: It is strongly recommended that all emergency planning requirements developed from this study should be implemented simultaneously and as an integrated whole. The current emergency planning requirements in the KSA appear insufficient for responding to flash floods. The evaluation of the Jeddah flash floods case study and the perceptions of the expert officers from the GDCD demonstrated that the current emergency planning requirements need to be improved and strengthened. Additionally, this recommendation is important because the best approach for responding to flash floods needs to be established based on previous actions for effective emergency planning, which is not observable in the current requirements.

Recommendation three: It is recommended that all parts of the National Plan for Natural Disaster Risk Reduction are annually reviewed and evaluated, then developed and improved in light of the lessons learned from past flash flood events. Furthermore, it was found that there was not a National Plan which focused on responding to flash floods in particular. Therefore, it is recommended that a National Flash Flood Risk Reduction Plan should be created and developed in the KSA.

Recommendation four: It is recommended that the current challenges and deficiencies related to emergency planning and its requirements are managed through

cooperation among stakeholders and the use of all available resources that push towards the success of the GDCD in effectively responding to flash floods.

Recommendation five: The results of the interviews conducted with the expert officers from the GDCD revealed that in emergency planning for responding to flash floods in the KSA, the stakeholders need more commitment. Therefore, it is recommended that emergency planning includes clear and well-defined objectives which are agreed upon by all stakeholders to achieve an effective flash flood response.

Recommendation six: The results demonstrated a weakness in managing the current database related to the KSA's emergency planning procedures and flash flood risks. Therefore, it is recommended that an updated database is developed, which is vital in enabling the exchange of information among all stakeholders, leading to the right decision.

Recommendation seven: Without the vulnerable community's engagement, emergency planning and flash flood response will be ineffective. The results revealed that the local community was not involved in emergency planning. Therefore, it is strongly recommended that local community individuals participate in emergency planning since they have knowledge and information that may help to improve and support emergency planning.

Recommendation eight: The interview results revealed a lack of coordination and collaboration among relevant stakeholders. Effective coordination and collaboration are vital in successful emergency planning and flash flood response. Accordingly, in order for the GDCD to achieve its role efficiently, it should proactively collaborate and coordinate with the relevant stakeholders.

6.7 Suggestions for Future Research

The suggestions highlighted in this section present ideas for fields of future research. Firstly, this study focused on assessing the emergency planning for responding to flash floods,

using case studies of Jeddah's recent flash floods and the GDCD at the KSA. Hence, the researcher encourages conducting research exploring emergency planning for other phases, such as mitigation, preparedness, or recovery.

Secondly, the relationships, interactions, and contributions in emergency planning between government emergency agencies and the local community could also be investigated. It would be interesting to compare the perceptions of government emergency agencies and the local community regarding emergency planning.

Thirdly, this study was based on a case study of Jeddah's recent flash floods. Therefore, conducting a similar study in another city in the KSA or another country would be an interesting topic.

Fourthly, this study evaluated emergency planning through the perceptions of expert officers in the GDCD. Therefore, examining the perceptions of other government emergency agencies is also a worthy topic.

Lastly, this research adopted a qualitative methodology for developing the emergency planning requirements for responding to flash floods. Thus, conducting studies using other approaches, particularly quantitative or mixed methods, would be valuable.

6.8 Research Conclusion

This study sought to verify GDCD officers' perceptions towards emergency planning for responding to flash floods in the KSA. Although the scope of this research was limited, the data collected and analysed and the results that emerged were consistent with previous literature.

The data analysis results were consistent with the research aims, objectives, and questions, and they offered comprehensive data on the participants' perceptions of emergency planning for responding to flash floods. The results revealed that the emergency

planning approach currently used in the KSA is the dominant top-down approach. From the perspective of the expert officers at the GDCD, the dominant approach has proven somewhat effective and efficient in reducing flash flood risks. However, the participants' perceptions showed that it would be more appropriate to rebalance emergency planning so that it focuses as much on employing the community-based bottom-up approach as it does on the dominant top-down approach.

The analysis of the participants' perceptions demonstrated that the emergency planning requirements for responding to flash floods include: administrative requirements, such as regulations and legislation; technical requirements, such as equipment; human resources, such as responders and stakeholders; identifying, analysing, and evaluating the flash flood risks; coordination and cooperation among stakeholders; recruiting experts; knowledge gained from international experiences; updated databases; and availability of sufficient financial resources. The participants' perceptions also revealed that the National Plan for Natural Disaster Risk Reduction needs improvement and development.

The analysis of the participants' perceptions identified the challenges and deficiencies of emergency planning for responding to flash floods in the KSA. This included: encroachment on the channels and pathways of flash floods; climate change issues; poor or incomplete infrastructure; lack of updated databases; failure to involve all stakeholders; lack of equipment, technical tools, or human resources; lack of training; delay in decision-making; and lack of experts and specialists. These perceptions are consistent with the findings of previous studies in this field that employed a similar methodology.

Finally, the participants were experts in the field of emergency planning and flash flood response in the KSA. All of them had educational qualifications related to the research topic. In addition, all of them were top officers in the GDCD who had extensive experience in emergency planning and flash flood response and had access to high-level data. This

shared culture or experience affects their perceptions of the current state of emergency planning for responding to flash floods in the KSA, and thus their perceptions have a high value. Therefore, the results of this study could help decision-makers and emergency planners at government emergency agencies to improve, develop, and reinforce emergency planning, specifically concerning reducing flash flood risks.

References

Abbas, A., Amjath-Babu, T. S., Kächele, H., Usman, M., & Müller, K. (2016). An overview of flood mitigation strategy and research support in South Asia: implications for sustainable flood risk management. *International Journal of Sustainable Development & World Ecology*. 23 (1), 98-111.

Abdalla, R. (2018). Urbanization and Crisis Management Using Geomatics Technologies. *Crisis Management-Theory and Practice*. Available from: doi:10.5772/intechopen.76415.

Abdelkhalek, A. (2011). *Development of an early warning system for flash floods in wadi Watir–Sinai desert*. Doctoral Thesis, Universiteit Brussel, Belgium.

Abosuliman, S., Kumar, A. & Alam, F. (2013). Disaster preparedness and management in Saudi Arabia: an empirical investigation. *International Journal of Social, Human Science and Engineering*. 7 (12), 295- 299.

Abosuliman, S., Kumar, A. & Alam, F. (2014). Flood disaster planning and management in Jeddah, Saudi Arabia - a survey. *Proceedings of the 2014 International Conference on Industrial Engineering and Operations Management*, 7-9 January 2014, Bali, Indonesia. pp. 2380-2387.

Acharya, A., & Prakash, A. (2019). When the river talks to its people: Local knowledge-based flood forecasting in Gandak River basin, India. *Environmental Development*, *31*, 55-67.

Al-Amin, A. Q., Nagy, G. J., Masud, M. M., Leal Filho, W., & Doberstein, B. (2019). Evaluating the impacts of climate disasters and the integration of adaptive flood risk management. *International journal of disaster risk reduction*. 39, 101241.

Alamri, Y. A. (2010). *Emergency management in Saudi Arabia: Past, present and future*. Un. Of Christchurch report. New Zealand. Report number: 21.

Al-Bassam, A. M., Zaidi, F. K. & Hussein, M. T. (2014). Natural hazards in Saudi Arabia. In *Extreme natural events, disaster risks and societal implications*. Cambridge Univ. Press, Cambridge, pp. 243-251. Available from: doi:10.1017/CBO9781139523905.024

Al Blooshi, I.A. et al. (2023). IT Governance and Control: Mitigation and Disaster Preparedness of Organizations in the UAE. In: Alshurideh, M., Al Kurdi , B.H., Masa'deh, R., Alzoubi , H.M., Salloum, S. (eds) The Effect of Information Technology on Business and Marketing Intelligence Systems. Studies in Computational Intelligence, vol 1056. *Springer*, Cham. https://doi.org/10.1007/978-3-031-12382-5_35

Alexander, D. E. (2002). *Principles of Emergency Planning and Management*. Oxford University, Press on Demand.

Alexander, D. (2005). Towards the development of a standard in emergency planning. *Disaster Prevention and Management: An International Journal*. 14 (2), 158-175.

Alexander, D. E. (2016). Book Abstract: How to Write an Emergency Plan by David Alexander. Reproduced by Permission. *Health in Emergencies and Disasters*. 1 (4), 215-224.

Alexander, D. E. (2017). *How to write an emergency plan*. Dunedin Academic Press Ltd.

Alharbi, M. (2013). The Cause of Flood Disaster in Saudi Arabia. *In Proceedings of the First Saudi International Conference on Crisis and Disaster Management,* September 2013, Riyadh, KSA.

Ali, A.B. & Ameur, F. (2018). An Assessment of Jeddah's Hydraulic Protection and Management Systems of Flood. *Open Access Library Journal*. 5 (02), 1-16. Available from: doi:10.4236/oalib.1104288.

Alkhalaf, A.K. & Basset, H.A. (2013). Diagnostic study of a severe thunderstorm over Jeddah. *Atmospheric and Climate Sciences.* 3, 150-164.

Al Kurdi, O.F. (2021). A critical comparative review of emergency and disaster management in the Arab world. *Journal of Business and Socio-economic Development,* 1 (1), 24-46. https://doi.org/10.1108/JBSED-02-2021-0021

Almazroui, M. (2011). Sensitivity of a regional climate model on the simulation of high intensity rainfall events over the Arabian Peninsula and around Jeddah (Saudi Arabia). *Theoretical and applied climatology*. 104 (1), 261-276.

Almazroui, M. (2013). Simulation of present and future climate of Saudi Arabia using a regional climate model (PRECIS). *International journal of climatology*. *33* (9), 2247-2259.

Almazroui, M., Islam, M. N., Balkhair, K. S., Şen, Z., & Masood, A. (2017). Rainwater harvesting possibility under climate change: A basin-scale case study over western province of Saudi Arabia. *Atmospheric research*. 189, 11-23.

Alpert, P., Ben-Gai, T., Baharad, A., Benjamini, Y., Yekutieli, D., Colacino, M., & Manes, A. (2002). The paradoxical increase of Mediterranean extreme daily rainfall in spite of decrease in total values. *Geophysical research letters*, 29 (11), 31-1.

Alpert, P., Osetinsky, I., Ziv, B., & Shafir, H. (2004). Semi-objective classification for daily synoptic systems: Application to the eastern Mediterranean climate change. *International Journal of Climatology: A Journal of the Royal Meteorological Society*. 24 (8), 1001-1011.

AlQahtany, A.M. and Abubakar, I.R. (2020). Public perception and attitudes to disaster risks in a coastal metropolis of Saudi Arabia. *International journal of disaster risk reduction*. 44,101422.

Al Saud, M. M. (2015). *Flood control management for the city and surroundings of Jeddah, Saudi Arabia*. Springer.

Alshamsi, H. R. (2017). *Managing Major Emergencies: Recommendations to develop effective contingency planning in the United Arab Emirates* Doctoral Thesis, University of Salford, United Kingdom.

Al-Wathinani AM, Barten DG, Borowska-Stefańska M, Gołda P, AlDulijan NA, Alhallaf MA, Samarkandi LO, Almuhaidly AS, Goniewicz M, Samarkandi WO, et al. (2023). Driving Sustainable Disaster Risk Reduction: A Rapid Review of the Policies and Strategies in Saudi Arabia. *Sustainability*. 15 (14), 10976. https://doi.org/10.3390/su151410976

Alyami, A., Dulong, C. L., Younis, M. Z., & Mansoor, S. (2020). Disaster preparedness in the kingdom of Saudi Arabia: exploring and evaluating the policy, legislative organisational arrangements particularly during the hajj period. *European Journal of Environment and Public Health*. 5 (1), em0053.

Amaratunga, D., Baldry, D., Sarshar, M., & Newton, R. (2002). Quantitative and qualitative research in the build environment: application of "mixed research approach". *Work Study*. 17-31.

Ambruster, A. (2008). *Collaborative versus technocratic policymaking: California's Statewide Water Plan.* California State University, Sacramento, Center for Collaborative Policy.

Ameur, F. (2016). Floods in Jeddah, Saudi Arabia: Unusual Phenomenon and Huge Losses. What prognoses. In: *E3S Web of Conferences*. EDP Sciences. 7(1), 4-19.

AMS, (2017). *Flash flood*. American Meteorological Society (AMS), Glossary of Meteorology.

Andrew Wells, Brandon Klenzendorf, & Garrett Myler. (2021). A Strategic Approach to Flood Risk Management. *Journal of Critical Infrastructure Policy*. 2 (1), 97-121. doi:10.18278/jcip.2.1.8

Andrews, T. (2012). What is social constructionism?. *Grounded theory review*. 11 (1).

Ashoor, A. and Eladawy, A. (2024). Watch and upgrade or deconstruct and relocate: derna catastrophe lessons amid the climate-change era of unpredictable flash floods. https://doi.org/10.21203/rs.3.rs-3858769/v1

Atanga, R. A. (2020). The role of local community leaders in flood disaster risk management strategy making in Accra. *International journal of disaster risk reduction*. 43, 101358.

Azeez, O., Elfeki, A., Kami's, A.S. & Chaabani, A. (2020). Dam Break Analysis and Flood Disaster Simulation in Arid Urban Environment: The Um Al-Khair Dam Case Study, Jeddah, Saudi Arabia. *Natural Hazards*. 100 (3), 995-1011.

Azzam, A. & Ali, A.B. (2019). Urban Sprawl in Wadi Goss Watershed (Jeddah City/Western Saudi Arabia) and its Impact on Vulnerability and Flood Hazards. *Journal of Geographic Information System*. 11 (03), 371-388.

Barakat, R., El Morshedy, H., & Farghaly, A. (2014). Human schistosomiasis in the Middle East and North Africa region. In *Neglected Tropical Diseases-Middle East and North Africa*. Springer, Vienna, 23-57.

Barriendos, M., Ruiz-Bellet, J. L., Tuset, J., Mazón, J., Balasch, J. C., Pino, D., & Ayala, J. L. (2014). The" Prediflood" database of historical floods in Catalonia (NE Iberian Peninsula) AD 1035–2013, and its potential applications in flood analysis. *Hydrology and Earth system sciences*. 18 (12), 4807-4823.

Bashawri, A. M. A. (2019). *An Emergency Relief Shelter Response Framework for Flash Floods in Saudi Arabia*. Doctoral Thesis, University of Leeds, United Kingdom.

Becker, S., Bryman, A. & Ferguson, H. (eds.). (2012). *Understanding research for social policy and social work*: themes, methods and approaches. policy press.

Bin Ottai, N.H. (2017). *Capacity Assessment Framework to Enhance Disaster Resilience within Kingdom of Saudi Arabia*. Doctoral Thesis, University of Salford, United Kingdom.

Bowling, A. (2014). *Research Methods in Health: Investigating Health and Health Services.* UK, McGraw-Hill Education.

Box, P., Thomalla, F., & Van den Honert, R. (2013). Flood risk in Australia: Whose responsibility is it, anyway?. *Water*. 5 (4), 1580-1597.

Brody, S. D. (2003a). Implementing the principles of ecosystem management through local land use planning. *Population and Environment.* 24 (6), 511-540.

Brody, S. D. (2003b). Measuring the effects of stakeholder participation on the quality of local plans based on the principles of collaborative ecosystem management. *Journal of Planning Education and Research*. 22 (4), 407-419.

Brown, B. & Baker, S. (2007). *Philosophies of Research into Higher Education*. Bloomsbury Publishing.

Bryman, A. (2016). *Social Research Methods. 5th Edition*. Oxford university press.

Buckle, P., Marsh, G. L. & Smale, S. (2003) Reframing Risk, Hazards, Disasters, and Daily Life: A report of Research into Local Appreciation of Risks and Threats. *Australian Journal of Emergency Management*. 18 (2), 81-87.

Burby, R. J. (2003). Making Plans that Matter - Citizen Involvement and Government Action. *Journal of the American Planning Association*. 69 (1), 33-49.

Burchett, H., Umoquit, M., & Dobrow, M. (2011). How do we know when research from one setting can be useful in another? A review of external validity, applicability and transferability frameworks. *Journal of health services research & policy*. 16 (4), 238-244.

Burt, T.; Boardman, J.; Foster, I.; Howden, N. (2016). More rain, less soil: Long-term changes in rainfall intensity with climate change. *Earth Surf. Process. Landf.* 41, 563–566.

CAO, Vu Quynh Anh and Nakamura, Shinichiro and Otsuyama, Kensuke and Namba, Miki and Yoshimura, Kei. (2024). Current Status and Challenges in Operating Flood

Early Warning Systems at the Local Level in Japan. Available at SSRN: https://ssrn.com/abstract=4788834 or http://dx.doi.org/10.2139/ssrn.4788834

Centre for Research on the Epidemiology of Disasters (CRED). (2014). *Annual Disaster Statistical Review 2014: The numbers and trends*. Belgium.

Centre for Research on the Epidemiology of Disasters (CRED). (2021). *EM-DAT Database*. Available from: https://www.emdat.be/database [Accessed 6 May 2021].

Chan, N. W., Tan, M. L., Ghani, A. A., & Zakaria, N. A. (2019, April). Sustainable urban drainage as a viable measure of coping with heat and floods due to climate change. In *IOP Conference Series: Earth and Environmental Science* (Vol. 257, No. 1, p. 012013). IOP Publishing.

Chen, Z.-M., Yeh, Y.-L. & Chen, T.-C. (2018). Assessment of a Regional Flood Disaster Indicator via an Entropy Weighting Method. *Natural Hazards Review*. 19 (2), 05018002.

Climate knowledge portal. Worldbank org (2024). country/saudi-arabia/climate-data-historical. https://climateknowledgeportal.worldbank.org/country/saudi-arabia/climate-data-historical

Coghlan, D., & Brannick, T. (2014). Understanding action research. *Doing action research in your own organization*. 43-62.

Collis, J. & Hussey, R. (2013). *Business Research: A Practical Guide for Undergraduate and Postgraduate Students.* 4th edition. London, Macmillan Press.

Cope, D. (2014). Methods and meaning: credibility and trustworthiness in qualitative research. *Oncology Nursing Forum*. Vol 41, Number 1, Jan 2014. DOI: 10.1188/14.ONF.89-91.

Crespo, R. D. J., Wu, J., Myer, M., Yee, S., & Fulford, R. (2019). Flood protection ecosystem services in the coast of Puerto Rico: Associations between extreme weather,

flood hazard mitigation and gastrointestinal illness. *Science of the total environment*. 676, 343-355.

Creswell, J.W. (2013). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches.* Thousand Oaks, CA. Sage Publications.

Crotty, M. (1998). *The foundations of social research: Meaning and perspective in the research process*. Sage.

Davidoff, P. & Reiner, T. A. (1962). A choice theory of planning. *Journal of the American Institute of Planners*. 28 (2), 103-115.

Davies, D., & Dodd, J. (2002). Qualitative research and the question of rigor. *Qualitative health research*. 12 (2), 279-289.

Davis, R. S. (2001). Flash flood forecast and detection methods. In *Severe convective storms*. American Meteorological Society, Boston, MA. 28 (50), 481-525.

Denscombe, M. (2017). *EBOOK: The good research guide: For small-scale social research projects*. McGraw-Hill Education. UK.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2011). *The Sage handbook of qualitative research*. sage.

Dietz, T., & Stern, P. C. (2008). *Public participation in environmental assessment and decision making*. Washington DC, The National Academies Press.

Dynes, R.R. (2003). Noah and Disaster Planning: The Cultural Significance of the Flood Story. *Journal of Contingencies and Crisis Management*. 11 (4), 170-177.

Easterby-Smith, M., Thorpe, R. & Jackson, P. R. (2012). *Management Research: An Introduction.* London, Sage Publication Ltd.

El-Rawy, M.; Fathi, H.; Zijl, W.; Alshehri, F.; Almadani, S.; Zaidi, F.K.; Aldawsri, M.; Gabr, M.E. (2023). Potential Effects of Climate Change on Agricultural Water Resources in Riyadh Region, Saudi Arabia. *Sustainability*. 15, 9513.

Elkhrachy, I. (2015). Flash flood hazard mapping using satellite images and GIS tools: a case study of Najran City, Kingdom of Saudi Arabia (KSA). *The Egyptian Journal of Remote Sensing and Space Science*. 18 (2), 261-278.

Fan J, Huang G. (2020). Evaluation of Flood Risk Management in Japan through a Recent Case. *Sustainability*. 12 (13), 5357. https://doi.org/10.3390/su12135357

Fearn-Banks, K. (2016). *Crisis Communications: A Casebook Approach.* Routledge.

Fellows, R. F., & Liu, A. M. (2021). *Research methods for construction*. John Wiley & Sons.

Fischer, F. (2003). Risk assessment and environmental crisis: Toward an integration of science and participation. *Readings in Planning Theory*. Malden, Blackwell.

Fleming, G. (2002). Learning to live with rivers—the ICE's report to government. *Proceedings of the Institution of Civil Engineers-Civil Engineering*, May 2002, Thomas Telford Ltd. 150 (5), pp. 15-21.

Flyvbjerg, B. (1998). *Rationality and power: Democracy in practice*. Chicago, University of Chicago Press.

Fordham, M. (1999). Participatory Planning for Flood Mitigation: Models and Approaches. *Australian Journal of Emergency Management*. 13 (4), 27-34.

Friedmann, J. (2020). *Planning in the public domain: From knowledge to action*. Princeton, NJ: Princeton University Press.

Gaitan, S., Calderoni, L., Palmieri, P., Ten Veldhuis, M. C., Maio, D., & Van Riemsdijk, M. B. (2014). From sensing to action: Quick and reliable access to information in cities vulnerable to heavy rain. *IEEE Sensors Journal*. 14 (12), 4175-4184.

General Directorate of Civil Defence (GDCD). (2020a). *National Plan for Natural Disaster Risk Reduction*. Available from: https://www.998.gov.sa/Ar/CivilDefence [Accessed 23 October 2020].

General Directorate of Civil Defence (GDCD). (2020b). *Civil Defence Legislation and Its Regulations.* Available from:

https://www.998.gov.sa/Ar/CivilDefenceLists/Pages/default.aspx [Accessed 19 November 2020].

General Directorate of Civil Defence (GDCD). (2023). *Official Statistic*. Ministry of Interior, Saudi Arabia.

Ghauri, P., Grønhaug, K., & Strange, R. (2020). *Research methods in business studies*. Cambridge University Press.

Giddens, A. (2013). *Politics, Sociology and Social Theory: Encounters with Classical and Contemporary Social Thought*. New York, John Wiley & Sons.

Gill, J. & Johnson, P. (2010). *Research Methods for Managers*. 4th edition. London, Sage Publications Ltd.

Gliner, J. A., Morgan, G. A. & Leech, N. L. (2016). *Research methods in applied settings: An integrated approach to design and analysis*. London, Routledge.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The qualitative report*. 8 (4), 597-607.

Gourley, J.J., Hong, Y., Flamig, Z.L., Arthur, A., Clark, R., Calianno, M. & Clark, E. (2013). A Unified Flash Flood Database Across the United States. *Bulletin of the American Meteorological Society*. 94 (6), 799-805.

Gray, D.E. (2017). *Doing Research in the Real World*. 3rd edition. London, Sage Publications Ltd.

Guion, L.A., Diehl, D.C. & McDonald, D. (2011). Triangulation: establishing the validity of qualitative studies: FCS6014/FY394, Rev. 8/2011. *Edis*, (8), 3-3.

Gulf, News. (November 17, 2015). *Flash floods turn deadly in Jeddah*. Available from: URL:https//:gulfnews.com/world/gulf/saudi/flashfloods- turn-deadly-in-jeddah-1.1621189 [Accessed 11 April 2021].

Haggag, M. & El-Badry H. (2013). Mesoscale numerical study of quasi-stationary convective system over Jeddah in November 2009. *Atmospheric and Climate Sciences*. 3 (1), 73-86.

Handmer, J.W. (2000). Flood Hazard and Sustainable Development. *Floods*. 2, 276-286.

Hartmann, T., & Spit, T. (2016). Legitimizing differentiated flood protection levels–Consequences of the European flood risk management plan. *Environmental Science & Policy*, *55*, 361-367.

Hildebrand, L. P. (2009). *Power sharing in the coastal zone: Shifting roles of government in community-based coastal management.* Doctoral Thesis, Cardiff University, United Kingdom.

Hilgert, S., Wagner, A., and Fuchs, S. (2015). Future changes in flash flood frequency and intensity of the Tha Di River (Thailand) based on rainfall–runoff modeling and advanced delta change scaling. *Hydrol Earth Syst Sci.* 12, 7327–7352.

Hoard, M., Homer, J., Manley, W., Furbee, P., Haque, A. & Helmkamp, J. (2005). Systems modeling in support of evidence-based disaster planning for rural areas. *International Journal of Hygiene and Environmental Health.* 208 (1-2), 117-225.

Hoegh-Guldberg, O.; Jacob, D.; Taylor, M.; Bolaños, T.G.; Bindi, M.; Brown, S.; Camilloni, I.A.; Diedhiou, A.; Djalante, R.; Ebi, K.; et al.(2019). The human imperative of stabilizing global climate change at 1.5 °C. *Science*. 365, eaaw6974.

Hossain, M. K., & Meng, Q. (2020). A fine-scale spatial analytics of the assessment and mapping of buildings and population at different risk levels of urban flood. *Land use policy*. 99, 104829.

Hussain Shah SM, Yassin MA, Abba SI, Lawal DU, Hussein Al-Qadami EH, Teo FY, Mustaffa Z, Aljundi IH. (2023). Flood Risk and Vulnerability from a Changing Climate Perspective: An Overview Focusing on Flash Floods and Associated Hazards in Jeddah. *Water*.15 (20), 3641. https://doi.org/10.3390/w15203641

Innes, J. E. (1996). Planning through consensus building. *Journal of the American Planning Association.* 62 (4), 460-452.

Innes, J. E. (1998). Information in communicative planning. *Journal of the American Planning Association.* 64 (1), 52-63.

Innes, J. E. (2004). Consensus building: Clarifications for the critics. *Planning Theory.* 3 (1), 5-20.

Iqbal, M. S., Dahri, Z. H., Querner, E. P., Khan, A., & Hofstra, N. (2018). Impact of climate change on flood frequency and intensity in the kabul river basin. *Geosciences* (Basel), 8 (4), 114-. https://doi.org/10.3390/geosciences8040114

Jackson, K., & Bazeley, P. (2019). *Qualitative data analysis with NVivo*. Sage.

Jain, N.K. (2000). Floods in a South Asian Context: Critical Reflections on the International Decade and Local Community Participation in Flood Disaster Reduction. *Floods*. 2, 255-259.

Janssen DNG, Ramos EP, Linderhof V, Polman N, Laspidou C, Fokkinga D, de Mesquita e Sousa D. (2020). The Climate, Land, Energy, Water and Food Nexus Challenge in a Land Scarce Country: Innovations in the Netherlands. *Sustainability*. 12 (24), 10491. https://doi.org/10.3390/su122410491

Jha, A. K., Bloch, R., & Lamond, J. (2012). *Cities and flooding: a guide to integrated urban flood risk management for the 21st century*. World Bank Publications.

Jódar-Abellán, A., Valdes-Abellan, J., Pla, C. & Gomariz-Castillo, F. (2019). Impact of Land Use Changes on Flash Flood Prediction Using a Sub-Daily SWAT Model in Five Mediterranean Ungauged Watersheds. *Science of The Total Environment*. 657, 1578-1591.

Jones, J.A.A. (2000). Human modification of flood-producing processes: the evidence from catchment studies. *Floods.* 2, 113-129.

Kagioglou, M., Cooper, R.F.D., Aouad, G. & Sexton, M. (2000). Rethinking Construction: The Generic Guide to the Design and Construction Process Protocol. *Engineering Construction and Architectural Management*. 7 (2), 141-153.

Kalof, L., & Dan, A. (2008). *EBOOK: Essentials of Social Research*. McGraw-Hill Education .UK.

Ketokivi, M., & Mantere, S. (2010). Two strategies for inductive reasoning in organizational research. *Academy of management review*. *35* (2), 315-333.

Khan, K. S., Ter Riet, G., Glanville, J., Sowden, A. J. & Kleijnen, J. (2001). *Undertaking systematic reviews of research on effectiveness: CRD's guidance for carrying out or commissioning reviews*. 4 (2). *NHS Centre for Reviews and Dissemination.* University of York.

Kiernan, M. J. (1983). Ideology, politics, and planning: Reflections on the theory and practice of planning. *Environment and Planning B: Planning and Design*. 10 (1), 71-87.

King, A. L. (2012). *The Influence of Risk Perception on Pharmaceutical Surge Capacity*. Doctoral dissertation, Walden University.

Klijn, F. (2009). Flood risk assessment and flood risk management; an introduction and guidance based on experiences and findings of FLOODsite. *an EU-funded integrated project*. T29-09-01.

Koontz, T. M., & Johnson, E. M. (2004). One size does not fit all: Matching breadth of stakeholder participation to watershed group accomplishments. *Policy Sciences.* 37 (2), 185-204.

Korstjens, I., & Moser, A. (2018). Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice*. 24 (1), 120-124.

Kothari, C. R. (2004). *Research methodology: Methods and techniques.* New Age International.

Kreibich, H., Bubeck, P., Van Vliet, M., & De Moel, H. (2015). A review of damage-reducing measures to manage fluvial flood risks in a changing climate. *Mitigation and adaptation strategies for global change*. 20, 967-989.

Krippendorff, K. (2009). *The Content Analysis Reader*. Sage.

KSA's Council of Ministers. (1986). *Civil Defence System*. Saudi Arabia.

Kvale, S. E. (1989). *Issues of validity in qualitative research*. Studentlitteratur.

Lam, N.S., Reams, M., Li, K., Li, C. & Mata, L.P. (2016). Measuring community resilience to coastal hazards along the Northern Gulf of Mexico. *Natural hazards review*. 17 (1), 04015013.

Lavell, A. (2003a). *Indicators for Disaster Risk Management Program: Some Results, Conclusions and Recommendations Following the First Expert Meeting on Disaster Risk Conceptualisation and Indicators Modelling*. Manizales, Colombia. Inter-American Development Bank.

Lavell, A. (2003b). *Local Risk Management: Ideas and Notions Relating to Concept and Practice*. Guatemala/Geneva. *Regional Programme for Risk Management in Central America.*

Ledraa, T.A. & Al-Ghamdi, A.M. (2014). A Review of Flood Hazard Planning, Management and Mapping within the Context of Saudi Arabia. *Proceedings of the 5th International Conference on Cartography and GIS*, June 2014. pp. 699-700.

Ledraa, T.A. & Al-Ghamdi, A.M. (2020). Planning and Management Issues and Challenges of Flash Flooding Disasters in Saudi Arabia: The Case of Riyadh City. *Journal of Architecture and Planning*. 32, 155-171.

Lee, A.C. (2015). *Developing evidence-based practice in emergency planning and management.* Doctoral Thesis, University of Sheffield, United Kingdom.

Levy, Y., & Ellis, T. J. (2006). A system approach to conduct an effective literature review in support of information systems research. *Information Science Journal*. 9, 181-212.

Levy, P.S. & Lemeshow, S. (2013). *Sampling of Populations: Methods and Applications.* Hoboken, New Jersey, John Wiley & Sons.

Liu, Y., Zhang, W., & Cui, X. (2012). Flood emergency management using hydrodynamic modelling. *Procedia Engineering*. 28, 750-753.

Li Q, Li Y, Zhao L, Zhang Z, Wang Y, Ma M. (2024). Comprehensive Risk Assessment Framework for Flash Floods in China. *Water*. 16 (4), 616. https://doi.org/10.3390/w16040616

Longhurst, R. (2003). Semi-structured interviews and focus groups. *Key methods in geography*. *3* (2), 143-156.

Lumbroso, D., Stone, K., & Vinet, F. (2011). An assessment of flood emergency plans in England and Wales, France and the Netherlands. *Natural Hazards*. 58, 341-363.

Lumbroso, D., & Vinet, F. (2012). Tools to improve the production of emergency plans for floods: Are they being used by the people that need them?. *Journal of Contingencies and Crisis Management*. 20 (3), 149-165.

Maxwell, J. A. (2013). *Qualitative research design: An interactive approach*. (3nd ed). London. Sage Publications.

McEwen, L., & Jones, O. (2012). Building local/lay flood knowledges into community flood resilience planning after the July 2007 floods, Gloucestershire, UK. *Hydrology Research*. 43 (5), 675-688.

McGuirk, P. M. (2001). Situating communicative planning theory: Context, power, and knowledge. *Environment and Planning.* 33 (2), 195-217.

McNamara, C. (2009). General Guidelines for Conducting Research Interviews. Retrieved June 29, 2015. http://managementhelp.org/businessresearch/interviews.htm

Mehring, P., Geoghegan, H., Cloke, H. L., & Clark, J. M. (2018). What is going wrong with community engagement? How flood communities and flood authorities construct engagement and partnership working. *Environmental science & policy*. 89, 109-115.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. London: Thousand Oaks, Calif. Sage Publications.

Ministry of Higher Education, Saudi Arabia. (2015). *Atlas of Kingdom of Saudi Arabia*. 2d Edition. Riyadh.

Miranda, J.; Armas, C.; Padilla, F.; Pugnaire, F. (2011). Climatic change and rainfall patterns: Effects on semi-arid plant communities of the Iberian Southeast. *J. Arid. Environ*. 75, 1302–1309.

Moazami, A.; Nik, V.M.; Carlucci, S.; Geving, S. (2019). Impacts of future weather data typology on building energy performance—Investigating long-term patterns of climate change and extreme weather conditions. *Appl. Energy*. 238, 696–720.

Mohamed, M.I.A. (2017). Khartoum and Hybrid Disasters. *Disaster Management and Human Health Risk V: Reducing Risk, Improving Outcomes*. 173, 195-206.

Momani, N.M. & Fadil, A.S. (2010). Changing Public Policy Due to City of Jeddah Flood Disaster. *Journal of Social Sciences*. 6 (3), 424-428.

Moon, K., Brewer, T. D., Januchowski-Hartley, S. R., Adams, V. M., & Blackman, D. A. (2016). A guideline to improve qualitative social science publishing in ecology and conservation journals. *Ecology and Society*. 21 (3).

Morgan, D.L. (2007). Paradigms Lost and Pragmatism Regained: Methodological Implications of Combining Qualitative and Quantitative Methods. *Journal of Mixed Methods Research*. 1 (1), 48-76.

Moy de Vitry, M., Kramer, S., Wegner, J. D., & Leitão, J. P. (2019). Scalable flood level trend monitoring with surveillance cameras using a deep convolutional neural network. *Hydrology and Earth System Sciences*. 23 (11), 4621-4634.

Myers, M. D. (2019). *Qualitative research in business and management*. Sage.

Naoum, S. G. (2012). *Dissertation research and writing for construction students*. Routledge.

National Centre for Disaster Management, (NCDM). (2002). *The Report of High-Powered Committee on Disaster Management.* Department of Agriculture and Cooperation. Ministry of Agriculture, Government of India. Available from: https://nidm.gov.in/pdf/pubs/hpc_report.pdf [Accessed 28 October 2020].

National Oceanic and Atmospheric Administration (NOAA). (2010). Flash flood early warning system reference guide. http://www.meted.ucar.edu/communities/hazwarnsys/ffewsrg/FF_EWS.pdf [Accessed 12 January 2022].

Neuman, L. W. (2000). *Social research methods: Quantitative and qualitative approaches*. Boston: Allyn and bacon.

Neussner, O. (2009). Manual Local Flood Early Warning Systems Experiences from the Philippines. Philippines, GTZ, Comisión Europea. 100.

Neumayer, E. & Barthel, F. (2011). Normalizing Economic Loss from Natural Disasters: A Global Analysis*. Global Environmental Change*. 21 (1), 13-24.

Norbiato, D., Borga, M., Degli Esposti, S., Gaume, E., & Anquetin, S. (2008). Flash flood warning based on rainfall thresholds and soil moisture conditions: An assessment for gauged and ungauged basins. *Journal of Hydrology*. 362 (3-4), 274-290.

Nordhaus, W. (2019). Climate Change: The Ultimate Challenge for Economics. *Am. Econ. Rev*. 109, 1991–2014.

Norman, S., Stuart-Black, J., & Coles, E. (Eds.). (2006). *Health emergency planning: a handbook for practitioners*. The Stationery Office.

Olsson, J., Gidhagen, L., Gamerith, V., Gruber, G., Höppe, H. & Kutschera, P. (2012). Downscaling of Short-Term Precipitation from Regional Climate Models for Sustainable Urban Planning. *Sustainability*. 4 (5), 866-887.

Orach, G.C., Mamuya, S., Mayega, R.W., Tabu, S.J., Kiguli, J., Keim, M., Menya, D., Mock, N., Burnham, G., Killewo, J. and Bazeyo, W. (2013). Use of the automated disaster and emergency planning tool in developing district level public health emergency operating procedures in three East African countries. *East African journal of public health*. 10 (2), 440-448.

O'Sullivan, T. M., & Emmelhainz, R. (2014). Reframing the climate change debate to better leverage policy change: An analysis of public opinion and political psychology. *Journal of Homeland Security and Emergency Management*. 11 (3), 317-336.

Perera, A.T.D.; Nik, V.M.; Chen, D.; Scartezzini, J.-L.; Hong, T. (2020). Quantifying the impacts of climate change and extreme climate events on energy systems. *Nat. Energy*. 5, 150–159.

Perera, F.; Nadeau, K. (2022). Climate Change, Fossil-Fuel Pollution, and Children's Health. *N. Engl. J. Med*. 386, 2303–2314.

Pescaroli, G. & Alexander, D. (2016). Critical infrastructure, panarchies and the vulnerability paths of cascading disasters. *Natural Hazards*. 82 (1), 175-192.

Pescaroli, G. & Alexander, D. (2018). Understanding compound, interconnected, interacting, and cascading risks: a holistic framework. *Risk analysis*. 38 (11), 2245-2257.

Pescaroli, G., Wicks, R.T., Giacomello, G. & Alexander, D.E. (2018). Increasing resilience to cascading events: The M. OR. D. OR. scenario. *Safety science*. 110, 131-140.

Phaup, M., & Kirschner, C. (2010). Budgeting for disasters: focusing on the good times. *OECD Journal on Budgeting*. 10 (1), 1-24.

Plas, J. M., & Kvale, S. (1996). *Interviews: An introduction to qualitative research interviewing*. Sage.

Prein, R.M. Rasmussen, K. Ikeda, C. Liu, M.P. Clark, G.J. Holland (2017). The future intensification of hourly precipitation extremes. *Nat. Climate Change*. 7, 48-52.

Punch, K. F. (2013). *Introduction to social research: Quantitative and qualitative approaches*. sage.

Quarantelli, E. L. (1999). Implications for programmes and policies from future disaster trends. *Risk Management.* 1 (1), 9-19.

Rahm, D., & Reddick, C. G. (2011). US city managers' perceptions of disaster risks: Consequences for urban emergency management. *Journal of Contingencies and Crisis Management*. 19 (3), 136-146.

Rahman, M. T., Aldosary, A. S., Nahiduzzaman, K. M., & Reza, I. (2016). Vulnerability of flash flooding in Riyadh, Saudi Arabia. *Natural Hazards*, *84*, 1807-1830.

Reddick, C. (2011). Information technology and emergency management: preparedness and planning in US states. *Disasters*. 35 (1), 45-61.

Remenyi, D., Williams, B., Money, A., & Swartz, E. (1998). *Doing research in business and management: an introduction to process and method*. Sage.

Rentschler, J., Salhab, M. and Jafino, B. A. (2022). Flood exposure and poverty in 188 countries. *Nature Communications*. 13 (1), 3527. doi: 10.1038/s41467-022-30727-4.

Riege, A. M. (2003). Validity and reliability tests in case study research: a literature review with “hands-on” applications for each research phase. *Qualitative market research: An international journal*. 6, 75 - 86.

Robson, C., & McCartan, K. (2016). *Real world research*. John Wiley and Sons.

Rogers, G. O. (1992). Community decisions during chemical emergencies. *Proceedings of the Second National Research and Development Conference on the Control of Hazardous Materials, San Francisco, CA*.

Rong, L., & Jia, X. (2008, October). A systematic study on emergency policy documents for quick response. In *2008 IEEE International Conference on Systems, Man and Cybernetics* (pp. 856-861). IEEE.

Rosenfeld, L. A., Fox, C. E., Kerr, D., Marziale, E., Cullum, A., Lota, K., & Thompson, M. Z. (2009). Use of computer modeling for emergency preparedness functions by local and state health officials: A needs assessment. *Journal of Public Health Management and Practice.* 15 (2), 96-104.

Rozalis, S., Morin, E., Yair, Y., & Price, C. (2010). Flash flood prediction using an uncalibrated hydrological model and radar rainfall data in a Mediterranean watershed under changing hydrological conditions. *Journal of hydrology*, 394 (1-2), 245-255.

Sabatier, P. (1978). The Acquisition and Utilization of Technical Information by Administrative Agencies. *Administrative Science Quarterly.* 23 (3), 396-417.

Saldaña, J. (2013). *The coding manual for qualitative researchers*, 2nd ed, London, Sage.

Sampson, H. (2004). Navigating the waves: the usefulness of a pilot in qualitative research. *Qualitative research*. 4 (3), 383-402.

Sayers, P., Yuanyuan, L., Galloway, G., Penning-Rowsell, E., Fuxin, S., Kang, W., & Le Quesne, T. (2013). *Flood risk management: a strategic approach.* Paris.

Sekaran, U., & Bougie, R. (2019). *Research methods for business: A skill building approach*. john wiley & sons.

Saunders, M., Lewis, P. & Thornhill, A. (2016). *Research Methods for Business Students*. 7th edition. Harlow. Pearson Education Limited.

Schanze, J., Zeman, E., & Marsalek, J. (Eds.). (2007). *Flood risk management: hazards, vulnerability and mitigation measures*. Springer Science & Business Media. Vol. 67.

Skendžić, S.; Zovko, M.; Živković, I.P.; Lešić, V.; Lemić, D. (2021). The Impact of Climate Change on Agricultural Insect Pests. *Insects*. 12, 440.

Smith, K., & Ward, R. (1998). *Mitigating and Managing Flood Losses. Floods: Physical Processes and Human Impacts.* Wiley & Sons.

Soeder, D.J. (2021). Greenhouse gas sources and mitigation strategies from a geosciences perspective. *Adv. Geo-Energy Res*. 5, 274–285.

Sofia, G., Yang, Q., Shen, X., Mitu, M. F., Patlakas, P., Chaniotis, I., Kallos, A., Alomari, M. A., Alzahrani, S. S., Christidis, Z., and Anagnostou, E. (2023). The operational flash-flood forecasting system for the Kingdom of Saudi Arabia: A case study of the 24th November 2022 flash flood in Jeddah. *EGU General Assembly*. Vienna, Austria, 24–28.

Sovacool, B.K.; Griffiths, S.; Kim, J.; Bazilian, M. (2021). Climate change and industrial F-gases: A critical and systematic review of developments, sociotechnical systems and policy options for reducing synthetic greenhouse gas emissions. *Renew. Sustain. Energy Rev*. 141, 110759.

Tammar A, Abosuliman SS, Rahaman KR. (2020). Social Capital and Disaster Resilience Nexus: A Study of Flash Flood Recovery in Jeddah City. *Sustainability*. 12 (11), 4668. https://doi.org/10.3390/su12114668

Tarawneh, Q.Y.; Chowdhury, S. (2018). Trends of Climate Change in Saudi Arabia: Implications on Water Resources. *Climate*. 6, 8.

Tariq, Muhammad Atiq Ur Rehman, Rashid Farooq, and Nick van de Giesen. (2020). A Critical Review of Flood Risk Management and the Selection of Suitable Measures. *Applied Sciences*. 10 (23), 8752. https://doi.org/10.3390/app10238752

The National Risk Council. (2022). The Organizational Arrangements of the National Risk Council. Available from: https://uqn.gov.sa/?p=12316 [Accessed 21 March 2023].

Theilen-Willige, B. & Wenzel, H. (2019). Remote sensing and GIS contribution to a natural hazard database in western Saudi Arabia. *Geosciences*. 9 (9), 380.

Török, I. (2018). Qualitative assessment of social vulnerability to flood hazards in Romania. *Sustainability*. 10 (10), 3780.

Turner III, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. *The qualitative report*, *15* (3), 754-760.

Tyler, J., Sadiq, AA. & Noonan, D.S. A review of the community flood risk management literature in the USA: lessons for improving community resilience to floods. (2019). *Nat Hazards*. 96, 1223–1248. https://doi.org/10.1007/s11069-019-03606-3

United Nations Development Programme (UNDP), Bureau for Crisis Prevention. (2004). *Reducing Disaster Risk: A Challenge for Development-a Global Report*. United Nations.

United Nations Office for Disaster Risk Reduction (UNDRR), Centre for Research on the Epidemiology of Disasters (CRED). (2020). *The Human Cost of Disasters: An Overview of the Last 20 Years 2000-2019*. Available from:

https://www.undrr.org/publication/human-cost-disasters-overview-last-20-years-2000-2019 [Accessed 25 January 2021].

Vis, M., Klijn, F., De Bruijn, K. M., & Van Buuren, M. (2003). Resilience strategies for flood risk management in the Netherlands. *International journal of river basin management*, 1(1), 33-40.

Wang, X., & Bi, H. (2020). The effects of rainfall intensities and duration on SCS-CN model parameters under simulated rainfall. *Water*. *12* (6), 1595.

Wannous, C., & Velasquez, G. (2017). United nations office for disaster risk reduction's contribution to science and technology for disaster risk reduction and the role of the international consortium on landslides. In *Workshop on World Landslide Forum*, May 2017, Cham. pp. 109-115.

Wassen, M. J., Runhaar, H., Barendregt, A. & Okruszko, T. (2011). Evaluating the role of participation in modeling studies for environmental planning. *Environment and Planning B: Planning and Design.* 38 (2), 338-358.

Weber, E. P., Leschine, T. M. & Brock, J. (2010). Civic science and salmon recovery planning in Puget Sound. *Policy Studies Journal.* 38 (2), 235-256.

Wehbe, Z. H. (2014). *Policy Makers' Future Emergency Planning: Abu Dhabi's Managers' Perceptions of Potential Cyberdisasters*. Doctoral dissertation, Walden University.

White, P. (2017). *Developing Research Questions*: *A Guide for Social Scientists*. Macmillan International Higher Education.

Williams, A., & Archer, D. (2002). The use of historical flood information in the English Midlands to improve risk assessment. *Hydrological sciences journal*. 47 (1), 57-76.

WMO. (2006). *Technical Regulations*. Volume III: Hydrology, WMO-No. 49. World Meteorological Organization (WMO).

WMO. (2020). *Climate and Water- Floods.* Geneva, Switzerland. Retrieved from https://public.wmo.int/en/resources/world-meteorological-day/previous-world-meteorological-days/climate-and-water/floods

World Bank. (2020) *Population, total - Saudi Arabia*. Available from: https://data.worldbank.org/indicator/SP.POP.TOTL?locations=SA[Accessed 21 November 2020].

Yamada, F., Kakimoto, R., Yamamoto, M., Fujimi, T., & Tanaka, N. (2011). Implementation of community flood risk communication in Kumamoto, Japan. *Journal of advanced transportation*. 45 (2), 117-128.

Yatheendradas, S., Wagener, T., Gupta, H., Unkrich, C., Goodrich, D., Schaffner, M., & Stewart, A. (2008). Understanding uncertainty in distributed flash flood forecasting for semiarid regions. *Water Resources Research,* 44 (5).

Yin, R. K. (2015). *Qualitative research from start to finish*. Guilford publications.

Yin, R. K. (2017). *Case Study Research: Design and Methods.* Sage Publications.

Youssef, A.M., Sefry, S.A., Pradhan, B. & Alfadail, E.A. (2016). Analysis on Causes of Flash Flood in Jeddah City (Kingdom of Saudi Arabia) of 2009 and 2011 Using Multi-Sensor Remote Sensing Data and GIS. *Geomatics, Natural Hazards and Risk*. 7 (3), 1018-1042.

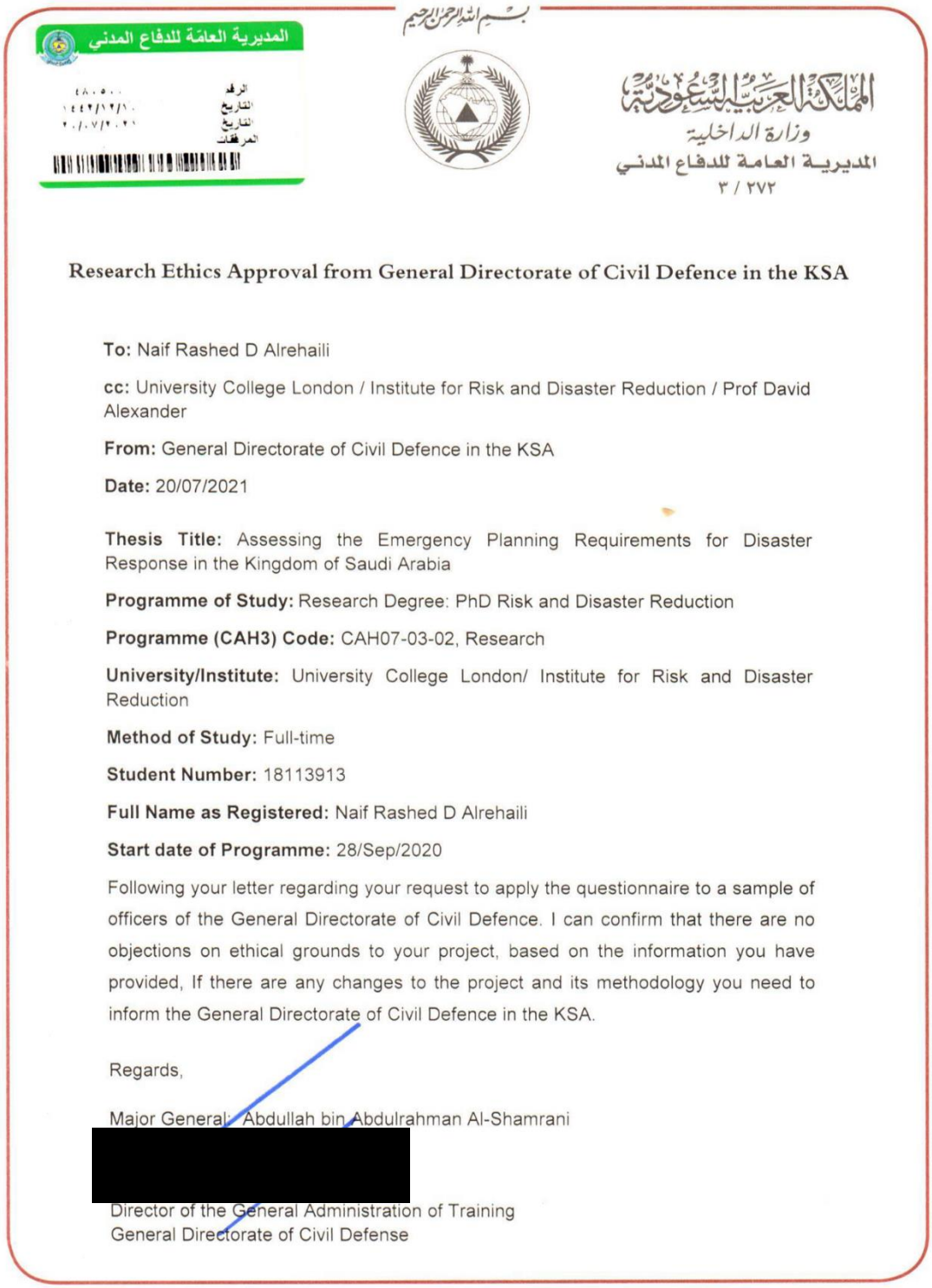
Zhang, Y., Wang, Y., Chen, Y., Xu, Y., Zhang, G., Lin, Q., & Luo, R. (2021). Projection of changes in flash flood occurrence under climate change at tourist attractions. *Journal of Hydrology*. 595, 126039. https://doi.org/10.1016/j.jhydrol.2021.126039

Zhao, L., Li, H., Sun, Y., Huang, R., Hu, Q., Wang, J. & Gao, F. (2017). Planning Emergency Shelters for Urban Disaster Resilience: An Integrated Location-Allocation Modeling Approach. *Sustainability*. 9 (11), 2098.

Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2013). *Business research methods*. Cengage learning.

Appendices

Appendix 1: Research Ethics Approval from the General Directorate of Civil Defence in the KSA



بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة الداخلية
المديرية العامة للدفاع المدني
٣ / ٢٧٢

المديرية العامة للدفاع المدني
الرقم ٤٨٠٥٠٠
التاريخ ١٤٤٢/١٢/١٠
التاريخ ٢٠٢١/٠٧/٢٠
المرفقات

Research Ethics Approval from General Directorate of Civil Defence in the KSA

To: Naif Rashed D Alrehaili

cc: University College London / Institute for Risk and Disaster Reduction / Prof David Alexander

From: General Directorate of Civil Defence in the KSA

Date: 20/07/2021

Thesis Title: Assessing the Emergency Planning Requirements for Disaster Response in the Kingdom of Saudi Arabia

Programme of Study: Research Degree: PhD Risk and Disaster Reduction

Programme (CAH3) Code: CAH07-03-02, Research

University/Institute: University College London/ Institute for Risk and Disaster Reduction

Method of Study: Full-time

Student Number: 18113913

Full Name as Registered: Naif Rashed D Alrehaili

Start date of Programme: 28/Sep/2020

Following your letter regarding your request to apply the questionnaire to a sample of officers of the General Directorate of Civil Defence. I can confirm that there are no objections on ethical grounds to your project, based on the information you have provided, If there are any changes to the project and its methodology you need to inform the General Directorate of Civil Defence in the KSA.

Regards,

Major General: Abdullah bin Abdulrahman Al-Shamrani

[redacted]

Director of the General Administration of Training
General Directorate of Civil Defense

ص.ب ١١١٧٤ الرياض فاكس (٤٩٢٥٠٤١) الموقع على الشبكة WWW.998.GOV.SA

Appendix 2: UCL Notification of Ethics Approval

UCL RESEARCH ETHICS COMMITTEE
OFFICE FOR THE VICE PROVOST RESEARCH

05/08/2021

Professor David Alexander
Institute for Risk and Disaster Reduction
Faculty of Mathematical & Physical Sciences
UCL

Cc: Naif Rashed Alrehaili

Dear Prof Alexander,

Notification of Ethics Approval
Project ID/Title: 19189/001: Assessing the Emergency Planning Requirements for Disaster Response in the Kingdom of Saudi Arabia

Further to your satisfactory responses to the reviewer's comments, I am pleased to confirm that your study has been ethically approved until **05/08/2022.**

Ethical approval is subject to the following conditions:

Notification of Amendments to the Research
You must seek Chair's approval for proposed amendments (to include extensions to the duration of the project) to the research for which this approval has been given. Each research project is reviewed separately and if there are significant changes to the research protocol you should seek confirmation of continued ethical approval by completing an 'Amendment Approval Request Form' http://ethics.grad.ucl.ac.uk/responsibilities.php

Adverse Event Reporting – Serious and Non-Serious
It is your responsibility to report to the Committee any unanticipated problems or adverse events involving risks to participants or others. The Ethics Committee should be notified of all serious adverse events via the Ethics Committee Administrator (ethics@ucl.ac.uk) immediately the incident occurs. Where the adverse incident is unexpected and serious, the Joint Chairs will decide whether the study should be terminated pending the opinion of an independent expert. For non-serious adverse events the Joint Chairs of the Ethics Committee should again be notified via the Ethics Committee Administrator within ten days of the incident occurring and provide a full written report that should include any amendments to the participant information sheet and study protocol. The Joint Chairs will confirm that the incident is non-serious and report to the Committee at the next meeting. The final view of the Committee will be communicated to you.

Office of the Vice Provost Research, 2 Taviton Street
University College London
Tel: +44 (0)20 7679 8717
Email: ethics@ucl.ac.uk
http://ethics.grad.ucl.ac.uk/

Final Report
At the end of the data collection element of your research we ask that you submit a very brief report (1-2 paragraphs will suffice) which includes in particular issues relating to the ethical implications of the research i.e. issues obtaining consent, participants withdrawing from the research, confidentiality, protection of participants from physical and mental harm etc.

In addition, please:

- ensure that you follow all relevant guidance as laid out in UCL's Code of Conduct for Research: www.ucl.ac.uk/srs/governance-and-committees/research-governance
- note that you are required to adhere to all research data/records management and storage procedures agreed as part of your application. This will be expected even after completion of the study.

With best wishes for the research.

Yours sincerely

Professor Michael Heinrich

Joint Chair, UCL Research Ethics Committee

Appendix 3: UCL Risk Assessment Authorised

UCL
Risk Assessment

Summary

Reference: RA058939/1 **Sign-off Status:** Authorised

Date Created:	27/02/2022	**Confidential?**	No
Assessment Title:	Assessing the Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia		
Assessment Outline:	This thesis's primary goal is to assess emergency planning requirements for responding to flash floods in the Kingdom of Saudi Arabia (KSA) to enhance flash flood response planning. The research uses a quantitative approach. The research population includes all officers in all ranks - which currently includes only males – within the General Directorate of Civil Defence (GDCD) who are currently 'in service'; this consequently totals 3,841 officers, located in various regions within the KSA. The research sample will be no less than 5% of the research population. The research will present findings related to the GDCD officers' perceptions of emergency planning requirements for responding to flash floods in the KSA. The process will be carried out in detail by using the questionnaire as the research instrument to collect this data. The data will be analysed via SPSS.		

Area Responsible (for management of risks)		**Location of Risks**	On-Site
Division, School, Faculty, Institute:	Faculty of Maths and Physical Sciences	**Building:**	South Wing
Department:	Inst for Risk & Disaster Reduction	**Area:**	Ground and Above
Group/Unit:	All Groups/Units	**Sub Area:**	Office/Meeting Room

Further Location Information:	The survey (questionnaire) will be applied to a simple random sample of officers in the General Directorate of Civil Defence in the KSA.
Is additional GM or HG approval required? Only relevant to specialist biological risk assessments (GMM2, GMM3, HG2, HG3, GM animals, GM plants) except GMM class 1.:	**Click SELECT to change ONLY if this is a GMM Class 2, GMM Class 3, HG2, HG3, GM animals or GM plants risk assessment**

Assessment Start Date:	27/02/2022	**Review or End Date:**	27/02/2023

Relevant Attachments:

Description of attachments:
Location of non-electronic documents:

Assessor(s):	ALREHAILI, NAIF
Approver(s):	DAVID ALEXANDER
Signed Off:	DAVID ALEXANDER (28/02/2022 17:29)

PEOPLE AT RISK (from the Activities covered by this Risk Assessment)

CATEGORY
Employees

UCL
Risk Assessment

Reference: RA058939/1 **Sign-off Status:** Authorised

1. No hazardous activities will be undertaken. No exceptional or untoward risks are associated with the fieldwork campaign.

Description of Activity:	No hazardous activities will be undertaken. No exceptional or untoward risks are associated with the fieldwork campaign.

Hazard 1. No hazardous activities will be undertaken. No exceptional or untoward risks are associated.

No hazardous activities will be undertaken. No exceptional or untoward risks are associated with the fieldwork campaign.	**Existing Control Measures**

Risk Level

With Existing Controls:

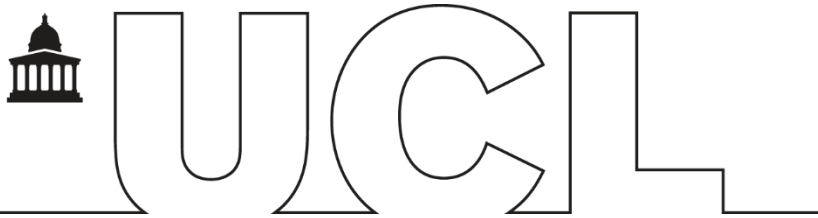
Risk Level: **A - Very Low / Trivial**

Appendix 4: Interview Invitation Letter to Participants

Institute for Risk and Disaster Reduction

UCL, Gower Street, London, WC1E 6BT

www.ucl.ac.uk/risk-disaster-reduction



Interview Invitation Letter to Participants

Dear…,

I write to you to invite you to take part in a research study on the topic of "Assessing the Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia".

I am an employee in the General Directorate of Civil Defence in the Kingdom of Saudi Arabia, and I am currently undertaking research in the field of emergency planning and flash flood response as part of my doctoral study.

I am especially interested in identifying the knowledge and research gaps for assessing the emergency planning requirements for responding to flash floods in the KSA. I intend to do this through a review of the existing literature on this topic, as well as by conducting interviews to obtain the views of GDCD officers in the KSA in this field. It is hoped that the outputs from this project will help guide both future emergency planning and flash flood research.

You have been identified as an officer working in the field of emergency planning and flash flood response who also possesses considerable expertise and/or experience on this topic. I am therefore very keen to interview you. I have attached an information sheet outlining my research.

I hope you will agree to take part in this research. If so, please kindly send me back the attached consent form, either by email to [redacted] or by mobile on [redacted]. Should you have any further queries, please do not hesitate to contact me.

Yours sincerely,

Naif Alrehaili

PhD student in Risk and Disaster Reduction at University College London

[redacted]

Mobile: [redacted]

دعوة للمشاركة في مقابلة بحثية

سعادة/ ...

السلام عليكم ورحمة الله وبركاته.... وبعد

أكتب إليكم لأدعوكم للمشاركة في دراسة بحثية حول "تقييم متطلبات التخطيط للطوارئ للاستجابة للفيضانات المفاجئة في المملكة العربية السعودية".

انا موظف في المديرية العامة للدفاع المدني بالمملكة العربية السعودية. أقوم حاليًا بإجراء بحث في مجال التخطيط للطوارئ والاستجابة للفيضانات كجزء من دراسة الدكتوراه.

أنا مهتم بشكل خاص بتحديد الفجوات المعرفية والبحثية لتقييم متطلبات التخطيط للطوارئ للاستجابة للفيضانات السريعة في المملكة العربية السعودية. أعتزم القيام بذلك من خلال مراجعة الأدبيات الموجودة حول هذا الموضوع والمقابلات للحصول على آراء مسؤولي **GDCD** في المملكة العربية السعودية في هذا المجال. من المأمول أن تساعد مخرجات هذا المشروع في توجيه كل من التخطيط لحالات الطوارئ وأبحاث الفيضانات المفاجئة في المستقبل.

لقد تم تحديدك كضابط يعمل في مجال التخطيط للطوارئ والاستجابة للفيضانات السريعة ولديه خبرة و / أو خبرة كبيرة في هذا المجال. لذلك أنا حريص جدًا على إجراء مقابلة معك. لقد أرفقت ورقة معلومات تلخص دراستي.

آمل أن توافق على المشاركة في هذه الدراسة. إذا كان الأمر كذلك، يرجى التفضل بإرسال نموذج الموافقة المرفق إليّ عبر البريد الإلكتروني على **naif.alrehaili.19@ucl.ac.uk** أو عبر الهاتف المحمول على الرقم +44 07869122313. إذا كان لديك أي استفسارات أخرى، فيرجى عدم التردد في الاتصال بي .

وتفضلوا بقبول فائق الاحترام

نايف بن راشد الرحيلي

طالبة دكتوراه في تقليل المخاطر والكوارث في كلية لندن الجامعية

[redacted]

الجوال: [redacted] 44+

Appendix 5: Participant Information Sheet for Interview

Participant Information Sheet for Interview

Title of Thesis: Assessing the Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia.

Department: Institute for Risk and Disaster Reduction - UCL

The Principal Researcher – Ph.D. Student: Naif Alrehaili, [redacted]

Principal Supervisor: Prof. David Alexander, [redacted]

Subsidiary supervisor: Dr. Gianluca Pescaroli, [redacted]

UCL Data Protection Officer: Alex Potts, data-protection@ucl.ac.uk

Invitation

We would like to invite you to take part in a research study on emergency planning requirements for responding to flash floods in the Kingdom of Saudi Arabia that I am currently carrying out as part of my doctoral study at the Institute for Risk and Disaster Reduction at University College London. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask me if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part. Thank you for reading this.

What is the study's purpose?

There are different requirements used around the world for emergency planning for disaster responses. However, it is not known which requirements work best. This study aims to identify the gaps in the emergency planning requirements for responding to flash floods in the KSA.

Why have I been chosen?

I would like to speak to expert leaders that are involved in disaster management and emergency planning within the General Directorate of Civil Defence in the KSA who can give me insight into emergency planning requirements for responding to flash floods in the KSA and be able to help me to identify the research gaps. Therefore, I have chosen to speak to you as you have expertise, knowledge, and experience in this field.

Do I have to take part?

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. You are free to withdraw at any time without having to give a reason, and your non-participation in the study will have no effect on your position/career.

What will happen to me if I take part?

If you agree to take part, I will arrange to have a face-to-face (one-to-one) interview with you. This will be in person at a time and place that is convenient for you. The interview will be with me and will likely take no longer than 60 minutes.

What do I have to do?

You will be asked to answer open-ended questions on topics relevant to the emergency planning requirements for responding to flash floods in the KSA. You only have to respond to questions that you feel comfortable answering in your professional position. You do not need to answer questions that you do not know the answer to, or feel uncomfortable or unable to answer for any reason.

Will I be recorded and how will the recorded media be used?

The interview will only be audio recorded as part of this study.

What are the possible disadvantages and risks of taking part?

I do not expect you to experience any discomfort, disadvantage, or risk as a result of taking part.

What are the possible benefits of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will help academics and professionals identify and fill in any gaps in this field.

What happens if the research study stops earlier than expected?

If this is the case the reason(s) will be explained to you.

What if something goes wrong?

If something goes wrong, please contact me via email: naif.alrehaili.19@ucl.ac.uk or the principal project supervisor, Professor David Alexander, at University College London by email: david.alexander@ucl.ac.uk, or the subsidiary supervisor, Dr. Gianluca, Pescaroli, at University College London by email: g.pescaroli@ucl.ac.uk. If your complaint is not handled to your satisfaction, then please contact the Chair of the UCL Research Ethics Committee – ethics@ucl.ac.uk.

Will my taking part in this project be kept confidential?

All the information that we collect about you during the course of the research will be kept strictly confidential. You will not be able to be identified in any reports or publications. No information collected will be shown to anyone apart from the research team. Transcripts and recordings will be kept in a locked cabinet. Transcripts will be anonymised and parts in which participants might be identified will be avoided in publications. For regulatory purposes, data from the study will be stored securely for one year following the study and destroyed as confidential waste thereafter.

What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

I am interested in your reflections, opinions, and thoughts on various issues in the emergency planning requirements for responding to flash floods in the KSA from your professional perspective.

What will happen to the results of the research project?

This research will take place over a year, after which the results will be used as part of my doctoral study. The information may also be presented at academic conferences and be published in research journals. You can also obtain a copy of the published report once this is completed by contacting me. The results of the project might be used to inform additional or subsequent research. Should this be the case, any information about you will continue to be kept confidential.

Who is organising and funding the research?

This research is organised and undertaken by me and is funded by the Government of the Kingdom of Saudi Arabia. I receive no monies for this from University College London (UCL) or other funding body.

Who has ethically reviewed the project?

This project was reviewed and ethically approved by the UCL Research Ethics Committee on 05/08/2021.

Contact for further information

PhD student: Naif Rashed Alrehaili, University College London, Institute for Risk and Disaster Reduction, IRDR, UCL, Gower Street, London, WC1E 6BT, Mobile: [redacted], Email: [redacted].

The principal project supervisor, Professor David Alexander, University College London, Institute for Risk and Disaster Reduction, IRDR, UCL, Gower Street, London, WC1E 6BT, Phone: [redacted], Email: [redacted].

The subsidiary project supervisor, Dr Gianluca Pescaroli, University College London, Institute for Risk and Disaster Reduction, IRDR, UCL, Gower Street, London, WC1E 6BT, Phone: [redacted], Email: [redacted]

This information sheet is for you to keep. Thank you for reading it and for considering to take part in this research study.

Appendix 6: Participant Consent Form for Interview

Institute for Risk and Disaster Reduction
UCL, Gower Street, London, WC1E 6BT
www.ucl.ac.uk/risk-disaster-reduction

Participant Consent Form for Interview

Please complete this form after you have read the Information Sheet

Title of Study: Assessing the Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia.

Department: Institute for Risk and Disaster Reduction - UCL

The Researcher - Ph.D. Student: Naif Alrehaili, [redacted]

Principal Supervisor: Prof. David Alexander, [redacted]

Subsidiary supervisor: Dr. Gianluca Pescaroli, [redacted]

UCL Data Protection Officer: Alex Potts, data-protection@ucl.ac.uk

This study has been approved by the UCL Research Ethics Committee: Project ID number: 19189/001

Thank you for considering taking part in this research. If you have any questions arising from the Information Sheet, please ask the researcher before you decide whether to join in. You will be given a copy of this Consent Form to keep and refer to at any time.

I confirm that I understand that by ticking/initialling each box below I am consenting to this element of the study. I understand that it will be assumed that unticked/initialled boxes means that I DO NOT consent to that part of the study. I understand that by not giving consent for any one element that I may be deemed ineligible for the study.

No	Statement	Tick Box YES/NO
1.	I confirm that I have read and understood the Information Sheet for the above study. I have had an opportunity to consider the information and what will be expected of me. I have also had the opportunity to ask questions which have been answered to my satisfaction.	
2.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason. I understand that if I decide to withdraw, any personal data I have provided up to that point will be deleted unless I agree otherwise.	
3.	I understand that all personal information will remain confidential and that all efforts will be made to ensure I cannot be identified. I understand that my data gathered in this study will be stored anonymously and securely. It will not be possible to identify me in any publications.	
4.	I understand the potential risks of participating and the support that will be available to me should I become distressed during the course of the research.	
5.	I understand the direct/indirect benefits of participating.	
6.	I understand that the data will not be made available to any commercial organisations but is solely the responsibility of the researcher(s) undertaking this study.	
7.	I understand that I will not benefit financially from this study or from any possible outcome it may result in in the future.	
8.	I agree that my research data may be used by others for future research. No one will be able to identify you when this data is shared.	
9.	I understand that the information I have submitted will be published as a report and I wish to receive a copy of it.	
10.	I consent to my interview being audio recorded.	
11.	I am aware of who I should contact if I wish to lodge a complaint.	
12.	I voluntarily agree to take part in this study.	

_____	_____	_____
Name of participant	Date	Signature
Naif Rashed Alrehaili	_____	_____
Researcher	Date	Signature

Appendix 7: Interview Questions Form of the Pilot Study

Institute for Risk and Disaster Reduction

UCL, Gower Street, London, WC1E 6BT

www.ucl.ac.uk/risk-disaster-reduction

Research Title: Assessing the Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia

Semi-Structured Interview questions

Part One: Personal Information

الجزء الأول: معلومات شخصية

Name		الاسم
Participant Code		رمز المشارك
Organisation		الجهة
Job Title		المسمى الوظيفي
Rank		الرتبة
Region		المنطقة
Years of Experience		سنوات الخبرة
Academic Qualifications		المؤهل الأكاديمي
Email		البريد الالكتروني

Part Two: The Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia

الجزء الثاني: متطلبات التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية

Q1.	In your opinion, what is the current state of emergency planning for responding to flash floods in the KSA? من وجهة نظرك، ما حال التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية؟
Q2.	Based on your knowledge, what emergency planning approach is currently being used for responding to flash floods in the KSA? Why? بناءً على معرفتك، ما هو نهج التخطيط للطوارئ للاستجابة للسيول المستخدم في المملكة العربية السعودية؟ ولماذا؟
Q3.	In your opinion, can the biggest improvement in flash flood response in the KSA be achieved by rebalancing emergency planning so that it focuses as much on achieving the community-based approach as it does on the dominant approach? Why? من وجهة نظرك، هل يمكن تحقيق أكبر تحسن في الاستجابة للسيول في المملكة العربية السعودية من خلال إعادة موازنة التخطيط للطوارئ بحيث يركز على تحقيق النهج المجتمعي بقدر ما يركز على النهج السائد؟ ولماذا؟

Q4.	What is your opinion of the National Plan for Natural Disaster Risk Reduction? Why? ما رأيك في الخطة الوطنية للحد من مخاطر الكوارث الطبيعية؟ ولماذا؟
Q5.	Are there any aspects of the Plan that require improvement? If so, how do you think they can be improved? هل هناك جوانب تتطلب التحسين في الخطة الوطنية للحد من مخاطر الكوارث الطبيعية؟ وكيف يتم ذلك؟
Q6.	What do you think are the emergency planning requirements for responding to flash floods? ما هي متطلبات التخطيط للطوارئ للاستجابة للسيول؟
Q7.	Based on your experience, what is the current state of emergency planning requirements for responding to flash floods in the KSA? Why? بناءً على خبرتك، ما واقع متطلبات التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية؟ ولماذا؟
Q8.	What are your perceptions of emergency planning requirements for responding to flash floods in the KSA? ما هي تصوراتك لمتطلبات التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية؟
Q9.	Reflecting on your own experience of or work in the field of emergency planning for responding to flash floods, are there any particular challenges, deficiencies, difficulties, or issues that come to mind? بالتفكير في تجربتك الخاصة أو عملك في مجال التخطيط للطوارئ للاستجابة للسيول، هل هناك أي تحديات، أو أوجه قصور، أو صعوبات، أو قضايا معينة تتبادر إلى الذهن؟

Appendix 8: The Pilot Study Data Analysis Summary

Table 1

Theme Code *Subcode*	Files	References
Theme 1. current emergency planning approach	1*	10*
current state of emergency planning	1*	5*
good with room for improvement	1	2
very good	1	3
emergency planning approaches used	1*	5*
combined system that defines roles and responsibilities	1	1
preparation based on predetermined assumptions	1	2
top down approach	1*	2*

* Indicates an aggregated total

Table 2

Theme Code *Subcode*	Files	References
Theme 2. The current state of emergency planning	1*	5*
The current state of emergency planning	1*	5*
excellent because of involvement of experts and officials	1	2
good but needs improvement	1	2
good focus on frequent updating of requirements and capabilities	1	1

* Indicates an aggregated total

Table 3

Theme Code *Subcode*	Files	References
Theme 3. Expert perceptions of emergency planning requirements	1*	50*
emergency planning requirements for responding	1*	31*
identified planning requirements	1*	21*
A flash flood risk analysis and the use of modern technology	1	3
Climatological studies that determine agency capacities	1	2
Ensuring regular training of each emergency team	1	3
Evacuating the population impacted before flooding	1	1
Geological and topographical studies	1	1
identifying suitable and unsuitable areas for building	1	1
Regulations and laws for violators of the regulations	1	1

Theme Code *Subcode*	Files	References
Seeking assistance of residents in identifying risks	1	1
Studies provided by relevant authorities	1	3
Taking advantage of previous accidents	1	4
Updating the geographical maps	1	1
National plan needs for improvement	1*	5*
activating coordination between those implementing and those liable	1	1
awareness of regulations that criminalise	1	1
more use made of volunteers	1	1
plan should be updated in all sections	1	1
plan should take advantage of technological developments	1	1
opinion of the National Plan for Natural Disaster Risk Reduction	1*	5*
good	1	2
good but needs improvement	1	3
rebalancing emergency planning with focus on community	1*	5*
is possible	1	3
not enough volunteers-community awareness	1	2

* Indicates an aggregated total

Table 4

Theme Code *Subcode*	Files	References
Theme 4. challenges perceived for emergency planning	1*	4*
reflection on challenges and deficiencies	1*	4*
failure to hold people accountable	1	1
multiple areas where change is needed	1	2
Plan not being widely available	1	1

* Indicates an aggregated total

Appendix 9: Interview Questions Form of the Main Study

Institute for Risk and Disaster Reduction

UCL, Gower Street, London, WC1E 6BT

www.ucl.ac.uk/risk-disaster-reduction

Research Title: Assessing the Emergency Planning Requirements for Responding to Flash Floods in the Kingdom of Saudi Arabia

تقييم تخطيط الطوارئ للاستجابة لكوارث السيول في المملكة العربية السعودية

Semi-Structured Interview Questions

Part One: Personal Information

الجزء الأول: معلومات شخصية

Name		الاسم
Participant Code		رمز المشارك
Organisation		الجهة
Job Title		المسمى الوظيفي
Rank		الرتبة
Region		المنطقة
Years of Experience		سنوات الخبرة
Academic Qualifications		المؤهل الأكاديمي
Email		البريد الالكتروني

Part Two: Emergency Planning for Responding to Flash Floods in the Kingdom of Saudi Arabia

الجزء الثاني: التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية

Q1.	In your opinion, what is the current state of emergency planning for responding to flash floods in the KSA? من وجهة نظرك، ما حال التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية؟
A1.	إجابة السؤال الأول:
Q2.	Based on your knowledge, what emergency planning approach is currently being used for responding to flash floods in the KSA? Why? بناءً على معرفتك، ما هو نهج التخطيط للطوارئ للاستجابة للسيول المستخدم في المملكة العربية السعودية؟ ولماذا؟
A2.	إجابة السؤال الثاني:
Q3.	In your opinion, can the biggest improvement in flash flood response in the KSA be achieved by rebalancing emergency planning so that it focuses as much on achieving the community-based approach as it does on the dominant approach? Why?

	من وجهة نظرك، هل يمكن تحقيق أكبر تحسن في الاستجابة للسيول في المملكة العربية السعودية من خلال إعادة موازنة التخطيط للطوارئ بحيث يركز على تحقيق النهج المجتمعي بقدر ما يركز على النهج السائد؟ ولماذا؟
A3.	إجابة السؤال الثالث:
Q4.	What is your opinion of the National Plan for Natural Disasters Risk Reduction? Why? ما رأيك في الخطة الوطنية للحد من مخاطر الكوارث الطبيعية؟ ولماذا؟
A4.	إجابة السؤال الرابع:
Q5.	Are there any aspects of the Plan that require improvement? If so, how do you think they can be improved? هل هناك جوانب تتطلب التحسين في الخطة الوطنية للحد من مخاطر الكوارث الطبيعية؟ وكيف يتم ذلك؟
A5.	إجابة السؤال الخامس:
Q6.	What do you think are the emergency planning requirements for responding to flash floods? ما هي متطلبات التخطيط للطوارئ للاستجابة للسيول؟
A6.	إجابة السؤال السادس:
Q7.	Based on your experience, what is the current state of emergency planning requirements for responding to flash floods in the KSA? Why? بناءً على خبرتك، ما واقع متطلبات التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية؟ ولماذا؟
A7.	إجابة السؤال السابع:
Q8.	What are your perceptions of emergency planning requirements for responding to flash floods in the KSA? ما هي تصوراتك لمتطلبات التخطيط للطوارئ للاستجابة للسيول في المملكة العربية السعودية؟
A8.	إجابة السؤال الثامن:
Q9.	Reflecting on your own experience of or work in the field of emergency planning for responding to flash floods, are there any particular challenges, deficiencies, difficulties, or issues that come to mind? بالتفكير في تجربتك الخاصة أو عملك في مجال التخطيط للطوارئ للاستجابة للسيول، هل هناك أي تحديات، أو أوجه قصور، أو صعوبات، أو قضايا معينة تتبادر إلى الذهن؟
A9.	إجابة السؤال التاسع:

Appendix 10: The Main Study Data Analysis Summary

Theme 1 table 1

Theme	Files	References
Code		
Subcode		
Theme 1. Current emergency planning approach	1	26*
current state of emergency planning	1	13*
good to excellent	1	10
good with room for improvement	1	3
emergency planning approaches used	1	13*
combined approach	1	2
top down approach	1	11

* Indicates aggregated total

Theme 2 table 1

Theme	Files	References
Code		
Subcode		
Theme 2. The current state of emergency planning	1	13*
The current state of emergency planning	1	13*

Theme	Files	References
Code		
Subcode		
adequate	1	3
good but needs improvement	1	7
very good	1	3

* Indicates aggregated total

Theme 3 table 1

Theme	Files	References
Code		
Subcode		
Theme 3. Perceptions of emergency planning requirements	1	104*
emergency planning requirements for responding	1	31*
identified planning requirements	1	30*
administrative technical and staff	1	7
human and equipment resources	1	8
identifying analysing and assessing risks	1	8
trained staff and specialists	1	4
updated database	1	3
ranked order of requirements	1	1

* Indicates aggregated total

Theme 3 table 2

Theme	Files	References
Code		
Subcode		
Theme 3. Perceptions of emergency planning requirements	1	104*
National plan needs for improvement	1	13*
many aspects need update and improvement	1	3
need for annual review and update of all plan aspects	1	5
plan needs to be rewritten	1	3
updating roles and tasks of stakeholders	1	2
opinion of the National Plan for Natural Disaster Risk Reduction	1	13*
good	1	6
good but needs improvement	1	2
good with continuous evaluations and updates	1	5

* Indicates aggregated total

Theme 3 table 3

Theme	Files	References
Code		
Subcode		
Theme 3. Perceptions of emergency planning requirements	1	104*
perceptions of emergency planning requirements	1	13*
aspects included in planning	1	7
need to consider association between climate change and flash floods	1	3
optimism about future of emergency planning	1	3
rebalancing emergency planning with focus on community	1	13*
no	1	3
yes but should be done with caution	1	3
yes it is possible	1	7

* Indicates aggregated total

Theme 4 table 1

Theme	Files	References
Code		
Subcode		
Theme 5. Perceived challenges	1	22*
challenges and deficiencies	1	22*
changes to flash flood pathways	1	2

Theme	Files	References
Code		
Subcode		
climate change issues	1	3
inadequate human and equipment resources	1	2
lack of coordination and cooperation among stakeholders	1	5
lack of flash flood risk database	1	6
poor or incomplete infrastructure	1	2
poor training	1	2

* Indicates aggregated total

Appendix 11: Publications

The following papers have been published in a peer-reviewed journal or conference:

- Alrehaili, Naif. R. (2021). A Systematic Review of the Emergency Planning for Flash Floods Response in Saudi Arabia. *Australian Journal of Emergency Management.* 36 (4), 87-93. https://knowledge.aidr.org.au/resources/ajem-october-2021-a-systematic-review-of-the-emergency-planning-for-flash-floods-response-in-the-kingdom-of-saudi-arabia/
- Alrehaili, Naif. R. (2021). An Investigation into Emergency Planning Requirements and Challenges of Disaster Management in Saudi Arabia. *International Journal of Disaster Management.* 4 (3), 1-10. https://doi.org/10.24815/ijdm.v4i3.21722
- Alrehaili, Naif. R. (2021). Emergency planning requirements for flash floods response in Saudi Arabia. *Proceedings of 2021 the Society for Risk Analysis (SRA) Annual Conference,* 5-9 December 2021, Herndon Parkway Suite 450 Herndon, VA, USA.
- Alrehaili, Naif. R. (2022). A Structural Review on Disaster Management Models and Their Contributions. *International Journal of Disaster Management.* 5 (2), 93-108. http://www.e-repository.unsyiah.ac.id/IJDM/article/view/27087/0
- Alrehaili, Naif. R. (2023). The Need for Emergency Management Models. *Journal of Emergency Management and Disaster Communications.* 4 (1), 1-15. DOI: 10.1142/S2689980923500021. https://www.worldscientific.com/doi/abs/10.1142/S2689980923500021
- Alrehaili, Naif. R. (2023). Flood Preparedness in the United Kingdom and China: A Comparison Study Focusing on Social and Economic Factors. *International Journal of Disaster Management.* 5 (3), 181-192. DOI:https://doi.org/10.24815/ijdm.v5i3.28854.https://jurnal.usk.ac.id/IJDM/article/view/28854.

- Alrehaili, Naif. R. (2023). The Significance of Using Models in Emergency Management. *Proceedings of the 6th Global Summit of GADRI,* 15th to 17th March 2023, Organised at the Disaster Prevention Research Institute (DPRI), Kyoto University, Uji Campus, Kyoto, Japan.
- Alrehaili, Naif. R. (2023). Evaluation of Emergency Planning Approach for Managing Disaster in the Kingdom of Saudi Arabia. *Proceedings of the seventh Nothern European Emergency and Disaster Studies Conference (NEEDS 2023),* 31st of October till the 2nd of November 2023, Organised at the University of Twente, Enschede, the Netherlands.
- Alrehaili, Naif. R. (2023). Exploring the Emergency Planning Requirements: A Qualitative Research Study at the Kingdom of Saudi Arabia. *International Journal of Disaster Management.* 6 (2), 165-178.DOI: https://doi.org/10.24815/ijdm.v6i2.32602