



An Emergency Preparedness Framework for Sand and Dust Storms (SDSs) in Kuwait

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Declaration

I confirm that this thesis is my own work, and that all published material or other sources consulted have been acknowledged within the text and in bibliography. I confirm that this thesis has not been submitted for a comparable academic award.

According to the University of Salford regulation I have also signed and submitted a declaration stated that:

This is to certify that the copy of my thesis, which I have presented for consideration for my postgraduate degree: -

1. embodies the results of my own course of study and research
2. has been composed by myself
3. has been seen by my supervisor before presentation
4. has been granted the appropriate level of ethics approval

Musaed Al-Qattan

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Abbreviations

AERONET	Aerosol Robotic Network
CAMS	Copernicus Atmosphere Monitoring Services
CCA	Civil Contingency Act
EM	Emergency Management
EMA	Watch Emergency Management Australia
EMAP	Emergency Management Accreditation Program
FEMA	The Federal Emergency Management Agency
GAW	The Global Atmosphere
GHG	Green House Gases
IAEM	International Association of Emergency Management
ICAP	International Cooperative for Aerosol Prediction
IFRC	International Federation of Red Cross and Red Crescent Societies
KISR	Kuwait Institute for Scientific Research
MENA	Middle East and North Africa
NAAPS	Navy Aerosol Analysis and Prediction System
NGO	Non-governmental Organizations
PSC	Public Service Commission
SDS	Sand and Dust Storm
SDSs	Sand and Dust Storms
UN	United Nations
UNEP	United Nations Environmental Programme
UNISDR	United Nations International Strategy for Disaster Reduction
WHO	World Health Organization
WMO	World Meteorological Organization

Abstract

Background

The current literature suggests that there is a lack of preparedness framework for Sand and Dust Storms (SDSs) globally and regionally and the existing disaster response strategies are not fit for purpose. Evidence suggests that research is warranted in this area. Thus, this research aims to investigate and develop the emergency preparedness framework for SDSs in the state of Kuwait.

Methods:

In this research an initial framework was designed to inform further research. Consequently, to understand what the current level of preparedness for SDSs within Kuwait is, and what is the possible method to integrate community-based approaches within existing disaster mitigation frameworks. Two studies using different methods were planned and conducted in Kuwait City. The first study was a questionnaire-based study that was distributed to 700 members of the community, of which only 398 responded. The second study involved interviewing 26 members of the emergency services. The results of the two studies were used for the development of the emergency preparedness framework. This in turn was used in the discussion held in the form of focus group study with 12 top emergency managers for framework validation.

Results

The findings showed that people in Kuwait consider SDS to be very severe and are aware of SDS related to health issues. However, when it came measures that need to be taken due to SDS the Kuwait community were unaware on what needs to be done. The respondents accept that there is more to be done by emergency departments during SDSs. Surprisingly, health organization was not significant in any preparedness plans according to members of the community. The findings also showed that SDSs responders need to change their approaches to improve their reaction time during SDS events. The Kuwaiti community was not satisfied with the information that was published on SDSs or with the support that was provided by civil defense, fire department, emergency services, red cross, and health organization. The Kuwaiti community did not attend or get involved with aspects related to SDSs, such as sharing knowledge and responsibility through attending meetings, developing emergency plans, preparing emergency supply kits, or training others.

Interviews with experts showed that the challenges that faces SDSs preparedness were slow warning system, pressure on financial resources and on emergency agencies, need to coordinate efforts and develop a disaster management framework, improve communications, training and research and allocate the proper resources. The framework resulted from the first two studies suggested different measures to control SDSs including long-term measures such stabilizing the soil and improving warning system. Global cooperation was also lacking at the moment in Kuwait response to SDSs according to some experts' views.

In the focus group 5 themes were identified. These were the need to improve preparedness, the need for education at all levels, better coordination between agencies, improve warning system and communication and implementing long-term solutions.

Conclusion

The results suggest that the preparedness plan in Kuwait should be improved and the main point raised is the need of establishing an authority to coordinate the effort of the different departments to deals with SDSs. There is also a need for a broad and specific education programme and training plan to improve both the governmental and the community-based response. The final emergency preparedness framework, presented here, is a starting point to increase the maturity level of emergency preparedness

and to undertake further research.

Recommendations

- Through SDSs bespoke governmental regulations and the relevant legislations the response to SDSs must be improved according to research findings and expert views and recommendation from global organizations of concern such as WHO.
- Education of the community on SDSs must be part of a campaign to raise the readiness of the community.
- A central coordinating authority to deal with SDSs should be created and coordinate all actions on the preparedness plan as per the framework.
- Continuous feedback and dissemination of information between different Ministries and Departments is essential.
- Provide training for all emergency departments to enable them to act swiftly when SDS events are happening.
- Global and regional cooperation is also essential.
- Active research targeted at improving preparedness should be prioritised and disseminate findings.
- All media outlets should be activated when early warning system provide information about an SDS event.
- The community at large, including nomads and marginalised groups, should engage in the SDSs preparedness plan.

CHAPTER 1: INTRODUCTION

In this chapter the research problem statement and questions will be outlined after a brief background on the Sand and Dust Storms (SDSs) in The Middle East and globally. The rationale of the research and why this research is aimed to develop a framework as a contribution to knowledge is also presented and discussed in this chapter. This chapter should be viewed as a summary of the approach to study SDSs preparedness in Kuwait. It will be followed by a detailed literature review on the SDSs and the different emergency plans and frameworks used in countries other than Kuwait. The literature review will then be followed by a further account of the profile of Kuwait as far as SDSs are concerned. After the methodology chapter three studies are presented and then a general discussion and conclusion chapter.

1.1 Background

The Middle East region is described as notorious for sand and dust (SDSs) storms (Moridnejad, Karimi, & Ariya, 2015), although much of the dust in the Middle East is locally generated, substantial amounts of dust arrive from the Sahara and north eastern Africa (Middleton & Goudie, 2006). According to climate change projections (UNEP, 2016), the Middle East is expected to become drier, and the intensity and frequency of SDSs will consequently increase (Shepherd et al., 2016). In this regard, the UNEP, (2016) report states that dust emissions showed an annual increase of 20 to 50%. However, SDSs frequency and intensity does not follow a fixed pattern. Their seasonal timing is governed by a range of factors, including rainfall patterns. They are result of interlinked factors like wind, dry and arid land, and human interventions.

SDSs are derived from wind, which causes particles of sediment to be released from the grounds surface in the lower atmosphere (Shepherd et al., 2016; UNEP, 2016). SDSs originate from desert and semi-desert areas, which explains why the material they carry is commonly referred to as “desert dust” (Middleton, 2017). The likelihood of a dust storm forming depends on the wind speed and the soil’s level of vulnerability to surface disturbance (Gemma et al., 2016; UNEP, 2013). Main areas with high SDSs intensity extend from the North Africa’s west coast, Middle East, Central and South Asia, to China. Small SDS concentrations also found in the North America Great Basin, South America, Australia and southern Africa (Prospero et al, 2002).

Although SDSs have some positive impact like providing ocean waters with nutrients and fertilize forests (Goudie, 2014; Wiggs, 2011), they have adverse effect on human health, environment and

economy. In terms of economy, SDSs can have an immediate term effect, a long-term effect, or both (Shepherd et al., 2016; UNEP, 2016). There are direct effects related to material costs pertaining to instantaneous human health problems (e.g. Fungal disease) and mortality; annual and perpetual crop destruction; livestock mortality; infrastructural damage (e.g. cable lines and construction); costs of removing sand from infrastructure (e.g. roads, airports, power facilities); interruption to transport (air, road, rail) and communication, and road traffic accidents. Research on the economic costs of SDSs remains somewhat limited, and a comprehensive and accurate analysis that would cover all segments of the economy is virtually non-existent (Tozer & Leys, 2013). Hence, reported figures on economic losses are often deflated, and the real economic damage of SDSs can be much higher (Middleton, Tozer, & Tozer, 2019).

The negative impact of SDSs on the environment is disturbing the earth's radiative balance because airborne dust affects solar radiation (Goudie, 2014; Middleton, 2018; Middleton, 2017; Middleton et al., 2019; Yahya & Seker, 2018). Therefore, this alteration can result in climatic variations and drought intensification (Highwood & Ryder, 2014; Yahya & Seker, 2018). It has been also reported that cloud optical properties can be altered as a result of interaction with dust particles. Put differently, dust can affect cloud formation and may inhibit precipitation (Al-Dousari, Doronzo & Ahmed, 2017).). Moreover, when dust falls on glaciers, it can speed up their melting process (Martin, Jacob, Yantosca, Chin, & Ginoux, 2003). It has been also demonstrated that wind erosion is a major contributor to land degradation (Arimoto, 2001; Ravi et al., 2011). This is because it removes fine soil particles that retain organic and nutrient matter. In turn, land degradation not only leads to reduced soil productivity, but also, it contributes to climate change through the production of greenhouse gases.

The exposure to SDSs can result in serious health problems. Such problems are attributed to the biological and chemical properties of dust. According to World Health Organization's (WHO, 2013) reports, it has been found that airborne dust pollution impacts on people's health in a greater degree than other pollutants. This is because when dust particles are transported, they absorb both atmospheric and anthropogenic pollutants, including nitrate ions, sulphate, ammonium and different metal compounds (Onishi et al., 2012; Xiao et al, 2018). SDSs can also carry bacteria, spores, fungi and potential allergens (Behzad, Mineta, & Gojobori, 2018; Schweitzer et al., 2018). Not surprisingly, researchers have found that lower respiratory infections, lung cancer and cardiovascular problems are associated with chronic exposure to fine dust particulates (Smith, Griffin, McPeters, Ward, & Schuerger, 2011).

A strong connection has been also found between exposure to dust particulates and a range of respiratory disorders such as pneumonia, tracheitis, aspergillosis and non-industrial silicosis, better known as the “desert lung syndrome” (Behzad et al., 2018; Chien, Lien, Yang, & Yu, 2014; Nieder, Benbi, & Reichl, 2018; Schweitzer et al., 2018). Researchers have also found that several diseases can be caused or aggravated by airborne dust. These include cardiovascular disorders, bronchitis, eye infections, emphysema, (e.g., stroke), (Chien et al., 2014), skin irritations, (García-Pando et al., 2014), meningitis and valley fever (Shepherd et al., 2016; Sprigg et al., 2014). Added to this, reduced visibility as a result of SDSs is reported to contribute to mortalities and injuries in motorway accidents (Call, Wilson, & Shourd, 2018; Goudie, 2014). Furthermore, De Longueville, Ozer, Doumbia, & Henry, (2013) indicate that compared to healthy individuals, those who have pre-existing cardio-pulmonary conditions have a higher morbidity and mortality rates as a result of inhaling dust.

Managing SDSs, like other types of emergencies, “requires considering four interrelated phases of disaster management cycle including: Mitigation, Preparedness, Response and Recovery” (Cao, Zhu, Han, & Zhu, 2018; Himes-Cornell et al., 2018). In order to prevent, protect, respond, mitigate, and recover from emergencies like SDSs, preparedness is crucial. A variety of critical activities and tasks that are required to improve, sustain, build, and improve the effective capabilities of related organization must be in place.

1.2 Research Rationale

Given the adverse effects of SDSs, there have been growing concerns over their negative impacts. According to UNEP (2016) report, such concerns are reflected in the increasing number of studies on SDSs since the early years of the 20th century (Gemma et al., 2016). Those studies have been influenced by research in the field of disaster, or emergency, management and risk information technologies (Dempsey, 2014; García-Pando et al., 2014; Gemma et al., 2016), and they cover a wide range of issues, including the natural and anthropogenic drivers of SDS; their sources, causes, economic and environmental impact; also policy of measuring their mitigation at all levels of the globe. However, researchers’ efforts, the protective measures, and initiatives they propose have resulted in important reductions in the desertification process and, consequently, in less frequent and less intense SDSs in many parts of the world (Shepherd et al., 2016; UNEP, 2016), in other words, conducting research on SDSs is not without problems.

The main focus of most studies on SDSs is on their characteristics, sources, causes, trends, impacts

and the technical measures and policy actions taken before the dust storm event to mitigate its negative impacts (Goudie, 2014; Middleton, 2017; Middleton, 2018; Middleton et al., 2019; Shepherd et al., 2016; Yahya & Seker, 2018). In those studies, reference to recovery and relief efforts and to the actions individuals or communities can perform to face the adverse effects that can lead to an emergency have little reference.

In fact, unlike research on other types of disaster or emergency (e.g. floods and hurricanes) where preparedness is seen central to the management and control of the impending emergency, research on SDSs pays little, if any, attention to the preparedness phase. This is either because SDSs are usually encountered fully in countries of the Middle East and other parts of the world in which emergency preparedness is not fully developed or it is because the expectations are that preparedness plans developed for other emergencies can be adapted for or employed in SDSs events. However, while it is true that losses in human life and damages to property as a result of SDSs are less than those caused by more serious types of emergency like: hurricanes and earthquakes (Al-Hemoud, Al-Sudairawi, Neelamanai, Naseeb, & Behbehani, 2017; Shepherd et al., 2016). There is an evidence that the impact of frequent SDSs as in Kuwait cause considerable impact on economy and particularly halt oil production for long period. People's life are also affected negatively.

Short and long-term effects of SDSs on human health, economy and the environment are considerable, especially in countries where they are more common and violent (Gemma et al., 2016; UNEP, 2016). Added to this, the possibility of a secondary hazard developing into an emergency cannot be excluded. This is the case especially when preparedness plans, or frameworks to deal with the hazard, are not in place. For example, Fatemi, Moslehi, & Ardalan, (2015) report that because people were caught unprepared when a fifteen- minute SDSs hit the Iranian capital Tehran in 2014, five people were killed and another 84 injured as a result of flying debris, broken masonry and fallen trees. Power supplies were also knocked out, telecommunication towers were toppled, essential services were disrupted, and it took 7000 emergency workers to restore those services back to normality.

1.3 Problem Statement

The examples mentioned above not only demonstrate the possibility of a SDS leading to an emergency, but also illustrate the importance of hazard knowledge and public awareness which are at the centre of any emergency preparedness plan (Kapucu, 2006; Sutton & Tierney, 2006). There is need for a robust decision support framework to guide preparedness and to ensure response is adequate and fast. In this respect, there is a good reason to claim that a preparedness plan or a framework to respond to SDSs

(and other forms of emergency for that matter) in Kuwait is required due to the following reasons:

Kuwait (a desert state) is considered as one of the most vulnerable countries to SDSs and is affected by 15 to 20 powerful SDSs each year. In recent years, there has been a considerable change in the pattern of SDSs in the country and they are getting more violent and frequent. The increase of SDSs escalates the damages and losses and impact on health. Also, it has a huge negative socio-economic impact (Middleton et al., 2019).

There is limited research in the area of hazard preparedness within Kuwait. As a matter of fact, research in the field of emergency and disaster management in the country is almost totally ignored, and even a database with records of hazards and emergencies in the country is non-existent (Al-Hemoud et al., 2017).

Response to recent SDS highlight the need to enhance community level preparedness. Communities in Kuwait are often caught unprepared for SDSs because they are often not aware of the hazard until it strikes; they usually underestimate the dangers involved in SDSs and the harmful consequences of exposure to dust; and they receive little support and guidance from public agencies in their efforts to cope with, counteract or recover from SDSs.

Preparedness framework were developed elsewhere to mitigate and respond to emergencies. This will be reviewed fully in the literature review chapter (Chapter 2). For example, WHO developed a strategic framework for Emergency preparedness which was of great use in many emergencies around the world (WHO, 2017). Frameworks of preparedness offered guidelines and road map to how to respond to emergencies and anecdotal evidence as well as the literature consulted suggested that there is no such framework in use in Kuwait in case of SDSs.

The preparedness framework is needed to enhance readiness of a prepared plan that has the potential to effectively respond and recover from the adverse effects of SDSs in Kuwait. This is precisely the problem that the present study attempts to address with focus on community preparedness. This thesis aims to develop such a framework based on concrete data from the literature, community viewpoint and experts' knowledge gathered in the field.

The community, in this thesis, refer to all members of the society who are exposed to SDSs. It consists

of families with children and individuals of different backgrounds, ethnicities, ages, social statuses, income and levels of education. This is an important aspect of the research as some members of the community are nomads and usually unaccounted for in any research. Hence, more will be gained by addressing the hazard preparedness needs of all social units instead of targeting one community or group.

Finally, the focus of this thesis is to develop a framework rather than plan. The rationale behind this approach is that the framework is more flexible conceptual approach to resolving an issue while a plan is the specific step by step protocol to resolve an issue. Therefore, framework is *“more advantageous than a strategic plan in the current era of fast-moving changes and technological advancements”* (Garden, 2017).

1.4 Research Questions

Based on the abovementioned discussions, key research questions guiding this research include:

1. What are existing methods of SDSs mitigation globally and regionally?
2. What is current level of preparedness for SDSs within Kuwait;
3. What is the possible approach to integrate community-based approaches within existing disaster mitigation frameworks within Kuwait?

At the end, the hope is to develop a model framework that can guide both research and response to SDSs in Kuwait and beyond. Subsequently the research will be guided to develop a methodology to answer the following specific questions:

1. What are the causes and trends of SDSs in Kuwait?
2. What are the issues that Kuwaiti community face due to SDSs?
3. What are t existing SDSs readiness practices in Kuwait?
4. What is the awareness of Kuwait community regarding response to SDSs?
5. What are the practices that are observed by Kuwait community during SDS?
6. What are key barriers to implement preparedness framework as a plan in terms of SDSs in Kuwait?
7. How effective are the current measures and practices by emergency services for addressing SDSs hazards in Kuwait?
8. What is the satisfaction level of Kuwait community on emergency responses during

SDS?

9. How can Kuwaiti community better prepare for SDSs related hazards?
10. How results from this research could be generalized to other countries in the region and globally?

1.5 Research Aim and Objectives

The aim of the study is to develop an emergency preparedness framework for Kuwaiti community in relation to sand and dust storms.

The following objectives need to be met if achieving this goal is to be possible.

1. To critically review literature on the emergency management, the nature and trends of SDSs in Kuwait.
2. To investigate the global best practices of preparedness during SDSs
3. To study the impact of SDSs on community in Kuwait
4. To explore the current preparedness plans in Kuwait during SDS.
5. To critically evaluate barriers to implementing preparedness plan for addressing SDSs in Kuwait.
6. To develop and validate a preparedness framework for SDSs.

1.6 Study Scope

Although the negative impacts of SDSs have been widely investigated, researchers hardly refer to the impact of this natural phenomenon on community. For example, only a few studies provide brief estimates of sand removal costs from houses after the storm event (Middleton et al., 2019; Tozer & Leys, 2013). In fact, there is a lack of reference on the community preparedness plan for SDSs in Kuwait. More significantly, the different emergency departments in the country and the community at large lack a preparedness framework linking all the departments and community actions and specify the maturity level that they should aim for. Hence, it stands to reason that in order to develop an effective framework that should inform future emergency plans, particularly in countries where disaster management research is totally absent (as is the case in Kuwait), primary data need to be exhaustive, comprehensive and informative. This is a challenging task as it is widely acknowledged that compiling vital data is a tiring process that can take years. However, the scope of this research is to collect the essential data from the community and emergency experts on how Kuwait respond or should respond to SDSs to develop a framework that should work as a baseline for future development of SDSs preparedness plan.

1.7 Study Contribution to Knowledge

Literature on disaster (emergency) management abounds with discussions on preparedness plans and frameworks targeting different types of disasters. With reference to Kuwait, SDSs research is mainly focused on describing this natural phenomenon and documenting its impact on selected areas of the economy. Only one study alludes to green belts as a SDSs mitigating measure, and research on emergency preparedness remains totally absent (Al-Dousari & Al- Awadhi, 2012; Al-Hemoud & Neelamani, 2015). Hence, by developing a community preparedness framework for SDSs, the present study will contribute to knowledge by providing not only useful findings to those who are responsible for public education campaigns and emergency services, but also a guidance for Kuwaiti researchers to advance preparedness plans, according to the framework developed in this thesis, targeting other forms of emergencies (e.g. floods, earthquakes) and other sectors (e.g. schools, public organisations). Moreover, this study will highlight awareness of researchers on the priority of disaster (emergency) management as a field of research.

1.8 Conclusion

Ongoing trends related to climate change necessitate an in-depth investigation into how impact of SDSs on communities can be mitigated. Nevertheless, there is a lack of preparedness plans and specifically preparedness framework for SDSs globally and regionally. In addition, specific problems related to SDSs are not very well integrated within existing disaster response strategies. In the Middle East at large, and in Kuwait specifically, there is limited understanding of the significance of having a framework to coordinate both the community and emergency departments' effort to deal with SDSs. There is a gap in the existing knowledge. This PhD programme of studies aims at answering the following questions:

1. What are existing methods of SDSs mitigation globally and regionally?
2. What is current level of preparedness for SDSs within Kuwait;
3. What is the possible approach to integrate community-based approaches within existing disaster mitigation frameworks within Kuwait?

CHAPTER 2: LITERATURE REVIEW

In this chapter, the key literature on sand and dust storms (SDSs), their impact on health, environment and economy is explored. In addition, the literature focused on community preparedness, the concept of emergency management, different theoretical models related to preparedness, emergency preparedness and best practices related to SDSs are reviewed and critically appraised.

2.1 Emergency Management

Emergency management is defined as the managerial functions which help to create a supportive structure for the communities to reduce the danger of hazards and cope with the situation of disasters and emergencies. In the concept of emergency management, the dimensions and actors are varied. The actors involved are government institutions, non-government or academic institutions. There is a common understanding of emergency management, however, each actor has its unique method of defining the concept of emergency management; therefore, it has the potential of becoming a confusing concept. The researcher must examine the scope of the literature to map out the variety of definitions within them. Definitions from academic institutions, international institutions which are named within the United Nations International Strategy for Disaster Reduction (UNISDR), and from government organisations like, Federal Emergency Management Agency (FEMA) must also be considered. The motive behind selecting various definitions for research is to establish a specific concept of emergency management.

By reviewing the literature, it has been observed that the two terms 'emergency' and 'disaster' can be used interchangeably. The difference between the two terms can be related to the number of human deaths and how capable a community is to deal with the situation. Hence, there is a need to differentiate between the terms of emergency and disaster.

Disaster is an unexpected situation which may affect people, a system, the workings of a society and the environment (IFRC, 2014). Some authors have defined a disaster as being an unexpected situation which may happen on a large scale and may have negative impacts in the form of loss of property, an increase in the death rate of humans and being destructive to society (Perry, Lindell, & Tierney, 2001; Quarantelli, Lagadec, & Boin, 2007). The authors of both studies elude to loss of lives at large scale being an indicator of disasters.

In the viewpoint of Quarantelli et al. (2007), the 9/11 attack was perceived to be a disastrous event because of the high death rate and wider spread destruction, and in comparison to how disasters in

Asia are responded to, there was no support are requested from other countries. Nevertheless, the word 'emergency' refers to those incidents which negatively impact society, with other countries also having the same view towards the concept of emergency. According to the UK's Civil Contingency Act (CCA, 2004), an emergency can be termed as the situation or conditions in which serious damage to life, property, esteem and social status of individuals is caused in a specific society due to war, terrorism or any other sort of security issue. In the same definition, which is adopted by Australia, there is a requirement of coordination in the emergency which is defined as a real event that may be dangerous to human life, harmful for the environment, and causes loss of property (EMA, 1998).

There is a requirement of quick response from police forces and rescue authorities to help when dealing with dangerous situations that are harmful to human life and damaging to property. Hence, in this research, the term 'emergency' is defined as an unexpected situation or event that requires urgent response to limit damage. The word 'disaster' has been defined as a high-risk event, which may impact human life, be harmful for the environment and could potentially damage property. Both terms: 'disaster' and 'emergency' may overlap.

2.1.1 Definitions of Emergency Management

Haddow, Bullock, & Coppola (2017) viewed Emergency Management, as in many countries, as the practice of planning institutional arrangements that guide and prepare the government, non-government bodies, volunteers and private agencies to act in a coordinated and comprehensive manner when responding to any severity of emergency. This definition covers the points related to emergency management which includes the utilization of an organisation's processes and procedures. As stated by the International Association of Emergency Management (IAEM), there is a need for the cooperation of all the elements of emergency management. According to the IAEM, emergency management is defined as "the managerial function and creating a supportive structure for the society or community to reduce the danger of risk and some appropriate mechanism to cope up with those disasters" (IAEM, 2013).

Emergency management not only considers the processes and procedures, but it based on the comprehensive principle. The comprehensive principle is also known as the systematic approach which may lead to all stages of Emergency Management and its standards (Haddow *et al.*, 2017). These four stages are the key to the comprehensive principles of emergency management which are widely used in many countries at the national level (Haddow *et al.*, 2017). These principles are essential and helpful for collecting the available resources which are required to meet the needs of people during and after

an emergency. It is also helpful to mitigate for emergencies in the decision-making process. For instance, the US agency for the management of emergencies, FEMA, 2015, argued that "Emergency Management is defined as an organized analysis of planning, decision making and to address the distribution of available resources (lessen the effect of or prevent)". Emergency management needs to prepare a response to all risks that hazardous situations present.

As per the views of FEMA, the main aim of emergency management is to avoid damage, to save the lives of humans and prevent damage to the property and environment while an emergency takes place. There are more academic definitions which define emergency management as the planning process. It is the appropriate mechanism used to reduce the effect of emergencies and provide relief from any negative impacts whether they are economic, social, or environmental (Nimpuno, 1998).

Waugh (2015) determines that emergency management is helpful in enabling societies to live without fear of hazards related to technology and the environment. It is essential to manage and accept the risk as part of life and risk management is important for the survival of the society. In relation to addressing the harmful effects of a disastrous event on a society, past events are analyzed to allow a modern society to create a supportive framework for the management of environmental and technological risks to decrease the impact of risk on human life and property (Wilson & Crouch, 2001).

Wilson & Oyola-Yemaiel, (2001) stated that emergency management is the risk management function. This definition may not describe the specific kind of risk, but it increases the awareness towards the process of management of risks and their impacts. This definition mainly focuses on the impact of risk by measuring the adequate preparedness framework which is beneficial for communities. Effectiveness in risk management is only achieved using proper mechanisms and a supportive framework.

Therefore, it is clear from this review that emergency management is a complicated subject, requiring significant resources and effort. Moreover, levels of perception, argument and explanations can vary significantly as professionalism varies significantly across the globe. Views on emergency management are also influenced by culture and religion which shape the response of communities. Lack of agreement and coordination about a generic definition among national, as well as international, organisations are also apparent. Hence, for the objectives of the present study, the Michigan Department of State Police's definition of emergency management (EM) will be considered: a holistic

system of policies, procedures and practices designed for the purpose of safeguarding people and property from the implications of emergencies or natural calamities (Michigan DOSP, 1998). It covers resources, mechanisms and capabilities to alleviate against, react to, plan for and recover from consequences of several hazards. Furthermore, it facilitates a common framework for all types of hazards along with the four stages of EM. Moreover, the definition lines up with the key aim of the presented research.

2.1.2 Emergency Management Lifecycle

Emergency management (EM) is part of a continuous process (Metzger, Baird, & Monroe, 2010). It plays a vital role for governments, when emergencies are manageable by local or state sources before the federal or central level become involved (Haddow *et al.*, 2017; Haddow & Haddow, 2013). Thévenaz & Resodihardjo (2010) suggest that the focus of emergency management is on all the required procedures for protecting the public during natural or man-made events. Most of the literature characterizes four main phases for emergency management by mitigation, preparedness, response and recovery (Cao *et al.*, 2018; Himes-Cornell *et al.*, 2018).

Over the last few decades, research has focused on understanding and examining phases of the emergency management lifecycle, to enhance decision making (Sotoodeh & Kruchten, 2008). These phases are placed into four categories to help emergency commanders analyze, plan and make decisions using the available resources to mitigate and recover from the potential harm caused by emergencies (Trim, 2003). All these phases are essential components in addressing different hazards (DuVernoy, 2002a).

These stages are helpful for the emergency commanders analyzing, planning, and decision making as they use the collective resources for the purpose of addressing and recovering the potential risk which is caused by the emergencies (Trim, 2003). These stages are an important component for mitigating different kinds of risk. Researchers and academic scientists use the term ‘emergency management’ to refer to the management of disasters (Haddow & Haddow, 2013).

EM is internationally recognized as a discipline and shares similar frameworks. For instance, in the UK a comprehensive approach for all hazards incorporates mitigation, preparedness, response and recovery (O’Brien & Read, 2005). In an equitable manner, in the United States, FEMA has also specified these four crucial stages of EM; that are, mitigation, response, preparedness, and recovery (DuVernoy, 2002a). Meanwhile, Canada and Australia share resembling norms (PSC, 2011, EMA,

2004). These stages are demonstrated as the complete principle of EM that is extensively used worldwide for disaster management and emergency management (Bullock, Haddow, & Coppola, 2011).

EM seems to be a reactive approach based on comprehensive principles. It incorporates risk measures, an all-hazards approach and parts of community coordination. These principles are focused on the domain of emergency management policy of directorate in Canada. The policy refers to EM as the management of emergency situations concerning all-hazards inclusive of varied practices and risk management tactics related to preparedness, mitigation, recovery and response. Similarly, these principles have been confirmed by Emergency Management Australia (EMA). This has been recognized as a comprehensive approach to EM, which includes four key phases of activities that enhance hazard reduction and improve the community or environment resilience to all hazards (Abrahams, 2001, EMA, 2004, DuVernoy, 2002b).

Emergency management is defined as the managerial functions which help to create a supportive structure for the communities to reduce the danger of hazards and cope with the situation of disasters and emergencies. The process of emergency management is described as the cycle which is interrelated with each stage: mitigation, preparedness, response and recovery (Seneviratne, Amaratunga, Haigh, & Pathirage, 2010; Warfield, 2004; RICS, 2009 –Figure 2.1).



Figure 2.1: Emergency Management Lifecycle. Haddow *et al.* (2017)

All these stages are crucial for emergency situations to be effectively handled by multiple emergency response agencies. According to Haddow *et al.* (2017), emergency management is defined as the preparation for disasters and emergency situations while also coordinating responses and management

protocols, rather than resources. There are many components for determining emergency management, some of which are given below.

2.1.2.1 Mitigating Risks to Minimize Societal Impact

Researchers are not firm in their explanation on the topic of mitigation, the term of mitigation is often considered as “*advanced actions taken to prevent and minimize the damage caused by the disaster*” (Tierney, 2006). Haddow et al. (2014) have stated that mitigation is a process of engaging in the activities that reduce or eliminate the disaster’s probability. In addition to this, mitigation is seen as the long-term activities that are performed to decrease effects and potential risks from disaster. According to FEMA (2015), appropriate choices should be made by the emergency manager and commander that help the community to reduce the long-term risk and be more resilient to future emergencies and disasters. Mitigation actions can be also taken after an emergency had occurred in the light of lessons learned from that emergency (UNEP, 2016). It involves removing or reducing the likelihood or results of a hazard. Mitigation looks to treat the hazard so that its impact on society is minimal.

2.1.2.2 Preparedness for an Emergency

EM lifecycle’s second phase is preparedness. It emphasizes on plans and preparations taken before a situation of emergency occurs to enhance the rate of response, support and rescue operation. In the stage of preparedness, the ambulance, fire department, and police collaborate with each other in a situation of emergency (Xu & Zlatanova, 2007). In the views of Haddow et al. (2017) coordination among emergency agencies and organisations is essential. Therefore, a systematic approach is needed amongst emergency managers and traditional emergency services. The systematic approach for a preparedness lifecycle has been identified by the FEMA national preparedness directorate (FEMA, 2011, Homeland Security, 2008). Those steps include planning, organisation and equipment, training, exercise, evaluation and improvement.

Furthermore, Johnson (2000) has stated that in the time period of preparedness, the government, along with individuals, makes action plans in order to reduce damage and save property and the lives of people affected by the situation of emergency (Subramaniam, Ali, & Mohd Shamsudin, 2010). This phase also includes all the activities that pertain to the examination of potential effects on life, property and the environment. Therefore, the preparedness phase involves all the requirements and actions for determining hazards, in order to deal with emergency response problems. Hence, it is evident to

implement the mitigation formulas and measures of preparedness in order to take appropriate tasks that are vital for reducing the risk from disaster.

In literature relevant to preparedness, the term is sometimes conflated with mitigation. For example, the American Emergency Management and Accreditation Program (2019, p. 2) defines the term preparedness as “the range of deliberate, critical tasks and activities necessary to build, sustain, and improve the operational capability to prevent, protect against, mitigate against, respond to, and recover from disasters”. The National Fire Protection Agency and Federal Emergency Management Agency, FEMA (as mentioned in Tierney, 2006) see efforts of mitigation as part of preparedness. In general, the term preparedness is defined as “the action taken prior to the incident of disaster in order to make sure that the acts taken to mitigate the risk from the disaster provides relief and helps in early recovery from the damage from the disaster” (Hayward, 2011; Coppola, 2007, p. 209). The preparedness phase is about providing necessary equipment and tools for people who may be able to help people affected or impacted by an emergency. The aim of preparedness is to minimize financial and other losses, whilst maximizing the chance of survival.

2.1.2.3 Response to Disasters and Emergencies

The stage of response is very important, and its objectives are saving property and life of the affected people. It covers all the activities that are the prime concern of the agencies in situations of emergency and afterwards. If preventive actions are taken adequately it helps in reducing the ill effects of a situation of emergency and ensures stability after the occurrence of emergency. Therefore, the stage of response is the stage in which the plans of the agencies and the government are converted into actions (Doyle, Paton, & Johnston, 2015; Ford & Schmidt, 2000; Subramaniam et al., 2010). According to Madry (2015), emergency response is the immediate response where actions are taken to save lives and property, involving crucial steps such as search and rescue, providing shelters, medical assistance, water and settlement. These actions are targeted to meet human needs after an incident, moreover, they involve the implementation of action plans that support short-term recovery (Wex, Schryen, Feuerriegel, & Neumann, 2014). It can be observed that, the term emergency response refers to events or situations that can be managed by a local agency through the process of standard operational procedures (Thompson, Altay, Green III, & Lapetina, 2006).

Although Xu & Zlatanova (2007) recognize the considerable importance of the four phases of EM, they regard the response and recovery stages as the most vital because they require immediate attention from response teams. Success is dependent on quick and informed decision-making between

emergency agencies, to provide immediate relief and support (Abrahams, 2001; Greitzer, Podmore, Robinson, & Ey, 2010). Furthermore, response is the most complex phase compared to other EM functions as it includes high stress, in an extremely pressurized time, with limited information (Coppola, Froio, Merli, & Chiumello, 2015).

For the purpose of this research, the response phase is the focus because Thévenaz & Resodihardjo (2010) emphasize that it is the stage that covers all the activities needed to save and maintain human lives. This stage is indeterminate, as it can last for days or many months, depending on the severity of the event. It is also the focus of this research because as a disaster unfolds, the first responders are usually local police and fire services, not state or federal agencies. Their roles and responsibilities are to secure the location, save lives, minimize damage to property and the surrounding environment and start the process of restoring order (Haddow et al., 2017). Consequently, this research will focus on the response phase, to minimize the impact of the hazards on the search, rescue and emergency relief services. Furthermore, this is a phase where critical decisions should be made by the responders.

Notably, Coppola et al. (2015) emphasizes that the response to an emergency does not only require activities such as immediate actions, search and rescue, but also contains structures and systems to support these activities. Response refers to the actions taken, and efforts made to cope with the event as it takes place. In other words, it involves making decisions and taking action to remove or reduce the impact of the emergency or disaster that has happened or is happening (Tierney, 2006). These actions and decisions should be taken and made in order to prevent further financial loss or suffering.

2.1.2.4 Recovery from Emergencies

The final stage of EM is recovery and incorporates special preparation that is made to restore numerous infrastructures of society such as electricity, transport services and water (Subramaniam et al., 2010). As per the EMA, the tasks of recovery incorporate activities that support the people of the region affected by the situation of emergency in their restoration of social, emotional, physical and economic wellbeing. It also supports reconstruction of infrastructure (EMA, 2004, p.4). The activities of recovery are made to benefit society by returning it to normal functionality (Thompson et al., 2006).

The activities of recovery are divided into two main parts, long term and short-term recovery. Activities that provide relief to the affected community in the short-term are providing shelters, food and medical assistance for a few weeks. In the second category, the activities of short-term recovery are performed but for a long time period such as for months or years (Homeland Security, 2008).

Haddow et al. (2017) assert that recovery is a process that is characterized by a set of decisions which should be made by communities. Many decisions must be made including rebuilding homes, restoring businesses and rebuilding infrastructure, in order to return the community to normality.

Recovery is concerned with the reconstruction and restoration of services to their original pre-event condition. These types of activities include returning the life of the affected community back to normal (Tierney, 2006). In most cases, the phase of recovery starts immediately after the end of the phase of response, and a large number of groups consist of the professionals that are participating in the four phases of recovery (Himes-Cornell et al., 2018; Madry, 2015; Warfield, 2004, ISDR, 2004).

2.1.3 Emergency Management Principles

In the views of the group made up of practitioners of emergency management and professors at the emergency management institutes and US Federal Emergency Management Agency (FEMA), there are mainly eight principles working as a base for the standards of EM (EMI, 2007). These eight principles are described below:

- Comprehensive - It assures that the strategies of emergency managers should consider all phases, stages, hazards, impacts and stakeholders in relation to the situation of danger. The principle of comprehensiveness is not limited to a single phase, stage, hazard or stakeholder.
- Progressive - The emergency managers should forecast the disaster and take necessary preventative actions in order to take preparatory and mitigating measures in order to make safe and disaster-resilient communities.
- Risk-driven - Emergency managers should utilize a clear principle in managing the risk and define priorities in preventative actions and allocation of resources. It is vital to identify affected stakeholders and manage the impact on them.
- Integrated - Emergency managers should collaborate and coordinate with government organisations, agencies and community members. This principle focuses on the fact that management decisions of an emergency situation are not restricted to the government and also include members of the community affected by the situation of disaster. It does not specify the community members and considers and all stakeholders and members of the community that need safety in the situation of danger.
- Collaborative- emergency managers should develop trust and healthy relationships between individuals and organisations, support a healthy environment in the team and provide a proper channel of communication between them.
- Coordinated - emergency managers should coordinate and sync activities of the management

of disaster in order to fulfil a common goal of all affected stakeholders.

- Flexible - emergency managers should implement innovative and creative strategies to reduce the effect of the disaster on the affected community.
- Professional - Emergency managers should implement strategies based on scientific research and experience, whilst regularly training members and focusing on improving services continuously.

The principles described above require the guidance of the four-phase approach of the lifecycle of emergency management as described in Section 2.2.2. It is important because the stage of EM defines the type of activities taken by managers whilst also affecting decisions such as whom the managers consider as stakeholders.

2.2 Sand and Dust Storms

2.2.1 Sand and Dust Storms Definition

Sand and dust storms are classified as events of the lower atmosphere which occur due to erosion from wind which causes the release of particles that are settled on the surface of the ground (UNEP, 2016). SDSs arise from semi-desert and desert areas, that are labelled as deserts due to having high levels of dust (Middleton, 2018; Middleton, 2017). The likelihood of a dust storm forming depends on the wind speed and the soil's level of vulnerability to surface disturbance (Table 2.1).

Table 2.1: Minimum speed of wind for various desert environments (UNEP, 2013)

Environment	Minimum speed wind
Fine areas that have medium sand along with sand dunes	16 to 24.1 kmph
Area of sand that have inappropriately developed desert pavement	32.2 kmph
Fine material presented in desert flats	32.3 to 40.2 kmph
Crusted salt flats and Dry lake beds	48.3 to 56.3 kmph
Well-developed desert pavement	64.4 kmph

The World Meteorological Organisation (WMO) defines SDSs as a raising of a large amount of dust particles in the air by the massive flow of wind and reduced visibility of the eyes to 1000 meters (McTainsh & Pitblado, 1987; Shao et al., 2011). In this respect, although the term, “sand and dust storms” appears to refer to sand and dust as distinct entities, there are no strict rules to distinguish between the two terms. However, it is widely accepted that particles greater than 60 microns are

described as sand and particles smaller than 60 microns are referred to as dust (UNEP, 2016). In general, the heavier sand particles are usually associated with low altitudes and the finer dust particles reach higher atmospheric levels. However, this is not a rule because both sand and dust particles are often found in any one single storm, and they both may travel thousands of kilometers from their original source (Ibid).

The area that is most heavily affected by high intensity of SDSs begins from the North African west coast, encompasses the Middle East and reaches as far as China, Central Asia and South Asia. South America, the Great Basin area in North America, Southern Africa and Australia are affected by SDSs of small concentrations (Prospero et al., 2002). The Middle East region, in particular, is described as a major source of dust (Middleton, 1986). Although much of the dust in the Middle East is locally generated, substantial amounts of dust arrive from the Sahara and North Eastern Africa (Middleton & Goudie, 2006). According to climate change projections, areas in the Middle East are expected to become drier, hence increasing the intensity and frequency of SDSs (UNEP, 2016).

Definitions of a sandstorm and a dust storm are almost similar, with the only difference being the size particles in the storm. As previously explained, sand particles are larger than 0.06mm (60 microns). If the storms consist of sand particles, for instance in the sandy desert, a large number of particles will pile up to a few meters above the ground. Sandstorms are low in latitudes and have a restricted extent of aerial elevation.

Many WMO synoptic codes are utilized for defining dust storms by the observers at the meteorological stations (Middleton & Goudie, 2006). According to WMO, blowing dust is the event in which the eye's visibility is reduced from ground level to 1000m above ground. Dust haze is the whirling columns of particles of dust that move along with the wind. Deflation and transport of the wind leads to generating the movement of particles due to the processes of creep, suspension and saltation. Particles that are bigger than 500 microns in diameter tend to creep on the surface of the land. Saltation is the process in which the wind blows the particles between 70 and 500 microns in size to a height below 1.5 meters. Suspension is associated with the transport of the particles that are less than 70 microns in size to a more considerable distance (Pye, (1987); Figure 2.2). Sandblasting is an activity where the saltating particles bombard soil aggregates which results in aggregate fragmentation and further release of particles that are small in size (Pye, 1987; Shao et al., 2011; Shepherd et al., 2016).

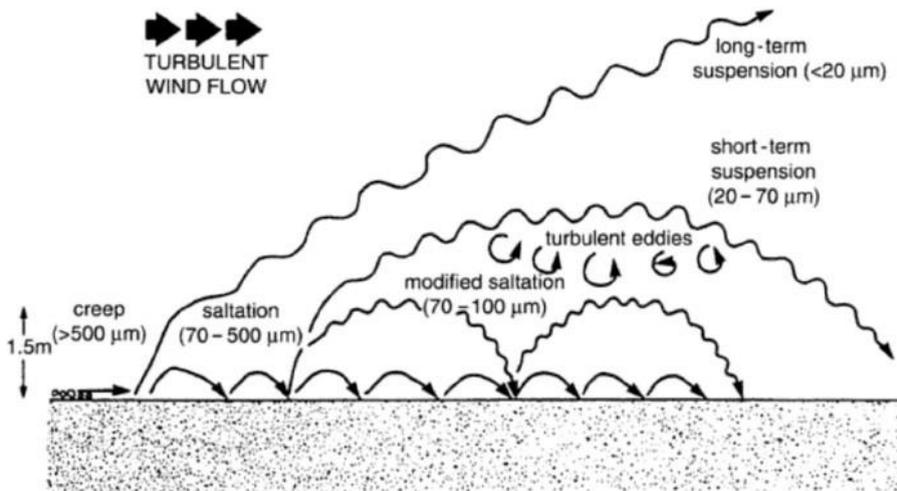


Figure 2.2: Particle Transportation Types (Pye, 1987)

2.2.2 Sand and Dust Storms Mechanism

The atmospheric events that occur due to the transport and erosion of sediments are termed dust and sandstorms. They relate to the semi-arid and arid areas but may occur in areas of unprotected sediment that are dry in nature (Middleton & Goudie, 2006; Ravi et al., 2011). The process of formation of dust and sandstorms is associated with three phases which are: erosion and emission of the materials from the surface, transport of the particles in the atmosphere and deposition of particles (Figure 2.3).

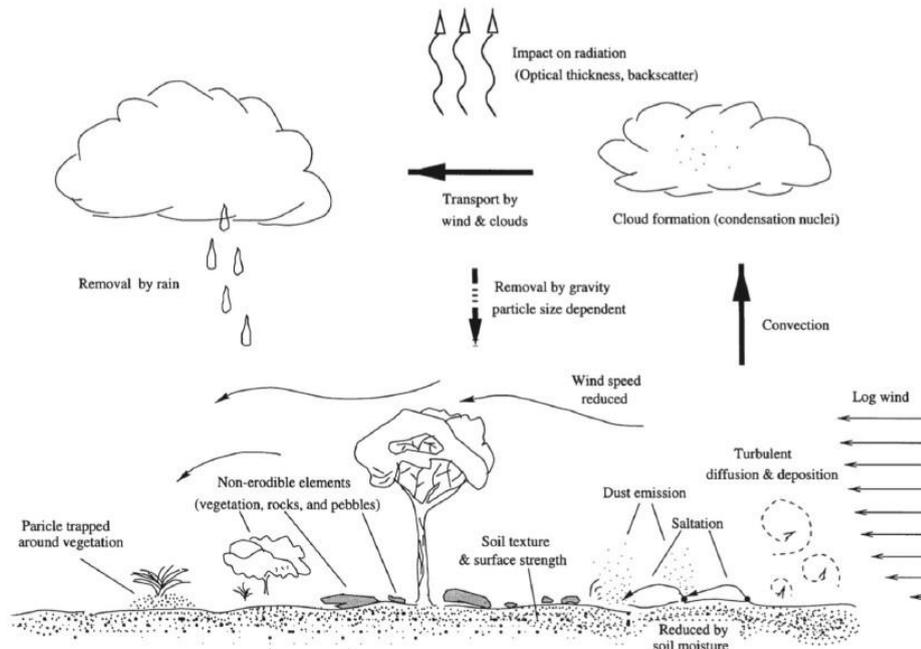


Figure 2.3: Simple description of the processes of sand and dust storms (Lu & Shao, 2001)

Particles entrainment happens in conditions when the shear stress of the wind exerted becomes higher than the capacity of the particles to refuse the process of transport and detachment (soil or sediment

erodibility). The term wind erosivity is defined as the product of characteristics of the flow of wind and velocity of wind, especially in the case of turbulence (Wiggs, 2011). Moreover, vegetation, roughness and characteristics of landform are vital in determining the erosivity (Wiggs, 2011). Wind systems also affected the conditions of local wind in the larger area, and thus, depend on physical factors such as: utilization of land, stability of surface or the wind erosion's resistance which relies on the extent of cover provided with material of non-erodible nature and the erodibility of particles at the surface (e.g. rocks, plant litter, or snow cover). A large amount of dust particles come from the surfaces of minerals that do not have soil formations on top. For insistence in the case of playas and lake beds (ephemeral lakes), erodibility depends on the size of the particles, composition of the minerals and the content of moisture present on the surface.

The process of sediments are hypersensitive towards sand storms and related to the internal drainage of large basins that have extensive deep deposits, however, sand dunes are associated with the movement of sand instead of fine dust particles (Prospero, Ginoux, Torres, Nicholson, & Gill, 2002; Thomas, 2011). Erodibility is also dependent on the density and structure of the soil that is associated with the organic material of the soil (Bronick & Lal, 2005). Physicals of soil such as gravel, skins of clay and silt or the biological crusts due to algae, bacteria and algae also increase the opposition to the erosion of wind (Dunkerley, 2011). In some of the arid zones, crusts of the biological materials play an important role in the protection of soil erosion but are affected by anthropogenic activity (Anderson et al., 2005; Belnap & Gillette, 1997).

The types of dust storms that are naturally frequent are connected to particular types of synoptic meteorological conditions that are different in every region. These include according to Knippertz, (2014) the following:

- i. Steep gradients of atmospheric pressure in the anticyclones of the subtropical region,
- ii. Surface cyclones and fronts associated with them,
- iii. Monsoonal airflows,
- iv. Local wind,
- v. and dust devils and convective plums

The distance of the deposition of particles from the source relies on the shape and mass of the particles, as well as other factors such as turbulence and wind speed. The dust presented in the atmosphere may be deposited by the process of precipitation known as wet deposition and gravitational settling known as dry deposition. The proposition of wet or dry deposition depends on the region, for instance, dry

deposition dominates in the interior region of China and the Mediterranean region, while wet deposition dominates in the North Pacific (Zhao, Gong, Zhang, & McKendry, 2003).

A large amount of transported materials of the coarser type settle within ten kilometers of the source of the storms, while the dust storms can transport the sediments thousands of kilometers away. Thus, dust storms cross the political boundaries of nations and affect the process of mitigation of hazards of sandstorms. For instance, the dust of the Saharan region is transported to the Amazonia, Europe, North America, China and the Middle East. Dust from the regions of China and central Asia are transported to Japan, Korea and North America (Middleton & Goudie, 2006).

2.2.3 Nature and Trends

The frequency and intensity of SDSs do not follow a fixed pattern, and their seasonal timing is governed by a range of factors including rainfall and snow patterns. During the 20th century, dust emissions showed an annual increase of 20 to 50% (UNEP, 2016). In recent times, the frequency and intensity of SDSs have increased in some areas whilst decreasing in other areas (Middleton & Goudie, 2006).

Sand and dust storms are a result of interlinked factors. These are related to wind, dryness of the land and human intervention. Wind is the main driver of sand and dust storm emissions. The meteorological conditions that generate it vary considerably from one part of the world to the other (Ginoux, Prospero, Gill, Hsu, & Zhao, 2012). However, according to the estimation of the agencies, 32 million square km of land are affected by the problem of erosion due to wind, and approximately 17 million square km of land does not have vegetation (Gill, 1996). In this situation, it is evident that vegetation provides resistance in the flow of wind, it lowers the stress on the surface of the ground and reduces the emission of soil (Knippertz, 2014).

Regarding human intervention, landscape management can often lead to land degradation and thus contributes to wind erosion and sand emission. Soil can be eroded through unsuitable farming practices, removal of forests, development of communication lines and roads, making new infrastructure and disturbing the hydrology around the water resources in urban areas (Gill, 1996). For instance, the Owens Lake in California created a new source of dust storms (Cahill, Gill, Reid, Gearhart, & Gillette, 1996; Gillette, 1999), as did Central Asia's Aral Sea (Micklin, 2007) and northwest China's Lake Ebinur (Abuduwaili et al., 2008). It is estimated that approximately 75% of global emissions of dust

comes from natural resources and 25% from anthropogenic sources. In addition to this, hydrologic sources contribute to 85% of anthropogenic sources (Shepherd et al., 2016; UNEP, 2016).

2.2.4 Impacts of SDSs

Although SDSs have some positive impacts in that dust provides ocean waters with nutrients and fertilizes forests (Goudie, 2009; Wiggs, 2011), discussions are usually focused on their negative impacts on human health, the economy and the environment (Shepherd et al., 2016).

2.2.4.1 Human Health

Many studies provide evidence that exposure to SDSs can result in serious health problems. Overall, such problems are attributed to the biological and chemical properties of dust (US Environmental Protection Agency). As per the World Health Organisation's (2013) report, airborne dust pollution is found to be the most hazardous pollutant that affects human health. This is because when dust particles are transported, they absorb both atmospheric and anthropogenic pollutants, including nitrate ions, sulphate, ammonium and different metal compounds (Onishi et al., 2012). SDSs can also carry bacteria, spores, fungi and potential allergens (Call et al., 2018). Not surprisingly, researchers have found that lower respiratory infections, lung cancer and cardiovascular problems are associated with chronic exposure to fine dust particulates (Smith et al., 2011).

A strong connection has been also found between exposure to dust particulates and a range of respiratory disorders such as pneumonia, tracheitis, aspergillosis and non-industrial silicosis, better known as the 'desert lung syndrome' (Behzad et al., 2018; Derbyshire, 2007). Researchers have also found that a number of diseases that can be caused or aggravated by airborne dust including emphysema, bronchitis, cardiovascular disorders, skin irritations, eye infections (Chien et al., 2014), valley fever (Shepherd et al., 2016) and meningitis (García-Pando et al., 2014).

Added to this, reduced visibility as a result of SDSs is reported to contribute to mortalities and injuries in motorway accidents (Goudie, 2014). Furthermore, it has been found that compared to healthy individuals, people with pre-existing cardio-pulmonary conditions have higher mortality and morbidity rates as a result of inhaling dust (De Longueville et al., 2013).

Different chemical, physical, biological and chemical properties of airborne dust have impacts on human health. Vast amounts of airborne mineral dust of streamlined sizes are respirable that causes

various respiratory diseases in humans, stated by the US Environmental Protection Agency defined coarse particles as of size between diameter of 2.5 and 10 microns (PM_{2.5} - PM₁₀) and fine particles of size equal to 2.5 microns (PM_{2.5}) wherein PM₁₀ is concerned with the particles of size equal to or less than a diameter of 10 microns. Respiration of these fine dust particles is a risk to health.

Reports by from the World Health Organisation (WHO, 2013) found that particle pollution due to dust affects people's health more than any air pollutant. This is because the lack of a safety threshold to which influence of these harmful mixtures of inorganic and organic substances and chemicals could be reduced. The lasting impact of dust particles results in early death because they cause lower respiratory infections such as pneumonia, lung cancer and respiratory and cardiovascular diseases. Respiration of dust particles does not only expose human to harmful mineral materials, but also expose them to dangerous combinations of bacteria, spores, pollutants, potential allergens, and fungi carried along with harmful mineral dust (Kellogg et al., 2004; Smith et al., 2011). It has been stated that dust particles could ingest various anthropogenic atmospheric waste materials during transport integrating nitrate ions, sulphate, a large compound as well as sulphate compounds and thus results in exposing to windblown dust that is increasingly linked with causing a wide range of health-related problems.

Long-term and acute influence of harmful dust could have a wide range of adverse health impacts. Still, while the worldwide concern of human health impact caused from dust storms and airborne mineral dust is identified to be significant, the area has lacked attention, for instance, by addressing the issue with regards to transportation, energy generation as well reducing emissions from industry. However, few long-term systematized researches have been conducted on health consequences in areas with significant dust (De Longueville et al., 2013); whilst the level of dust in these areas far exceed ideal air quality standards (Ginoux et al., 2012). For instance, Brown et al. (2008) found the average annual values of PM₁₀ denseness in Kuwait to range from 66 to 93 $\mu\text{g}/\text{m}^3$, whilst PM_{2.5} particles were observed to be between 31 to 38 $\mu\text{g}/\text{m}^3$. Both of these concentrations exceed the air quality guidelines provided by the World Health Organisation, wherein the annual mean for PM₁₀ and PM_{2.5} have been reported as 20 $\mu\text{g}/\text{m}^3$ and 10 $\mu\text{g}/\text{m}^3$ respectively (WHO, 2006).

The health impacts of SDSs can be seen worldwide, especially impacting people in adjacent and arid regions such as areas in the Middle East (Thalib & Al-Taiar, 2012), North Africa (Merrifield, Schindeler & Smith, 2013), Australia, Middle East, China (Yan et al. 2012), Mexico, and US SouthWest (Grineski, Staniswalis, Bulathsinhala, Peng, & Gill, 2011). The areas far from the major dust regions are also exposed when high, and long-reach atmospheric transport carries dust with itself,

for instance, from Mongolia and China to Korea and Japan (Hong et al., 2010). Fairlie, Jacob and Park (2007) have found that the dust in the Asian region contributes significantly to accumulate denseness in North America. Similarly, Prospero and Lamb (2003) found African dust to be a major contributor in impacting the air quality standards of the US, making up a high percentage of airborne materials in the South Florida region at summertime.

Of the world's entire population, the elderly, children, outdoor laborers working in exposed areas are the groups most at risk of developing respiratory and airborne diseases due to SDSs. Expectedly, those with existing conditions such as lung and heart affluence, heart disease, asthma, allergies and chronic clogging pulmonary disease have increased risk of being affected by excess sand and dust particles in the air.

Cardiovascular Issues

WHO relates mortalities and admissions to cardiovascular hospitals directly to windblown dust. This is backed by a growing number of studies highlighting how mineral dust emissions from desiccating lands result in causing various cardiovascular and respiratory sicknesses (Giannadaki, Pozzer, & Lelieveld, 2014; Goudie, 2014; Morman & Plumlee, 2013).

Dust particles moving to Taiwan from Asia's desiccate lands has been related with increasing the probability of heart and respiratory diseases, caused due to restraints in the supply of blood from the heart to tissues (a condition known as ischemia) (Bell, Levy, & Lin, 2008).

A study of 39 Dust Storm events in Taiwan found that emergency visits in cardiopulmonary increase alongside increases in PM10 concentrations. This results in increasing cerebrovascular patients by 20%, ischemic heart patients by 35%, cardiovascular patients visits by 67% and Chronic Obstructive Pulmonary patients by 20% at the time of high dust events in relation to pre-dust period (Chan et al., 2008). Additionally, in Japan, the accumulation of Asian dust has resulted in increasing cardio-vascular patients by 21% (Ueda, Shimizu, Nitta, & Inoue, 2012). Similarly, more than 1000 suffocation cases were found in Baghdad in 2005 due to increases in dust storms (Middleton & Goudie, 2006).

Respiratory Disease and Asthma

It has been found from epidemiological studies in Spain and Italy that respiratory disease among the elderly has raised significantly due to Saharan dust events (Sajani et al., 2011; Jiménez, Linares, Martínez, & Díaz, 2010). Dust moving to El Paso from the Chihuahuan Desert has resulted in an increasing number of patients, especially children in hospitals for bronchitis and asthma (Grineski et

al., 2011). As asthma is the most non-communicable disease in the world which annually affects 334 million people, special attention is required to examine the role of mineral dust in exacerbating or causing asthmatic conditions.

Asthma is an acute airway disorder wherein contraction, and inflammation of close muscles to the respiratory system limits the flow of air causing breathing difficulties in humans. Examples of different causes that give rise to asthma for for example, integrating inhalation of dust, mould and pollen. Inhaling dust particles that provoke allergic reactions or irritate the airways is the significant risk factor that develops asthma (WHO, 2013). The biological effect of desert dust particles identified in human respiratory epithelial cells; an impact could be seen in mouse respiratory system injuries following harmful dust inhalation (Ghio et al., 2014).

The researchers have benefited from exploring the probable relationship between asthma and airborne dust in the Caribbean from constant dust measurement events conducted in Barbados by the Miami University since 1965 (Prospero & Lamb, 2003). The Respiratory and Caribbean Allergy Association found asthma symptoms by 17-fold in Trinidad and Barbados since 1973 (Shinn et al., 2000; Prospero & Mayol-Bracero, 2013).

The largest number of patients attending accident and emergency departments across the Caribbean was considered to be the rainy season (mid-May to December). The number of patients in accident and emergency departments across the Caribbean increases aggressively from September to December with Antigua in the north to Trinidad in the south (Monteil, 1998). The rainy season in the Caribbean passes with a maximum of Sahara dust particles transported to the Atlantic causing the more hazardous situation in the region; however, the proof of the relationship between Caribbean asthma and Sahara dust is still unidentifiable.

The significant increase in dust since the 1970s has to lead to the rise in asthma in the Caribbean region (McCarthy, 2001); however, some of the researchers argued that dust from the Sahara in Barbados is not the likely factor to increase asthma in this particular region (Prospero et al., 2008; Prospero, Blades, Mathison, & Naidu, 2005). Even though the dust from African region often comprise fungal spores, the impact of pollen and spores from the localized sources profoundly influence visits of asthmatic patients to the hospitals (Blades et al., 2005).

In addition to this, some researchers have found an increase in the admission of asthma patients in emergency department with an increase in dust in the Sahara region over Trinidad, this concludes that

the flow of pollens, dust, pollutants and microorganisms from Saharan region cannot be neglected (Mohammed et al., 2006; Gyan et al., 2005). In 2011, the increase of asthma emergency room visits in Archipelago of Guadalupe for children aged 5 to 15 years old was measured by Cadelis, Tourres, & Molinie (2014). Following their exposure to Sahara dust of PM_{2.5}–PM₁₀ and PM₁₀, the researchers found no statistical difference in the risk of asthma between the different genders and age groups of the children when exposed to dust of PM_{2.5}–PM₁₀ and PM₁₀.

It has been shown in epidemiological studies that an increase in allergic inflammation and clinical visits and increased admissions for diseases such as asthma passes-off with Asian dust storms wherein are being profoundly affected (Chang, Lee, Tsai, & Yang, 2006; Ueda, Nitta, & Odajima, 2010; Kanatani et al., 2010) (Kanatani et al. 2010; Ueda et al. 2010; Yang 2011).

The exposure of children to dust materials transmitted globally from desert storms; for example, in Texas (Grineski et al., 2011), Trinidad (Gyan et al., 2005) and Japan (Kanatani et al., 2010) are associated with an increasing number of children visiting hospitals for bronchitis and asthma. Additionally, asthma cases in Qatar are found to be rising by 30 percent during windy and very windy conditions (Teather et al., 2013). Asian dust is responsible for causing worse asthma symptoms that contain significant air pollutants and particulate materials (Watanabe et al., 2011), and is associated with creating several allergic reactions due to dust exposure (Otani et al., 2014, 2012).

Valley Fever

In relation to aspergillosis, airborne dust-related fungal disease cause “Valley fever” or coccidioidomycosis (Williams et al., 1979; Chao et al., 2012). There are many endemic hotspots to cause valley fever in waterless lands, especially in northern Mexico, northeast Brazil and the southwest US. The soil domicile fungal spores related to coccidioidomycosis (cocci) or valley fever are moved along with desert dust and is easily inhaled causing different respiratory disease (Pappagianis & Einstein, 1978).

It has been found that about 150,000 people exposed to Valley fever each year wherein about 30 people die from the disease (Flaherman, Hector, & Rutherford, 2007). The data of Arizona Hospital shows 1,735 patients visited hospitals for the treatment of Valley fever in 2007 (Tsang et al., 2010). The potential scope of the Valley fever is still unknown because of difficulties faced in surveying cocci and availability of less information in its endemic range in the Americas (Flaherman et al., 2007; Hector & Laniado-Laborin, 2005).

A large amount of dust crosses the into Mexico and Texas at the time regular dust events in the area; also the sources of dust in the US impacts the quality of air in Mexico (Yin & Sprigg, 2010). Although, it has not been found that how long the cocci spore can remain alive in the free atmosphere. One of the reports suggests that spores blown along with the storm from California have infected people living in Oregon (Barker, Tabor, Shubitz, Perrill, & Orbach, 2012).

Meningococcal Meningitis

Meningococcal Meningitis also refereed as cerebrospinal meningitis that is grounded by the bacterium *Neisseria meningitides* can result in causing severe harmful epidemics. It is spread through Person-to-person contact wherein respiratory droplets from infected person transmitted to a non-infected person (WHO, 2015). An extensive research in profoundly impacted areas represents seasonal occurrence epidemic cases of is strongly connected with the levels of high concentrations and low humidity of dust arisen during dry weather (Cuevas et al., 2007; Agier et al., 2013; Abdussalam et al., 2013) and occurrence declines significantly with the onslaught of the rainy season(Molesworth et al., 2002). However, the impact of the environmental condition on the transmission of cases has not been yet completely understood, and it is pretended that the inhalation of dust affects pharyngeal mucosa and result in causing bacterial infection.

An outbreak can take place worldwide; however, African “meningitis belt” a semi-water less area pairing the Sahel from Ethiopia in the east to Senegal in the west (involving 26 countries) has the superlative risk of arising airborne disease (WHO, 2015). As the successful initiative of the Group A meningococcus solution vaccine started from 2010, more than 220 million have been provided with the vaccine in fifteen countries that has resulted in disappearing *Neisseria meningitidis* serogroup A, however, various other meningococcal serogroups yet occur in smaller sizes and at a lower frequency (WHO, 2015).

Eye and Skin Infections

The impact of Asian dust on causing skin and eye infections have been reported causing conjunctivitis (Yang 2011) (Chien et al., 2014), itchy skin and eye. However, the symptoms are not identified as intense, the effect of dust on the sore throat as well as nasal congestion are also documented in healthy humans (Otani et al., 2012; Onishi et al., 2012).

2.2.4.2 Environmental

Research on the effect of SDSs on the natural environment has indicated that airborne dust impacts on solar radiation and results in disturbing earth's radiative balance. This disturbance in the earth's radiative balance causes drought intensification (Highwood & Ryder, 2014) and other climatic variations (Du et al., 2002). Additionally, it has been found that cloud optical properties could also be altered as an effect of interaction with air dust.

In other words, the formation of the cloud is influenced by dust which eventually affects precipitation (Maley, 1982). In addition to this, dust falling on glaciers increases the rate of their melting process (Martin *et al.*, 2003). From another demonstration, it has been observed that abrading wind also contributes to the degradation of land, because of the removal of fine particles of soil by wind, with which the essential nutrient substances also wear off. Therefore, it can be stated that disintegration of land contributes to the reduced productivity of land as well as contributing to the production of Green House Gases (GHG) (Arimoto, 2001; Ravi et al., 2011).

Dust and Biological cycles

Dust storms affect the global environment both positively and negatively because of their reach to other continents and the essentialness of dust in both oceanic and terrestrial biogeochemical cycles as well as climate (Figure 2.4). Many different interactions are quite tangled and difficult to understand even now (Knippertz, 2014). Effects of dust have been observed on the processes related to ocean, climate, biology and human (Washington & Wiggs, 2011). It can be understood with an example of fertilisation of both oceans and forests by dust, which is an important function of dust (Goudie, 2009).

Dust affects the biogeochemical cycles on a global level through various mechanisms. 75% of 2000 Mt of dust is discharged to the atmosphere, deposits on land (considering that land covers approximately 30% of the total surface area of earth). Only 25% of the dust goes to the ocean.

Dust emitted from the Sahara Desert acts as a fertiliser for the Amazon forest, by compensating for the phosphorus loss from the basin caused by the hydrological process (Yu et al., 2015). Central Asian dust provides nutrients to the Hawaiian rainforests, helping it in sustaining the forest productivity for a long period of time (Chadwick, Derry, Vitousek, Huebert & Hedin 1999). Another example is the influence of nutritional matters, derived from the dust on the Colorado Plateau's plant composition (Reynolds & Hunter, 2001).

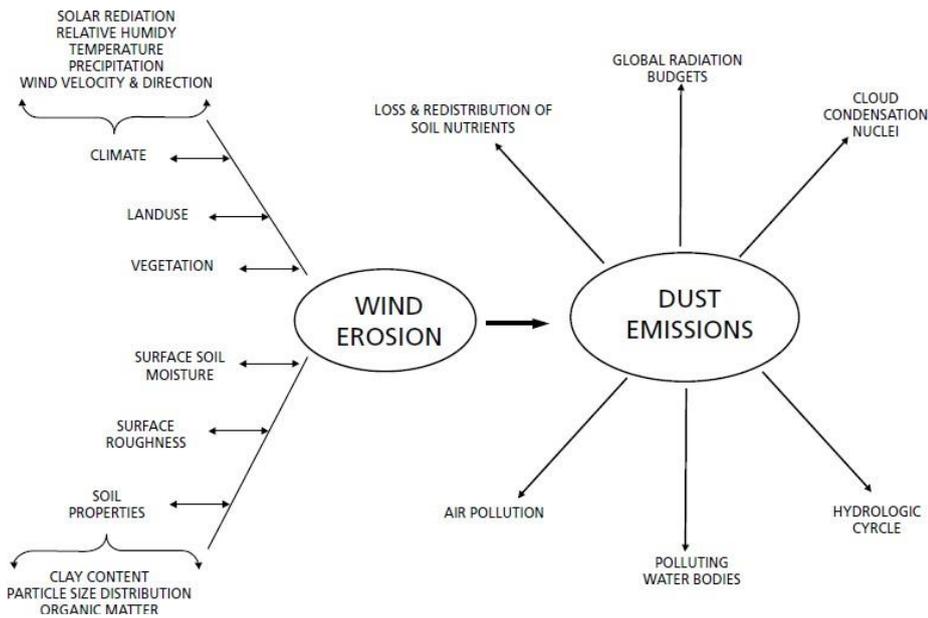


Figure 2.4: Factors affecting wind erosion and the resultant impacts of dust emissions on the environment (Ravi et al., 2011)

Oceans and Dust

Dust deposited on oceans is an important source of nutrients to the seabed and for the water at the surface of the ocean, which helps it in enhancing its fertility properties, particularly by emitting phosphorus restrictions to the fixated nitrogen and iron, which improves phytoplankton growth (Jickells, Boyd, & Hunter, 2014; Avila & Penueles, 1999; T. D. Jickells et al., 1998) (Jickells et al. 1998; Avila and Penueles 1999; Stuu 2014). The major source of new iron to some of the open ocean regions is the dust coming from the desert, as it contains small amounts of iron (Fung et al., 2000; Twohy, 2015). Iron acts as a primary micronutrient to the ocean (Boyd & Law, 2001; J. H. Martin, Gordon, & Fitzwater, 1991), and the deposition of iron has been related to the fixation of nitrogen in the ocean (Falkowski, Barber, & Smetacek, 1998). Almost half of the annual carbon dioxide generation and a dominating part of all carbon cloistered over geologic time is caused by ocean phytoplankton (Shao et al., 2011).

Varying dust fluxes to the ocean have the power to change the biogeochemistry of the ocean (Reiners & Turchyn, 2018; C. M. Moore et al., 2006; Aumont, Bopp, & Schulz, 2008). Mahowald et al. (2010) have conducted a demonstration, which showed that the patterns of dust deposition on the ocean enhanced its fertility by approximately 6% throughout the 20th century.

Asian and African dust may be having a negative impact on the coral reefs and many other American ecosystems. Nutritional substances, trace metal, microorganisms, and foreign organic compounds

found in dust which is deposited on the ocean and land as primarily responsible for the complex changes taking place on the coral reefs all across the world (Garrison et al., 2003).

Dust and Climate

As mentioned above, climate is affected by dust because of its role in the biogeochemical cycles particularly through the impacts on sea blooming and the surface temperature of the sea (Gautam, Liu, Singh, & Hsu, 2009), and through the different mechanism as a consequence of the reactivity of dust. Dust also has the potential to change the intensity of storms and cyclones. The loading of dust influences scattering and absorption of radiations coming from the sun, which can change the radiative balance of earth, which influences the intensity of draught (Han, Dai, Fang, Chen, & Kang, 2008; Highwood & Ryder, 2014).

Desert dust can also change the optical properties of ice and liquid clouds, and their lifetimes by interacting with them (DeMott *et al.*, 2003; Mahowald & Kiehl, 2003), as well as influencing the process of precipitation (Creamean *et al.*, 2013). Dust also changes the formation of clouds and their properties, and the nuclei of dust. It can act as a barrier of precipitation by reducing the size of the water particles considerably. They may also increase the precipitation by acting as nuclei for particles of ice (Nenes, Murray, & Bougiatioti, 2014; Toon, 2003). Dust can also have an indirect effect on precipitation through different impacts on activities of convection, which is the result of the varying temperature gradient (Maley, 1982).

Dust increases the rate of melting by getting deposited as mineral dust on the surface of glaciers and lowers its albedo (Oerlemans, Giesen, & Van den Broeke, 2009). The ozone layer in the troposphere also gets affected and their photolytic rates decrease down to 50% which increases the responsiveness of surfaces in order to support the processing of trace gases (Martin et al., 2003).

SDSs, Wind Erosion and Land Processes

The erosion and abrasion of wind is a dominating factor that causes the degradation of land, mainly in semiarid and arid regions (Middleton & Goudie, 2006; Blanco-Canqui & Lal, 2010). Wind erosion does not necessarily have to generate SDSs as it can damage the environment without that. In the process of wind erosion, the finer particles of the soils are removed which are the most important components of soil and contain most of the nutrients. Therefore, wind erosion reduces the biological, physical and chemical characteristics of the soil. This eventually reduces the productivity of soil and

other characteristics including the soils ability to give other ecological benefits like climate and hydrological regulations (see Section 2.3.3). Other losses caused by eroded material are abrasion of plant leaves and burial of plants under the sand blown (Ravi et al., 2011).

Particles of soil deposited on the surface of plant leaves hinder the process of photosynthesis (Squires, Restrepo, Garcia, & Dutton, 2018) and also decreases the capacity of plants to tolerate the effects of drought by acting as a desiccant (Burkhardt, 2010). The eroded matter also has pollutants and pathogens involved in it (Goossens, 2003). SDSs have been proven to be responsible for the death of livestock. In addition to it, soil also gets accumulated on the fence surface, which contributes to the increased rate of maintenance.

Deposited soil has contributed to the development of soil formation in different regions around the world. The most critical example is the effect of aeolian mechanism on the development of loess soils, also known as unconsolidated silt. This can take place on a large scale in both South and North America, China and rest of Asia (Muhs, Prospero, Baddock, & Gill, 2014; Middleton & Goudie, 2006). The process of aeolian also helps in the creation of duricrusts and stone pavements. In addition, they also contribute to the salinization and alkalinity of the soil, because of an accumulated soluble salt, which in effect reduces the acidity of soil (Middleton & Goudie, 2006). Dust particles deposited in deep sediments can also secure the organic carbon in soil from getting decomposed as the wind erosion exposes the organic matter in the soil which increases the rate of decomposition (Jacobs & Mason, 2005).

It can be concluded that there is a high scale of uncertainty relating to the impact of changes taking place in land uses and management in coming time and changes in climate on SDSs and emissions of dust, which is having large fluctuations (see Section 2.4.3), indicate an indefinite but huge impact on the environment. However, there is high-level sensitivity of the emission of soil particles to human interference, with large consequences relevant to climate and biogeochemistry (Mahowald et al., 2010). Considering the high sensitivity and impact of dust emissions on the environment, many systematic steps are needed to be taken in order to reduce the dust emission caused by humans.

2.2.4.3 Economic Impacts of SDSs

Economic impacts of SDSs are wide ranging, and they can have an immediate term effect, a long-term effect, or both (UNEP, 2016). Short term effects are related to the cost of substances related to urgent

human health issues, for example, breath related issues and other fatal diseases, damage to annual and perennial crops, damage caused to infrastructure, death of livestock and high cost of removal of sand from different components of infrastructure. For example, roads, airports, communication issues and barriers in transportation facilities. The long-term effects include cardiovascular diseases, erosion of soil, and deterioration of soil quality. Soil subject to solution through toxic materials deposited into it varies across worldwide climate regulations (Table 2.2).

Table 2.2: Economic effects of sandstorms (UNEP, 2016)

Immediate term	Long-term
Contiguous human health issues (e.g., breathing problems) and fatal diseases	Cumulative human issues of health (e.g., bronchitis, cardiovascular diseases)
Annual and perennial damage of crops	Eroding Soil and decreased soil quality
Livestock fatality	Sand contamination through mixing of toxic biological materials (fungi, bacteria) in the land, including heavy metals.
Damage caused to infrastructure (e.g., , electricity and telephone structures, buildings, power facilities, machinery, solar farms and greenhouses)	Disturbance of global climate control (through reviews including global warming, ocean fertility and CO2 generation, changes in precipitation, global ice, sea level, vegetation cover and hydrological cycle)
Price involved in cleaning dust from infrastructure (e.g., roads, airports, dams, canals used for irrigation, structures to control flood, ditches, power facilities)	
Interruption of transport	

Table 2.3: Cost involved in removing blown sand in the Middle East region (UNEP, 2016)

Area	Reference	Year	Cost (USD) of sand removal per cubic metre
Kuwait	Al-Dousari, <i>et al.</i> (in press)	1993	1.80
Kuwait	Al-Dousari, <i>et al.</i> (in press)	2013	5.33
Hafouf, Saudi Arabia	Alghamdi and Al-Kahtani (2005)	2004	0.50
Sistan, Iran	Pahlavanravie <i>et al.</i> (2012)	2000	2.00
Sistan, Iran	Pahlavanravie <i>et al.</i> (2012)	2004	0.50

Table 2.4: Financial losses because of SDS in northern China in spring season for period 2010 - 2013

Province	2010-2013		
	No. of storms	Affected cropland (1000 hectares)	Economic losses (USD millions)
Xinjiang	7	23	666
Inner Mongolia	3	600	67
Gansu	10	296	220
Ningxia	1	6	2
Shaanxi	1	3	9
Total	22	928	964

Converted from CNY at average rate for the period of USD 1 = CNY 6.4

Source: Yearbook of Meteorological Disasters in China (2011-2014), China Meteorological Press.

In the United States of America, the off-site soil erosion from the farms is dominated by the on-site loss in productivity of the soil. For instance, the expenses associated with the off-site erosion was reported to be approximately \$466 million annually and then the same was accounted to be only \$10 million for case of on-site erosion (Huszar & Piper, 1986). In South Australia, the cost associated with the off-site erosion was approximately between AUS\$11 billion to AUS\$56 million, which was mainly because of issues related to health (Williams & Young 1999).

Preventive measures for SDSs have not been given enough attention. The major preventive action used is the increase of vegetation in the land area which requires a large amount of effort and time before showing effects (as discussed in section 2.3). However, the other intervention strategies in the field of public health suggest that decreasing the level of critical risk factors in the overall population, including land area, reduce the possibility of damage (Shepherd et al., 2016). Increasing vegetation is considered to be the biggest cost-efficient strategy in decreasing the severity of negative impacts from SDSs in future (Shepherd et al., 2016).

2.2.4.4 Households

Studies on the impacts of SDSs in Kuwait are mainly focused on the economic costs to aviation, oil exports and exploration operations. Several studies were also conducted on the connection between

this natural hazard, the rates of road traffic accidents and the impact of airborne dust on human health. Only one study touched briefly on the effect of dust on different house parts and contents. In the discussion below, only the findings of studies are considered as directly related to members of the household. For example, a single adult living in a household usually owns at least one vehicle and so the impact of SDSs on road traffic is seen relevant to the purpose of the present study.

The relationship between SDSs and rates of road traffic accidents was investigated by Al- Dousari & Al-Awadhi, (2012); Khalaf, Abdul-Halim, Al-Qudsi, Al-Shatti, & Jafaar, (1988). They all concluded that SDSs were responsible for an increase in the rates of road traffic accidents and resulted in significant damage to property and vehicles. Al-Dousari & Al- Awadh., (2012), reported that one third of road traffic accidents occurring during a dust storm event was related to dust, and Al-Hemoud et al., (2017) found a strong correlation between SDSs and serious road traffic accidents. Ramadhan, (2015) provided evidence that road traffic accidents were more common when weather conditions were particularly dusty. For instance, on 18th April 2008 nearly 500 accidents, some involving serious injuries and casualties, were reported within the space of 48 hours during the severe dust storm that hit the country. Also, based on road traffic accident data for the period between 2008 and 2012, Al-Hemoud & Neelamani, (2015) found that throughout the country dust storms were responsible for 31 deaths.

Thalib & Al-Taiar, (2012) for more than five years studied the relation between the admission to hospitals because of diseases related to breathing and SDSs. It was found that 569 days out of the five years had incidents relating to a dust storm. The outcomes of this study had shown that during the storm incidents, the rate of admission in the hospitals increased considerably. It was also found out that children were more affected by these diseases. Another research conducted by Al-Taiar & Thalib, (2014) indicates that dust was a primary cause of asthma among youths in Kuwait.

Al-Enezi, Al-Dousari, & Al-Shammari, (2014) reported that polluted windblown dust was the major cause of respiratory and cardiovascular diseases. Similar findings were reported by Al-Hemoud et al., (2017) who found a strong connection between high concentrations of sand particles of 10 microns or smaller (PM 10), asthma, acute lower and upper respiratory tract infections. The properties of dust in Kuwait, relating to mineralogy were researched by Al-Hurban & Al-Ostad, (2010) whose results indicated that high amount of minerals including quartz, albite and gypsum was present in the dust. As per the study, inhaling those minerals is a possible cause of nasal irritation, sneezing, coughing and

even critical breathing issues like alkalosis and hypocalcaemia.

In the PhD thesis entitled, “Dust Storm Phenomena and Their Environmental Impacts in Kuwait”, Mohammed, (1989) argued that dust affects different house parts and contents and that the amount of damage created is dependent on the house type, location, the residents’ level of education and income. However, as is the case with the above cited studies, Mohammed, (1989) only describes the impacts, and makes no reference to any protective or precautionary measures or actions, nor does he mention the stakeholders’ perceptions of SDSs or the actual and potential roles of emergency services.

2.4 Global Best Practices for Sand and Dust Storms

There are various alternative ways of monitoring dust. Satellite products are used on a large scale authenticated with the ground parameters concerted with numerical simulation. It is easy to cover a large part using satellite products, ranging from a regional to a global level; frequent observation is possible which provided by climate centres and various other institutions in Near-Real-Time (NRT) (Benedetti et al., 2014).

It has been evaluated that the shortcomings of satellite measurements are generated due to its highly integrated nature in the atmospheric column, overall aerosol components, and low aerosol detectability over the bright surfaces. This practice generally affects the tools and instruments used to operate in varied parts of the spectrum that are visible as well as tangible. High resolution of infrared spectrometers and interferometers which are known as polar-orbiting satellite platforms, are generated due to this. Inertial Altitude Reference System (IARS) and the Infrared Atmospheric Sounding Interferometer (IASI) are the examples of such satellite platforms. These two polar-orbiting satellite platforms have the potential to provide appropriate quality of dust information (Hilton et al., 2012; Klüser, Martynenko, & Holzer- Popp, 2011; Peyridieu et al., 2010).

The latest generation of polar-orbiting satellites can be considered as excellent tools for monitoring the dust in the real-time. These satellites can collaborate with the specific advantages of the geosynchronous or the polar bodies in orbit, that facilitates high time resolution to the domain in significant volume in a geographic manner. Three genres or types of capabilities can be detailed with respect to the high-resolution radiometers, that are geometric, spectroscopic and radiometric.

With respect to the in-situ measurements of the radiometer for mapping air quality, data is monitored using the network associated with core surface data resources. Similarly, in the context of satellites, the air quality is measured using the process of integrating the contribution of varied types of atmospheric aerosol. Furthermore, the observation value of the integrated contribution is limited with

respect to the contraction of any particular matter which has less than 10 μm of diameter. Due to the low diameter of the satellites, the encompassment of the full-sized range of dust particles are released or generated in the atmosphere. On the other hand, consideration of selection from the provided or available states is necessary for the process of employing the process of dust monitoring that has been conducted in different cities, industrial parks, and roads. It has been evaluated that these areas of local human activities are also the main source of dust monitoring.

In addition to this, the stated areas are considered as the areas of local human activity as well as the main sources of dust monitoring. These geographical entities also tend to obscure the quantity and contribution of the dust with respect to the measured quantities. It has been evaluated that the air quality networks provide precise measurements that are of high spatial density in the developed countries; however, they are not present in the developing countries. In addition to this, the precise measurements are also highly sparse, rarely available in the real-time closure of the dust sources. Furthermore, there is no generic set of protocols for the routine of the international exchange of qualitative air and its data; thus, the satellite provides coverage and usage to the national level.

The Global Atmosphere Watch program (GAW) of the WMO, is an international body, who tend to provide international protocols to cover the gap between national, local and international bodies. The GAW Aerosol Programme focuses on determining the spatiotemporal distribution of the aerosol properties related to the forcing of climate as well as the quality of time up to the level of multi-decadal time scales. The Programme aims towards enhancing the coverage, effectiveness, and application of long-term aerosol measurements within the GAW by generating cooperative networks across the world. The key takeaways are increased harmonisation among the aerosol measurements and the promotion of coordinated networks.

The GAW initiative aims to reinforce coverage effectiveness as the application of the longer-term aerosol measurements. In this manner, GAW, as well as its networks at the global level, are focused on:

- Ensuring harmonisation in the aerosol measurements
- Promotion of the coordination in the network for observations
- Establishment of the GAW aerosol measuring system along with light detection and ranging network in cooperation with an existing network
- Contributing to the collaboration between satellite, aircraft, as well as surface-based aerosol

observations in alignment with the aerosol framework or system modelling.

- Providing support to the near-real-time aerosol knowledge exchange.

It has been shown that the vision of aerosol programmes need to be comprehensive, integrated and sustainable. Observations on a global level alongside the use and association with real-time analysis of the aerosol network complement crafts, satellite, and environmental agency networks (GAW Report No. 207). In addition to this, the GAW aerosol network consists of the 28 international stations in over two hundred regions. All these 28 stations are influential, operational and working stations (GAWSIS 2016).

It has been evaluated that the visibility data with respect to the meteorological observations are utilised for the purpose of gaining understanding and knowledge (Shao et al., 2003). The factor of visibility in this context is associated with the presence of water and aerosol in the outer atmosphere. Thus, it can be stated that the utilization of visibility knowledge needs to be complemented by the data with respect to weather conditions. In circumstances where there is reduced visibility, like fog and rain can be reduced with the help of hydrometeors. Ample data is present for describing the empirical relationship between the visibility and the mud surface in the literary sources (Camino et al., 2015; Shao et al., 2003) (Dalmeida 1986; Mohamed et al. 1992; Shao et al. 2003; Camino et al. 2015).

On the contrary, the relationship is restricted with respect to the outcomes that depict reduced visibility which does not solely depend on the factor of direct mass contractions, but also on the additional dimensions of the spectrum of particles and their factors including density, chemical and mineralogical composition, and region humidity. However, it has been noticed that these factors tend to have an effect on satellite knowledge. In addition to this, the direct-sun photometrical measurement is considered as one of the strong remote sensing tools, that provides the facility of retrieving the column-integrated aerosol microphysical and optical properties.

The Aerosol Robotic Network (AERONET), can be detailed as the comprehensive set of continental and coastal ground-based sun-sky scanning radiometers. Which is complemented by the meagerly distributed oceanic stations that provide large refined knowledge sets in the near-real-time (Holben et al. 1998; Dubovik and King 2000). Integral parameters such as aerosol optical depth are generally complemented with the spectral data. In addition to this, a significant defect has been evaluated with respect to the measurements of inconvenience caused by cloudy skies and dark atmosphere. The twin polarized measuring instruments has also been tested for the purpose of helping police investigations

in different emergency events.

Lidar, with the latest and up-to-date generations of the ceilometers, allows the routine of measuring the vertical aerosol profiles. On the contrary, the constant measurements are carried out in the ground-based stations that are solely distant from dirt sources. The Cloud-Aerosol measuring system along with orthogonal polarisation provides international spatial coverage of which the temporal resolution is restricted. Benedetti et al., (2014) provided a summary and well-accepted history of dirt predication, that is summarised in the following section.

As per the views of Westphal et al. (1987; 1988), satellite data is primarily developed with the help of 3D, size-resolving, full physics, and numerical dirt transport model, which is incontestable with respect to the usefulness of the quantitative simulations of the dirt storms.

In the following years, the idea of satellite data image processing was proposed as well as implemented for the purpose of ensuring adequate operational dirt prediction. Between 1991 and 1993, a formal version of the Dream Dirt model was implemented for the purpose of engineering the prognostic equations for dirt concentration with the help of region model drivers. The experimental daily dirt forecasts used to be carried out in the Republic of Tunisia, 1995, with the exploitation of the dirt Regional region model. Similarly, the Hellenic Republic, 1996-1997, used the SKIRON system which was a prognostication model. This model was operated by the University of Athens, and it provided with 3 days prognosis of the Mediterranean region (Kallos et al., 1997). In 1999, individuals from the United States of America Navy developed the Navy Aerosol Analysis and Prediction System (NAAPS). This system conducted reports on dirt, smoke and sea salt. Moreover, in the same year the (NAAPS) became the primary operational aerosol model. The operational forecasts became more accessible to a wide variety of quantitative weather forecasting and analysing centres across the world. Numerical models contributed to SDS-WAS are stated below.

Table 2.5: Numerical models contributive to the UN agency SDS-WAS, May 2016 (UNEP, 2016)

Model	Institution	Domain
BSC-DREAM8b_v2	Barcelona Supercomputing Center, Spain	Regional
CAMS	European center for Medium-Range Weather Forecast, U. K.	Global
DREAM-NMME-MACC	South east European Climate Change Center, Serbia	Regional
NMMB/BSC-Dust	Barcelona Supercomputing Center, Spain	Regional
MetUM	Met Office, U. K.	Global
GEOS-5	National Aeronautics and space Administration, U. S.	Global
NGAC	National Centers for Environmental Prediction, U. S.	Global
EMA REG CM4	Egyptian Meteorological Authority, Egypt	Regional
DREAMABOL	National Research Council, Italy	Regional
WRF-CHEM	National Observatory of Athens, Greece	Regional
SILAM	Finnish Meteorological Institute, Finland	Regional
CUACE/Dust	China Meteorological administration, China	Regional
MASINGAR	Japan Meteorological Agency, Japan	Global
ADAM	Korea Meteorological Administration, Korea	Regional

2.4.1. Copernicus Atmosphere Monitoring Services (CAMS)

It has been identified that the Copernicus Atmosphere Monitoring Services (CAMS) is an effective programme used throughout the European Union. It was developed for the purpose of facilitating operational data services. The main aim of CAMS was to provide industrial, societal, and individual policymakers with data and tools in order to comprehend and adapt to a dynamic environment whether it is associated with climate, a country's economy, or resilience.

In today's world, there is an essential environment related to different atmosphere compositions. It is evaluated that the rising greenhouse gases concentration and the impact of aerosols are found to be the significant drivers that lead to the change in the environment. At the surface of the earth, there are different harmful air gases that incorporate ozone, aerosols, and types of reactive gases like nitrogen dioxide adversely affecting the quality of the air, which, in turn, adversely affecting the health of humans and decreasing the level of life expectancy of every individual. In addition to this, the increasing level of distribution of ozone in the stratosphere is affecting the ultraviolet radiation that is reaching to the surface. It has been analysed that there are different elements such as volcanic aerosols, sand, dust, and smoke that adversely influences the operations related to the transportation, arrangement of rainfall and clouds, solar generation power availability, satellite sensing of the atmosphere, ocean, and land. The main purpose of formulating the CAMS tends to address the above-mentioned concerns by effective facilitation of the relevant data on atmospheric composition with the help of assimilation and modelling. All the significant and relevant data of CAMS can be accessible by the public in an easier manner.

2.4.2 International Cooperative for Aerosol Prediction (ICAP)

The International Cooperative for Aerosol Prediction was created as a forum to exchange experiences and share artistic solutions to common issues. ICAP was established when 2 first conferences fell in Spring 2010 in Oxford (Sessions et al., 2015). These conferences were documented in Reid et al. 2011 and Benedetti et al. 2011. Since then, many alternative conferences have taken place. The primary target has varied from aerosol observability and verification to source/sink processes, ensemble modeling, and assimilation. Additional details on the ICAP models are found in Benedetti et al. 2014. The most important accomplishment of ICAP has been Associate in the Nursing agreement between the different modeling centers to share their product (internally at first) on a standard web site where they may be simply compared. This has a semiconductor diode to the event of a web-based multi-model ensemble for dirt forecast, conceptually just like UN agency SDS-WAS, however, with an international instead of a regional focus.

2.4.3 A Global Dust-Health Early Warning System

Airborne mineral clouds of dust, as well as the biological and chemical matter that travels with them have an effect those that live in the prime supply regions, however the health of their neighbours and folks a continent or ocean away likewise (Kanatani et al., 2010). To avoid the adverse health conditions, a convenient system is required to warn vulnerable populations of approaching dirt plumes. Today dirt sources are often identified and monitored from satellites for emission characteristics. The composition of the soil sources, as well as mineral, chemical and biological knowledge, is being compiled worldwide (Nickovic, Vukovic, Vujadinovic, Djurdjevic, & Pejanovic, 2012), albeit rather slowly and erratically. Dirt plumes, formed by the wind, could also be half-tracked by satellite and verified by lidars. Their deposits are measured in air quality networks around the world, several of which collaborate with UNEP (UNEP 2015a).

Table 2.6: Measures to manage wind erosion in rangelands and natural ecosystems (UNEP, 2016)

Objective	Control measures
Manage vegetation in rangelands	Reduce the burning of grasses and plant litter
	Maintain perennial grasses
	Avoid overgrazing through reduced stocking rates or rotational grazing
	Avoid over-exploitation of trees and shrubs.
	Avoid/reduce disturbance of natural crusts (algal, lichens)
Protect vegetation in natural steppe and desert areas	Retain diverse vegetation cover
	Reduce fire risk
	Avoid/reduce disturbance of natural crusts.
Fix sand dunes	Planting of dead fences, grasses, and shrubs

Table 2.7: Measures to minimize wind erosion in croplands (UNEP, 2016)

Objective	Control measures
Reduce periods with little or no soil cover	Adjustment of time of planting
	Relay cropping
	Crop rotation
	Reduced or no tillage
Reduce area with little or no soil cover	Inter-cropping
	Cover cropping/ Nurse crops
	Mixed cropping
	Strip cropping
	Surface mulching
	Reduced or no tillage
	Multistrada systems
	Good crop management
Increase soil resistance to wind erosion	Increased input of organic residues through increased crop productivity, organic mulches, manures
	Reduce soil disturbance through reduced or no tillage
Reduce wind speed within and between fields	Ridging
	Strip cropping
	Crop rotation
	Hedgerows
	Dead fencing (crop or tree residues)
	Linear planting of trees
	Scattered planting of trees
Reduce soil movement	Tillage practices that increase surface roughness

The measures to safeguard urban areas and infrastructure from sand embody building ditches or fences are to reinforce deposition, the mechanically removal of sand, surface stabilisation techniques, vegetation, and planting trees to entice dirt outside the world (though this life might have a restricted result against dust particles higher than tree height solely). To combat any erosion and minimise the impact of SDS, alternative methods are planned by UNEP (2016). At the centre of these is the tree planting strategy. The Chinese GoGreen Wall initiative's purpose is to combat the geologic process. An additional spectacle is the African Union's 775 klick long and fifteen-kilometre wide wall of shrubs and trees that extends from the African nations within the west to Djibouti in the east.

2.5 Emergency Preparedness

Preparedness inside the sphere of emergency management will best be outlined as a state of readiness to reply to a disaster, crisis, or other forms of emergency scenario. All aspects of emergency management must be considered by the state and other emergency agencies. The US, UK, and Australia are advanced in terms of preparedness, and have frameworks for this purpose. As an example, in 2005 the USA founded tips for the state to follow in emergency scenarios (Edwards & Goodrich, 2007). In similar vein, the primary four phases within the UK commonplace operate below the state department (Zaalberg, Midden, Meijnders, & McCalley, 2009). However, though the state stage may be an essential part within the EM cycle, the UAE has no emergency state framework in their commonplace. As distinguished by Bullock et al. (2011), no emergency management organisation will operate without a powerful state capability. In the literature on emergency management, the terms of hazard and disaster are most likely the 2 most used terms. By hazard, it suggests that a possible damaging development or activity that might cause the loss of life or injury, property harm, social and economic disruption or environmental degradation (ISDR, 2004, p. 4).

On the opposite hand, disaster or emergency is outlined as a significant disruption that may cause widespread human, material, economic or environmental losses that exceed the flexibility of the affected community or society to cope with using its own resources (ISDR, 2004:3). An emergency is additionally represented because of the upshot of hazard and vulnerability combined (UNEP, 2016). Due to global climate change, natural hazards have recently become more frequent, powerful and unpredictable (WMO, 2002), and unless communities are more ready, the implications may well be far reaching, particularly once a hazard ends in disaster (Kapucu, 2006; Kapucu, 2008).

2.5.1 Definition of Emergency Preparedness

Emergency Preparedness can be defined as the necessary steps that are taken to actively respond to the emergency by ensuring advanced preparation of the resources and services that are required to survive during the emergency (EMA, 1998; Fagel, 2011). When disasters occur, there is a very short time for making last minute arrangements (Kapucu, 2006). In this context, it becomes equally important to be prepared for the emergency response in advance and prepare an adequate response strategy to help in reducing the impact of emergencies and to also help in carrying out the relief and recovery process efficiently (Coppola, 2007:209). According to studies in America (Waugh, 2015; Waugh, 2018), the scale of damage is greater when people are not prepared for a disaster. Preparedness can also safeguard development, save life and protect property (World Bank, 2010). It reduces or even eliminates vulnerability (Coppola, 2007); it maximises potential for resilience, especially in disaster prone communities; and is economical in that prepared individuals can help themselves their families and community and, as such, reduce demand for and pressure on emergency services (Kapucu, 2008). However, in order to be more effective, preparedness needs to be the shared responsibility of communities and government (Kapucu, 2008). In addition to this, it is also important for the stakeholders to be prepared for the emergency response by acquiring the knowledge and employing the right tools to respond to the emergency (Coppola, 2007).

In addition, emergency preparedness can also be referred to as the necessary measures that are taken to be prepared for the emergency so that the outcomes of the emergency can be reduced to a certain extent. Emergency preparedness also helps in ensuring that the society has deployed enough resources and services that help in reducing the effects of emergency (Gordon, 2002). According to FEMA (2015) emergency preparedness can be considered to be a state that shows the extent to which the society or community is prepared for responding to emergency situations. Furthermore, emergency preparedness can also help in maintaining a continuous process that includes careful planning, organising, practicing and taking preventative measures for reducing the impact of emergency. Planning forms one of the essential stages in the emergency response stage that, in turn help in devising appropriate strategies for controlling and mitigating the effects of the emergency (CCA 2004-218).

As evident from the above definitions of the emergency preparedness, all definitions are mainly focused on the basic components of preparedness that includes planning, training, organizing and exercising. In addition, the definition of FEMA mainly focused on providing an integrated perspective of all the components of emergency preparedness and thus, FEMA definition forms an important part in supporting the main aim of the research that mainly focused on key elements that have a significant

impact of the emergency preparedness. Thus, in the context of emergency preparedness, the FEMA's definition will be adopted to define the emergency preparedness in the research.

It can be inferred from the definitions of the emergency preparedness that the key emergency concept has led to explore the elements that include risk assessment, information system, early warning system, planning, training, and organizing. However, it can also be inferred from the above definitions that one of the most important stage in the emergency is the preparedness stage. In the similar context, the the next section mainly focuses on examine the key elements and features of emergency preparedness that are adopted in the US, the UK, as well as in Australia.

With respect to the emergency preparedness framework in the Kuwait, the previous chapters have not focused on explaining any of the element or the framework regarding the existence of emergency preparedness framework in the Kuwait. However, the present section mainly aims to explore and identify the key components that have a significant impact on the emergency preparedness phase and planning. Exploring the key components also help in improving the investigation process related to the existing practices for emergency preparedness that are adopted in Kuwait. The investigation also helps in carefully identifying the problems associated with the emergency preparedness that are adopted in Kuwait, and plan and organise the fieldwork to remove the barriers that are restricting the effective implementation of the emergency preparedness framework in the Kuwait.

2.6 Various Preparedness Models

The present section mainly aims to critically compare the different preparedness models that are adopted in nations such as the UK, Australia, and the United States. The comparison also helps in identifying the key components of emergency preparedness that inform the basis of analyzing the existing practices of Kuwait related to the emergency preparedness.

2.6.1 The Australian Model

In the context of the emergencies that exist in Australia, the nation faces difficulties in responding to the emergencies that include natural and non-natural hazards such as technological hazards, bush fires, tourism risks, cyclones, tsunami, avalanche, biodiversity, storm surge, terrorism and flooding (EMA, 2004). The nation has adopted a comprehensive and integrated approach to meet the challenges of emergency faced by the nation (EMA, 2004). The nation adopted a wider approach to implement the emergency prevention, preparedness and response strategies as well as recovery strategies to minimise the effect of the emergency outcomes. In addition, the Emergency Management Australia (EMA) has

made significant plans, guidelines and activities for fighting with the emergency situations at various stages. However, the present study will only extract the information related to the elements from the preparedness stage.

Moreover, the emergency approaches and emergency strategies implemented by Australia have similarities in respect to the Pelfrey's models. However, the main aim of the study is to explore the key components that have a significant impact on the preparedness stage in emergency responses. It is further evident from the emergency preparedness chart that Australia has adopted a series of precise activities that help the community members and the society to actively prepare for the emergency situations. Furthermore, it has also been observed that, among all the series of activities that has been readily focused by Australia in devising appropriate preparedness, a risk assessment strategy which is one of the most important factors that are omitted from the emergency preparedness. However, it is also assumed that within emergency preparedness a risk assessment strategy has been included.

Furthermore, Register and Larkin (2008), Dillon et al. (2009), Mendonca *et al.* (2001) have put significant emphasis on the importance of the role played by risk assessment in improving the overall decision making processes, and also enhancing the emergency planning, and resource capabilities. It can be said that although the preparedness activities does not show any evidence relates to the risk assessment processes included in the emergency preparedness activities. The risk assessment forms an important part in Australia's comprehensive and integrated approach towards emergency preparedness. It is further identified that refuge shelters and evacuation plans also form an important part in cases of large scale destruction and emergencies so that affected people can be safely transferred to refuge shelters with the help of strategic evacuation plans. In addition to this, no other preparedness stages are identified in the Australian emergency preparedness in addition to the two components that are implemented in the disaster management (Cao et al., 2018).

With respect to the inclusion of the key components in the emergency preparedness, maintaining resource inventories has been one of the most important criteria towards effective emergency planning process (McEntire & Myers, 2004). One of the most important strategy that determines the effective emergency preparedness is the contribution of the partner organizations, and the fulfilment of individual roles and responsibilities towards implementing a collected effort to utilize the available resources and devising appropriate response strategies (Kapucu, 2006). The emergency support is provided by the supporting organizations on mutually agreed terms who help in responding towards these emergencies. Furthermore, the mutually agreed terms and conditions are also documented and

signed by all the concerned supporting parties.

The key advantages associated with the Australian preparedness model is that the strategic preparedness activities are detailed and arranged in a sequence that help in enhancing the planning, organizing, and exercising of the emergency response and preparedness. Although the risk assessment model is not included in the Australian preparedness model, an in-depth knowledge and learning is provided by the model which relates to the key activities that help in limiting the negative impacts of emergency to the society and the communities.

Thus, it has been identified that the Australian preparedness model is similar to the US and does not take into account the risk assessment activities in devising appropriate emergency preparedness practices. However, the risk assessment concept is incorporated in all the stages of the emergency management standards. Therefore, it can be identified that some of the essential elements that form part of the emergency preparedness phases mainly includes Warning system, Exercise, Information system, Organise/equip, Planning, Training and Public education.

2.6.2 The UK Model

While the UK Model was not designed for SDSs emergencies, it is important to review here as it provides important elements in emergencies preparedness in general. Embed and consult are the two important processes that are adopted in the UK emergency planning cycle (CCA, 2004). The two important processes mainly provide a set of guidelines that help in the emergency preparedness process. In the context of the emergency preparedness process, the CCA (2004) guide mainly highlights the importance of risk assessment in setting the objectives for the preparedness stages that further includes the planning stage. Figure 2.5 mainly presents the relationship between the two important processes that forms an important part in the emergency planning cycle in the UK:

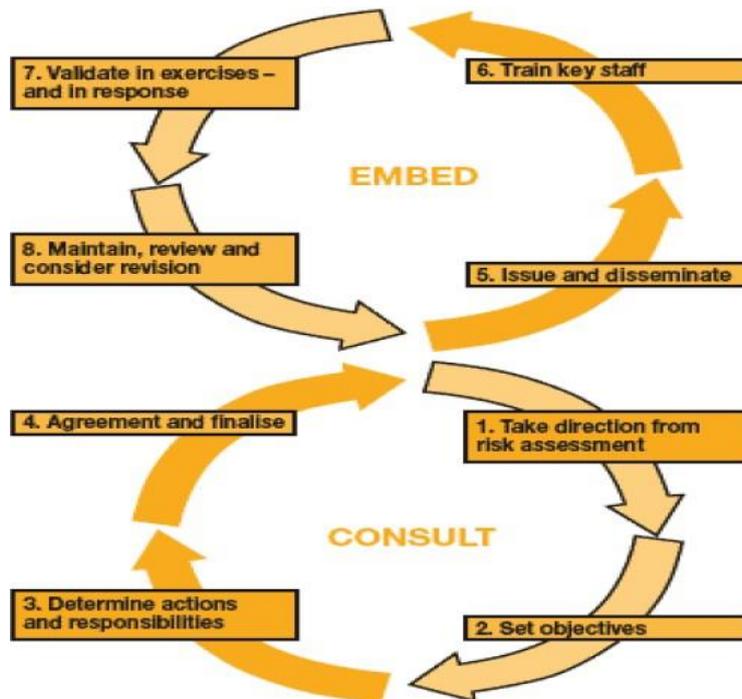


Figure 2.5: Emergency Planning Cycle in the UK (CCA, 2004)

It can be identified from Figure 2.5 that ‘consult’ and ‘embed’ are the two main points considered in the emergency planning cycle in the UK. Consult mainly focuses on determining the actions and responsibilities of organizations that play an important role in managing the risk in the emergency cycle. The actions and responsibilities are undertaken when once has been agreed. Four simple steps can be used to describe the process:

1. Take direction from risk assessment
2. Set objectives
3. Determine actions and responsibilities
4. Agree and finalize

The above-mentioned steps form significant importance in the context of emergency planning and are generally considered to be the important elements in managing the identified risk.

On the other hand, the second phase is called the embed phase and mainly involves four basic steps that are mentioned underneath:

1. The first step involved issuing and disseminating plans within organizations to ensure responsibility is taken. In addition, Dillon et al. (2009) asserted that the issue and disseminate stage help in selecting the information system, as well as, help in organizing and utilizing communication equipment and resources for the effective implementation of the emergency

plan.

2. The second stage is the training of the staff members towards executing the emergency planning. Training the staff members also helps in identifying and validating the plan to help in preparing for the emergency response stage (CCA, 2004).
3. Validate in exercise and in response forms the third stage and have a significant influence on the fourth stage.
4. 'Maintain, review and consider revision'

The above-mentioned steps significantly help in reviewing the emergency planning stages and prove to be of much importance. The stages help further in identifying the risk elements, setting strategic objectives of the execution of the emergency plan. The stages also help in identifying the organisational roles, responsibilities and resources to be employed for better emergency planning (Cabinet office, 2005; Canton, 2007).

It can be inferred that the UK emergency planning cycle's different stages have helped in presenting a detailed, comprehensive and holistic view of the necessary stages that are involved. The two main stages involved in the emergency planning cycle also help in identifying the emergency preparedness phase and adopts one or another form of the emergency planning cycle. Although the emergency planning cycle has presented a simplified view of various stages that are required in the emergency planning in the UK, the stages can be confusing. Although the UK emergency planning cycle possesses two independent cycles and has a series of steps involved, the two cycles do not intersect with each other and it can be identified from the cycle that the two processes form a continuous cycle.

It can only be inferred from the emergency planning cycle that each stage required, due coordination between the stages and the organisations, can identify and assess the risk on the basis of reviewing all the stages involved in the emergency planning cycle. It can also be identified that regular exercise is required by the organisation in the UK to better implement the key stages of the emergency planning cycle. Furthermore, both testing and validation forms an important part in validating and reviewing the importance of the stages in minimising the risks and impacts of emergency in the UK (McCreight, 2011). It can be further understood that in case of major emergency occurrence in the UK, both independent or public reviews form an important part in devising strategies for emergency planning which has significantly influenced the way flooding emergencies was managed (Pitts Review, 2008).

Thus, it can be said that planning forms a crucial importance in emergency preparedness and is

essential for reducing the effects of emergency. The Planning procedures help in improving the preparedness activities that, in turn help the organisations to fight against the emergencies (Gordon, 2002) (Alexander, 2002). In the similar context, CCA (2004) has proposed that it is equally important to define individual roles and responsibilities to help the responders, as well as, the multi-agencies to devise appropriate strategies in overcoming the emergency situations.

Among the other requirements CCA, 2004:203, insisted that a designated person need to employ emergency planning and implement the planning strategically and effectively to help in overcoming the emergency situations. However, it still remains unclear as to how the elements of "consult" and "embed" work to effectively respond to the emergency cases collectively.

Overall, it can be inferred from discussion in this section that the UK emergency planning cycle mainly includes two processes: embed and consult. Both the processes mainly focus on an information system, risk assessment, organisation, equip and providing training and exercise to the organizations staff. However, the lack of an early warning system and public education is also identified to be key deficiencies associated with the UK emergency planning system. The key components of the emergency preparedness framework in the UK includes: Information system, Planning, Risk management, Training, Warning system, Exercise, Organise/equip, and Public education.

2.6.3 Pelfrey's Model

According to Pelfrey, (2005), one of the strategic ways to better understand emergency preparedness is the strategic use of a timeline or cycle. Thus, the two important kinds of preparedness definition have arisen as a result of the Pelfrey definition. In the similar context, the first definition mainly discusses the 'preparedness cycle' and mainly focuses on varied steps that includes: planning, training, exercising, equipping, evaluating, and incorporating the required actions to take corrective measures to mitigate the outcomes of the emergency situations (Department of Homeland Security, 2004).

The second definition is called 'Cycle of Preparedness' that mainly focuses on developing a comprehensive approach to include varied elements before, during and after the occurrence of the emergency situation or the disaster (Pelfrey, 2005).

The second definition is represented in the below mentioned Figure 2.6. It can be inferred from the Figure 2.6 that the Cycle of Preparedness mainly focuses on the complete emergency management process rather than focusing on only one parameter that is emergency preparedness. It is further evident

from the Figure 2.6 that the emergency management cycle can be clearly visualized. In the similar context, the present research will adopt only the first definition that is ‘preparedness cycle’ as the objective of the research is to analyse key components of the emergency preparedness.

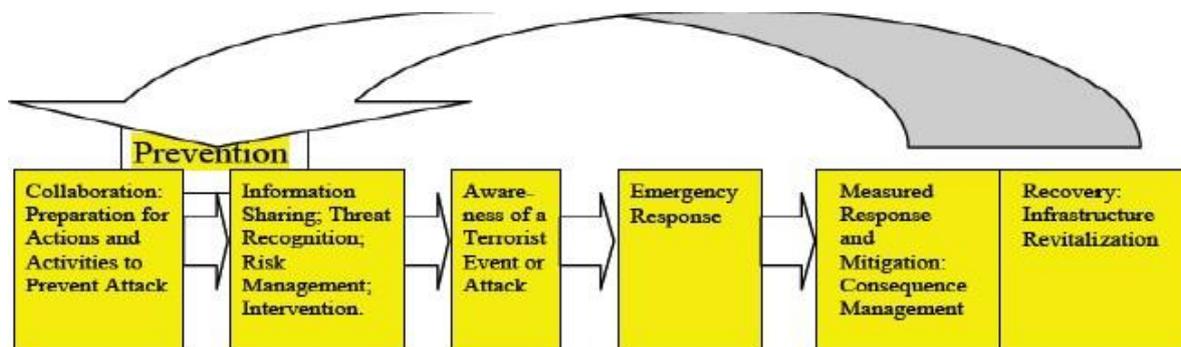


Figure 2.6: Different Elements of the Cycle of Preparedness (Pelfrey, 2005)

It can be analyzed from the model in the Figure 2.6 that the cycle of preparedness mainly consists of four steps leading to mitigation and recovery. starting with the prevention stage. The prevention stage mainly includes two stages that are a collaboration. Furthermore, the collaboration stage mainly refers to the integration of both public and private sector organizations and individuals who work in a collaborative environment, train and exercise together. Training and exercising form important components of the collaboration process and also assist in the key components involved in the preparedness process. The training and exercising also forms significant importance and are essential for mankind to prepare for all the natural or man-made disasters. The terms also agree with the key information that has been presented in section 3.2 that mainly provides information regarding training and exercising which are one of the important elements that help humans in emergency preparedness.

In the similar context, the second stage of prevention mainly focuses on information sharing, which is defined as the process of collecting, analysing and interpreting obtained data from organizations and individuals with the sole purpose of recognizing terrorist threats, illegal actions, and behaviours" (Pelfrey, 2005). It is further evident from the collected information that the information stage forms a significant part in the emergency preparedness. However, it has been inferred from the definitions that although the Pelfrey definitions form a significant part in the emergency management, the definition is strategically focused on including the specific risk factors that include emergencies such as terrorist attacks.

2.6.4 The US Model

The preparedness model discussed by Pelfrey, 2005 has been concerned with a specific risk factor,

terrorist attacks of which the United States holds significant importance. However, the nation has adopted a more generalised emergency preparedness model that is in use by the Federal Emergency Management Agency (FEMA). In the United States, FEMA provides guidelines on the ways in which emergency preparedness stages can be carried out to limit the effects of the emergency situations (FEMA, 2012). In addition, it has been identified that the US faces significant emergency situations and threats that include tsunami, earthquakes, hurricanes, extreme weather, floods, and as mentioned above, terrorist activities. In addition to this, the US mainly employs emergency preparedness models that help in overcoming threats and hazards (IAEM, 2013). The preparedness cycle is shown in Figure 2.7.



Figure 2.7: The Preparedness Cycle (FEMA, 2015)

Furthermore, with respect to the UK model, the US emergency preparedness model mainly focuses on five main processes that are illustrated in the Figure 2.6. It can be inferred from the Figure 2.7 that the emergency preparedness model that is followed in the US is a closed loop model that has a continuous process of five stages. The first stage is the planning stage, which is followed by organising/equipping, training and exercising, and then to evaluation.

The FEMA model mainly focuses on the early stages of the emergency situations that are prepared before the disaster. In the similar context, as per the Pelfrey model, it can be inferred that the emergency preparedness model has not been discussed broadly and the model mainly refers to the early stages in the emergency situations. Thus, the model can be effectively used to identify the key components involved in the emergency preparedness stage.

It can also be inferred from the US model that it does not consider some of the key elements of the emergency preparedness phase. These include risk assessment, promoting public education, and early

warning systems. However, risk assessment is an important element that forms the part of Emergency Preparedness Goal and Emergency Preparedness System (EPS). In alignment to this, it can be inferred that the key elements that are not discussed in the US model already form part of EPS and preparedness goals (FEMA, 2015).

In the views of Molino, 2006, communication forms an important element in all the stages of emergency management and is required to successfully manage the resources for emergency preparedness. Thus, some of the essential elements that are required in the effective emergency preparedness include risk assessment, information system, public education and early warning system that are not included in the US model. The omission of such key essential components raises questions on the US emergency preparedness framework. Furthermore, as identified from the research and reports on the US disasters, problems exist with the US emergency preparedness model (Molino Sr, 2006).

It is therefore evident that the comprehensive characteristics of Pelfrey's model are aligned with the key objectives and purpose of this research; the continuous process of the US preparedness model also forms the best practice to improve the emergency preparedness process. Thus, the five essential components are included in the main emergency preparedness framework that includes: Planning, Training, Exercise, and Organize/equip. The five elements will also form the part of emergency preparedness planning to be investigated in Kuwait.

2.7 Maturity models

Maturity models are a conceptual approach to the stages of response and describe the incremental behavior of the organizations and community toward the desired maturity model. Despite the limitations of the use of this approach in small and medium operations (Beadell, 2009; Huang and Zhang, 2010; Uskarci and Demirors, 2017), research indicates application of this concept improve behavior in large organization and big operations such as SDSs response and plans with higher maturity levels are successful (Backlund et al., 2014; Nikkhou et al., 2016). The maturity model provide opportunities for organizational and in this context community learning.

Maturity models, therefore, are commonly used to measure competency and to evaluate the capabilities of an organizations in certain discipline (Latif et al. 2017). These models refer to the natural lifecycle of the discipline it represented (Latif et al. 2017).

In EM and dealing with risks Dhea (2016) specified 5 levels of the maturity model to guide improvement and evaluate response. These are:

- Chaotic: There are no standards to follow and no plan or strategy,
- Reactive: There may be some standards and a primitive plan but react only when the situation occurs.
- Defined: a defined plan exists fully and there is strategy to predict and react but not fully operational.
- Proactive: There is a plan and a continuous feedback loop and a learning process and full strategy.
- Predictive: full plan and feedback loop and all people, process and technology working together in harmony.

Data gathered in this programme of studies suggested that Kuwaiti response to SDSs is chaotic at community level and reactive at organizational (EM) level. The following framework aims to increase the maturity level to proactive level at first and if fully implemented the predictive level could be reached in few years.

2.8 Preparedness Framework

Figure 2.8 provides the preparedness framework based on the extensive literature review in the previous section. There were different models and frameworks to manage disasters. Examples of these are WHO strategic model for health emergency and Ikeda Ikeda, Sato, & Fukuzono (2008) framework. Ikeda et al (2008) using some mathematical approach and experience of disasters in Japan produced a framework involving different variables. They suggested that their frameworks should “.. *involve stakeholders and citizens to achieve consensus on the choices for risk-reduction measures*” Ikeda et al (2008, P. 278).

According to literature this framework consists of many variables: the independent variables, mediating variables, and dependent variables.

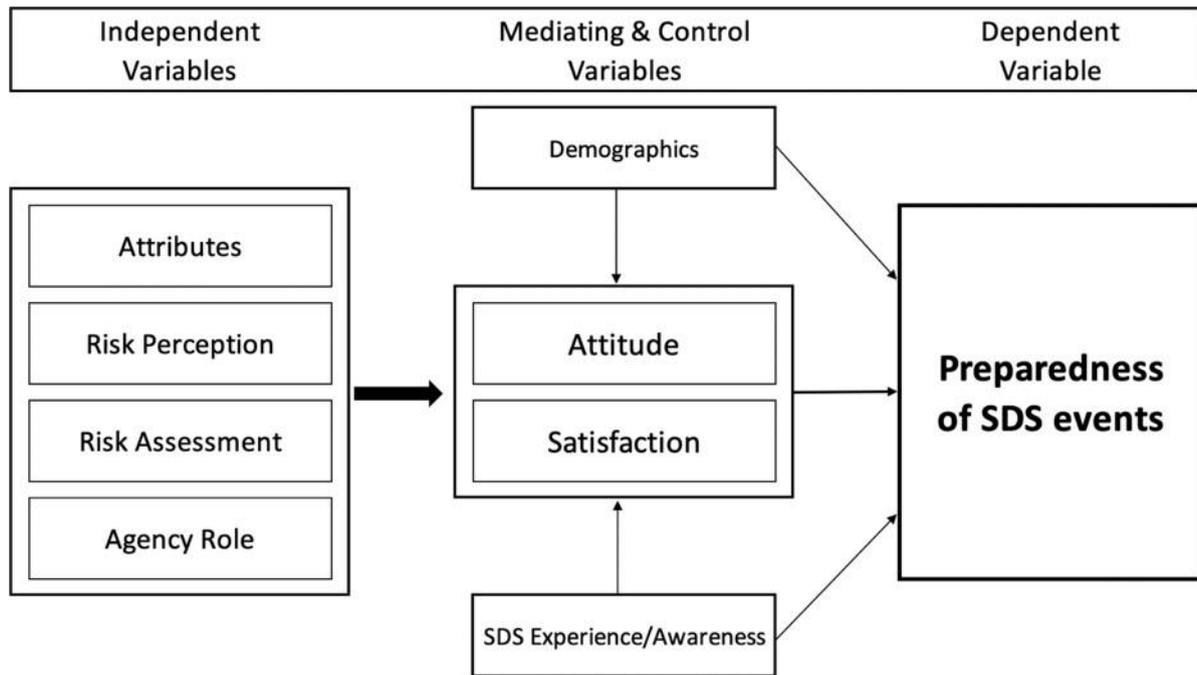


Figure 2.8: Framework

2.8.1 Independent Variables

The independent variables are attributes, perception, risk awareness, challenges, and agency role.

Attributes: The attributes include knowledge and skills that are required by the people in handling SDS events; time, effort and money required in preparing for SDS; tool and equipment required; and, cooperation from the community and related agencies in handling and adopting to SDS events (Terpstra & Lindell, 2013).

Risk Perception: The risk perception refers to the probability and consequences of SDS events. The literature (Chaney et al., 2013) and the empirical findings have shown that SDS can have impact on health, mobility, property, infrastructure and the economy. Higher risk perception is considered as the best indicator on the level of preparedness. Authors such as Chaney et al. (2013) further argue that risk perception can lead to positive attitude and preparedness.

Risk Assessment: Risk assessment refers to the response to information. The empirical findings from the survey has shown that Kuwait community does not find existing source of information as credible and relevant. However, it is important for information on SDS and other natural hazards to be relevant and credible so that people can rely on this information and take necessary measures on safety. Therefore, Heath et al. (2018) have argued that risk bearers (agencies) need to provide better information that

citizens can rely on. Risk assessment of hazardous situations such as SDS can create better calculation of cost, time and effort required in preparing and adopting to SDS events.

Agency Role: Agencies that respond to SDS are responsible in creating awareness and knowledge among the community. The community need to rely on the agencies in hazardous situations. Agencies have to be vigilant and based on the information that they have, they should be able to develop best practices to handle situations such as SDS. Agencies should be motivated in responding effectively during SDS events. The empirical findings are found in literature by authors such as Lindell, 2013; Health et al. 2018).

2.8.2 Control Variables

There are two control variables that impact the mediating variables (attitude and satisfaction) and dependent variables (adoption and preparedness). These are demographics and SDS experience/awareness.

Demographics contain factors such as age; gender; nationality; education level; type of property currently residing; property ownership; and duration in the property. Demographics is an important factor that has been stressed in the literature (for example, Phillips and Morrow, 2007; Lindell, 2013; Terpstra and Lindell, 2013). In addition to the demographics that are studied in this research, the literature has also included other demographics such as marital status and number of children.

The SDS *experience and awareness* also can have impact on the mediating and dependent variables.

2.8.3 Mediating Variables

The mediating variables are attitude and satisfaction of the community towards adoption of the SDS practices and preparedness towards SDS events.

Attitude is a behavioural intention where higher attitude can lead to action (Heath et al. 2018). Attitude is part of the Theory of Planned Behavior (TPB) that has been discussed in protective action decision model (Terpstra and Lindell, 2012). Therefore, positive attitude will lead to stronger preparedness.

Satisfaction is a variable that has been identified through empirical findings. The results showed the importance of Kuwait community satisfaction with agencies (civil defense, fire department, emergency

services, Red Cross, and health organisation), satisfaction in response to risk, and satisfaction to attributes (information source, validity, and credibility). Therefore, satisfaction of the individual with attributes, risks, and agencies will lead to better preparedness of SDS events.

2.8.4 Dependent Variable

The dependent variable is preparedness for an SDS event.

Preparedness: Individuals higher level on the hazard-related attributes, risks, and the role of agency will lead to stronger attitude and satisfaction that leads to better preparedness. People need to be prepared to react to SDS events. Higher attitude towards SDS events indicate the level of preparedness. Similarly, the satisfaction received from attributes, risks (perception and assessment) and agency role will lead to stronger preparedness of SDS events. This is also discussed in the literature by Terpstra and Lindell (2013) who studied people response towards earthquakes and found that people took necessary measures such as switching of electricity and shutting off utilities.

This framework will guide and inform the subsequent framework developed here based on the findings. This literature review will also be used to formulate the questions of the main survey in chapter (5) and inform the analysis of the interviews in chapter (6). On the next chapter the profile of the state of Kuwait and why it is susceptible to SDSs is highlighted.

2.9 Conclusion

Emergency preparedness is very important in mitigating the impact of disasters. However, the literature suggested that there is a lack of preparedness framework for Sand and Dust Storms (SDSs) globally and regionally and the existing disaster response strategies are not fit for purpose as long as SDSs are concerned. The findings from the literature review showed different models of emergency preparedness in different parts of the world. Some of the main ideas in these models while are designed to respond to and mitigate other emergencies are of value in developing preparedness for SDSs in Kuwait and other parts of the world if research on how to respond to SDSs is conducted. For example, the idea of maturity levels is generic and could be applied in any emergency plans. Anticipation of SDSs and early warning systems is another finding from the literature that could if implemented correctly help mitigating the impact of SDSs. Global cooperation and long-term solutions are also generic in nature and could be applied in SDSs preparedness.

Evidence from the few articles about emergency preparedness for SDSs in the state of Kuwait suggested that research is warranted in the area of emergency preparedness for SDSs. The impact of SDSs is mostly negative on health, economy and the environment. Some developed countries have a strategic framework to deal with all emergencies including SDSs. Investigating their frameworks allowed to develop a framework to inform this research.

CHAPTER 3: SDSs WITHIN KUWAITI CONTEXT

3.1 Country Overview

Situated on the Arabian Gulf; Kuwait's mainland is, on the most part, flat desert, whilst among its nine offshore islands, some are marshy and uninhabited (Alam & Sharif, 2013). Kuwait is located in the northeast of the Middle East and North Africa between latitudes 28° 30" and 30° 5" and longitudes 46° 33" and 48° 30" in the East. The total area of Kuwait is 17,818 km², including the nine unpopulated islands in the Arabian Gulf region. The country is technically a Gulf emirate which is also considered a constitutional state, where legislative, executive and judicial matters are decided democratically (EPA Kuwait, 2015).

Kuwait has a large petroleum industry with associated industrial and urban land uses. The country was harmed environmentally during the Iraqi invasion in 1990 due to oil fires which resulted in higher air pollution levels. This led to serious efforts to better measure air pollution levels. Historic data showed high particulate levels in Kuwait, which are affected by air pollution sources such as desert soil (particularly during dust storms), the petroleum industry and mobile sources (Brown et al. 2008).

The rise of urbanization and urban development has been associated with energy-intensive land use that replaces natural land cover, which leads to increased temperatures. The use of air conditioners reduces air flow from narrow streets and tall buildings (Zoulia, Santamouris, & Dimoudi. 2009), as well as reducing the absorbance of solar energy from dark surfaces (Deilami, Kamruzzaman, & Liu, 2018): both mechanisms contribute to the well-studied phenomenon of urban heat islands, where urban areas are hotter than surrounding rural areas. Recent research has revolved around the impact of urban heat islands on health and policy. Deilami et al. (2018) state that they have a negative impact on health. Firstly, they have been linked to an increase in the frequency and magnitude of thermal discomfort, which increases heat stress and heat-related diseases (Harlan et al. 2006; Goggins et al. 2012; Laaidi et al. 2012). Secondly, the urban warming also enhances the photochemical reaction that leads to higher levels of ozone (O₃) (Swamy et al. 2017). Environmental sustainability is also affected by urban warming. It is associated with an increase in electricity consumption (Santamouris et al. 2015), per-capita water consumption (Guhathakurta & Gober, 2007), and extensive irrigation of green cover (Yang et al. 2012).

With the current rate of climate change, projections of future temperatures for the end of this century in the region will possibly exceed the threshold of human adaptability (Pal & Eltahir, 2015). On days when extremely high ambient temperatures were recorded from monitoring stations across Kuwait, studies have shown that the overall and cardiovascular mortality risks are dramatically increased within vulnerable subpopulations (Alahmad et al. 2019). Most of the population of the small country live around the Kuwait City Metropolitan area in urban and suburban neighborhood units. Spatial characterization of the distribution of temperature exposure can be critical for population health studies (Alahmad et al. 2020).

3.1. Kuwait Climate

As a result of the geographic location of the State of Kuwait, its climatic conditions, geological nature, the characteristics of its soil, the attributes of its vegetation cover and the patterns of land use, Kuwait suffers from numerous environmental challenges. These include higher temperature rates, higher airborne dust and sand falling ratio, increased frequency of sandstorms, lack of seasonal rains, limited water resources, increased desertification and decline of vegetation cover (EPA Kuwait, 2015).

These environmental challenges have been aggravated dramatically as a result of global climate change. The State of Kuwait is suffering from a rise in average temperatures. The annual average temperature is expected to increase by 1.6°C during the period from 2010 to 2035 to reach its highest average temperature of 28.7°C (Figure 3.1). In the summer months (May to October) the maximum temperature will reach more than 50°C in the shade (EPA Kuwait, 2015).

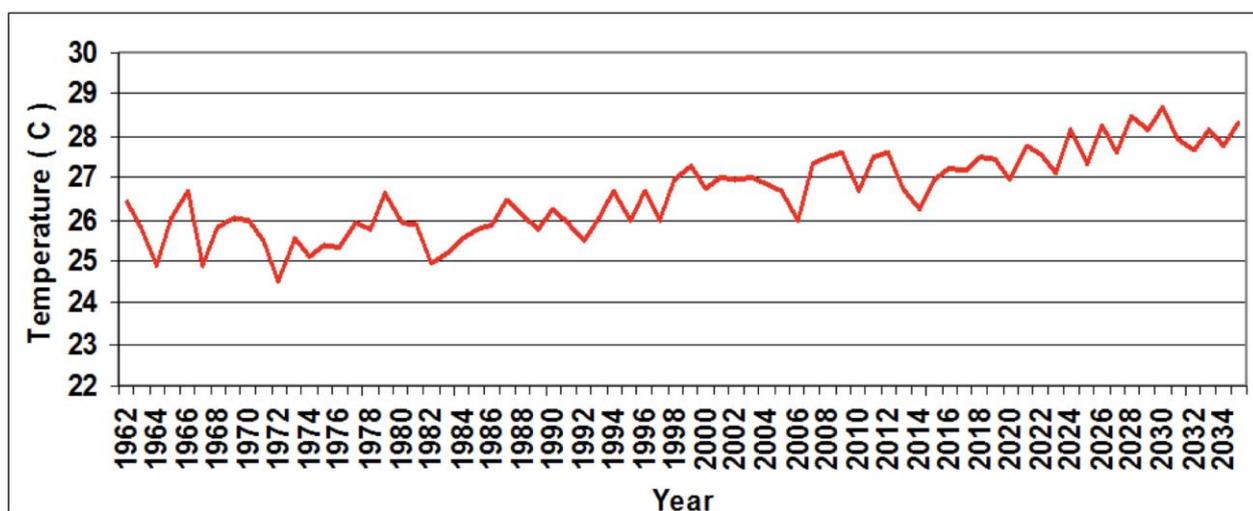


Figure 3.1: Annual Average temperatures expected during the period 1962-2035
EPA Kuwait (2015)

The long and dry summer extends from May through to October. August is the hottest month with an average temperature of 44°C. The winters are mild, with January being the coolest month, averaging a temperature of 7°C. There is potential for rainstorms and dust storms caused by the wind. The contribution of water to the carbon footprint of the region is unique to all Gulf states including Kuwait; this is because most of their drinking water comes from desalinated seawater. During the Gulf War, Saddam Hussain's forces set fire to oil wells whilst withdrawing from Kuwait, which resulted in human-induced climate change. Per day, 5 million barrels of oil and 70 million cubic meters of gas were burnt, producing 500,000 tons per day of carbon dioxide emissions and 40,000 tons per day of Sulphur dioxide (Alam & Sharif, 2013).

Gulf countries neighboring Kuwait, Qatar and the United Arab Emirates (UAE), have been reported to emit carbon dioxide (CO₂) at higher rates than countries in Europe. According to Alam, S. M. S., & Sharif, M. (2013), Qatar produces 59.56 metric tonnes of CO₂ per capita, and the UAE 29.2; whilst the United States of America and the European Union emit 17.82 and 8.09 respectively. Temperatures in the Gulf region have increased 50 percent faster than the global average: Kuwait, for example, has measured temperatures in excess of 52°C. This data was published during a summit in November 2012, hosted in the Qatari capital of Doha, as part of report by the World Bank (Alam & Sharif, 2013).

Many climate change issues are exclusive to Kuwait. Due to hot and humid climate, the demand for electricity is very high. A significant amount of electricity consumption is for desalination of water and air-conditioning, both processes using very high amounts of energy. Energy source in Kuwait is mainly gas. As a result, large amount of CO₂ emissions is released in the atmosphere. Undoubtedly climate change will impact Kuwait as well as other Middle East countries significantly in the future (Alam & Sharif, 2013).

Kuwait experienced floods in 1993 and 1997 and 160 km/h strong winds in 2011. These changes are indications of change in climate in Kuwait. The region between Syria, Jordan and Iraq known as the dust triangle is considered responsible for most of the dust storms in Kuwait (Alam & Sharif, 2013). Despite the harsh environment, Kuwait supports more than 4 million people.

3.2 SDSs in Kuwait

Al-Dousari and Al-Awadhi (2012) mentioned five source areas of dust for Kuwait, these are: the western desert of Iraq, the Mesopotamian flood plain, the northern desert of Saudi Arabia, the drained marshes in southern Iraq, and Iran. In another study Al-Dousari et al, (2017) listed the following origins

of SDSs that affect Kuwait:

- (1) The Mesopotamian flood plain,
- (2) The western desert of Iraq,
- (3) The Ahwar marshes,
- (4) Ahwaz-Iran,
- (5) The Nafud desert,
- (6) The empty quarter desert,
- (7) Bandar Lenga-Iran, and
- (8) Hurmuz

The Mesopotamia, or “the land between the two rivers - Euphrates and Tigris”, which was once the center for old civilization and fertile agricultural land has been recently affected by desertification due to regional drought, human-caused water misuse, and military operations. Satellite-derived data identified that major SDS trajectories are originated from the Mesopotamian flood plain, Ahwar marshes, and the western desert of Iraq (Al-Awadhi et al., 2014; Al-Dousari et al., 2017). Yassin et al. identified specific air mass trajectories for each season and concluded that Shamal winds from southern Iraq act as the main contributor to Kuwait's SDS (Yassin et al., 2018).

Moreover, the sand dunes and sand flats in Iraq occupy N1 million hectares, often in central and southern Iraq. Dust and sand encroachment from these areas affect many strategic land and irrigation projects, agricultural lands, roads, vital installations, and human health. The north eastern desert of Saudi Arabia was identified as a major source of dust affecting Kuwait (Al-Dousari et al., 2017; Al-Dousari and Al-Awadhi, 2012). Eastern Saudi Arabia extending across the Qasim region and the Adibdibah and As-Summan Plateau regions act as major sources affecting both Kuwait and Iraq (Alharbi et al., 2013). The highest depositional rates of dust fallout within major dust storm trajectories in the world were recorded in the western and southern Sahara desert ($913-10,446 \text{ tons.km}^{-2}/\text{y}^{-1}$), and Riyadh, Saudi Arabia ($392 \text{ tons/km}^{-2}/\text{y}^{-1}$); both regions were shown to affect Kuwait (Yassin et al., 2018).

Recent Moderate Resolution Imaging Spectroradiometer (MODIS) images from NASA's Terra and Aqua satellites have identified that the great proportion of SDS events in Kuwait are due to transboundary trajectories from a specific “hot spot” area in southern Iraq located at 250 km from the

northern border of Kuwait. Such storms transport aeolian aerosols that contain large amount of total suspended particulate (TSP) matter, coarse particles (PM10), fine particles (PM2.5) and pollens, which have detrimental health effects on people, services and industry. Kuwait's meteorological data has shown increasing trends for dust storms, rising dust, and suspended dust since 1992 onward. Previous satellite-based studies investigated the SDS trajectories over Kuwait using the back-wind Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model (Sabbah et al., 2018; Yassin et al., 2018); this backward trajectory model was not effective (usually 64 km/pxl) in delineating severe local SDS sources.

Several factors make the country susceptible to SDSs. These have been identified as: the country's geographic location (in that it falls within the great desert belt), aridity, light-textured topsoil, drought, scanty vegetation and recurring turbulent winds due to excessive radiation (A Al-Hemoud & Neelamani, 2015; Al-Hurban & Al-Ostad, 2010). According to the data of the satellite images, researchers found five significant dust trajectories storms: Flood Plain of Mesopotamian, Iraq's south-western desert, sabkhas and dry marshes in south-west Iran and southern Iraq's drained marshes (Ahwar) (Al-Dousari & Al-Awadhi, 2012). On the other hand, secondary sources of dust were identified as the Kuwaiti islands of Warba and Bubyah, the tri-border area between Kuwait, Iraq and Saudi Arabia, and the coastal Saudi sabkhas near the southern Kuwaiti border (Figure 2.4). In recent years, new sources of dust storms have also been created (Ibid). These are described as vast Iranian and Iraqi farmlands that have been destroyed, degraded and abandoned as a result of the three Gulf wars (the 1980- 1988 Iran-Iraq war; the first Iraq war of 1990-1991; and the second Iraq war of 2003).

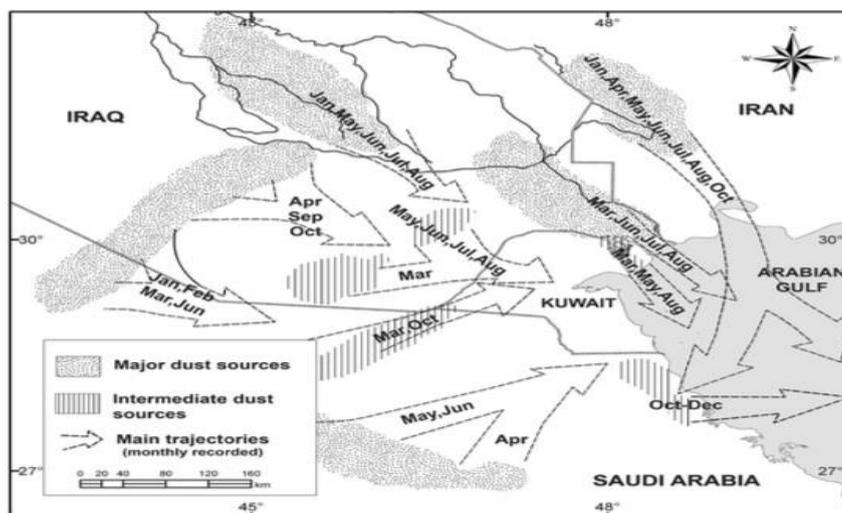


Figure 3.2: SDSs sources in Kuwait. Al-Dousari & Al-Awadhi, (2012).

Although SDSs in Kuwait have no fixed pattern of occurrence and duration, dust activity is usually low during the wet season between November and March. It then gradually gains momentum to reach

its peak during the hot and dry summer months (Al-Dousari & Al-Awadhi, 2012). However, according to data obtained on SDSs activity for the period between 2001 and 2014, there has lately been a dramatic increase in SDS rates during the relatively wet months of March and April (Ali Al-Hemoud et al., 2017). Moreover, SDSs now occurring in spring have become increasingly violent. For example, between 18 and 20 March 2012, Kuwait and parts of the Arabian Peninsula were hit by a violent dust storm that generated 94 million tonnes of dust and affected almost all aspects of human activities (Prakash, Kumar, Madhavi, & Varma, 2014). On 11 April 2008, a dust storm with wind speed of 90km/h uprooted hundreds of traffic signposts, damaged many vehicles and resulted in one fatality and several injuries. Other violent and high-speed sandstorms occurred on 10 March 2009, 25 March 2011, 4 April 2011 and 12 February, 2015.

Al-Dousari & Al-Awadhi, (2012) argued rising dust, dust from dust storms and suspended dust as the three different types of dust in Kuwait. Further, Al-Dousari & Al-Awadhi, (2012) found 255.4 days as annual dusty days in the country. Ramadhan, (2015) noted an average of 137 days in the country from 1968 to 2012 as stormy days wherein about 63 days were delineated with rising dust, 16 days with dusty storms and 58 days with suspended dust. Besides this, it was identified that rising dust, suspended dust and dust storms result for 46 percent, 35.9 percent and 17.3 percent respectively of the overall dusty days in the country (Al-Dousari & Al- Awadhi, 2012). The visibility in the country during a normal dust storm is found to be one kilometer, however, visibility goes down to zero in a severe storm and 200 meters during a medium storm (Al-Dousari & Al-Awadhi, 2012; Ali Al-Hemoud et al., 2017).

Table 3.1: Record of significant dust storm events in Kuwait during non-dusty season

Date	Wind speed	Visibility	Socioeconomic impact
11 April 2008	90 km/h		Semi-tornado, the violent wind uprooted hundreds of traffic signposts, billboards, and trees and damaged many cars in several parts of Kuwait, one killed and several wounded
10 March 2009	60 km/h	< 150 m	A blinding dust storm hit Kuwait, halting oil exports and forcing the closure of all three ports besides disrupting air traffic. Incoming planes were facing difficulty landing.
25 March 2011	50 km/h	About zero	Mobile networks were jammed, and heavy traffic resulted because of poor visibility that plunged to almost zero. Flights were disrupted and the airport was shut down. While incoming flights were directed to other nearby airports, outgoing flights were cancelled. Drivers had to slow down and stop as the sand turned skies into an orange-brown, enveloping the whole city.

4 April 2011	100 km/h	< 50 m	Dust storm forced Kuwait airport to shut down for hours. Planes have been diverted to nearby airports and all departing planes have been grounded until the weather condition improved. Several ministries and offices have told their employees to go or stay at home until conditions get better. Four people are believed to have died during the sandstorm.
12 February 2015	70 km/h	< 100 m	Sudden afternoon dust storm occurred during a national festival which blew out the event chairs, tables, and tents. Oil exports at terminals at the three oil refineries have been halted and air flight cancelled for 4 h.

Source: Al-Hemoud et al. (2017)

There is a corridor of shifting sands in the middle of the country which is susceptible for SDSs (Figure 3.2 and 3.3). It extends in a northwest southeast direction for a distance of 167 km between Huwaimiliyah Area (at the north) to Wafra Farms (at the south). Its width ranges between 50 km (upwind side) to 25 km (downwind side). Several strategic facilities are located in the corridor of shifting sands. These include:

- a) Two air bases (Ali Al Salem and Ahmad Al Jaber).
- b) Three oil fields (Burgan, Managish and Wafra)
- c) Segments of five highways (Wafra- Mena Abdullah, Wafra-Al Zoor, Wafra –Kabd, Salmi and Ras Sabiyah)



Figure 3.3: Severe sand encroachment along Wafra Roads (August 2018)
 Source: Misak et al. (2019).

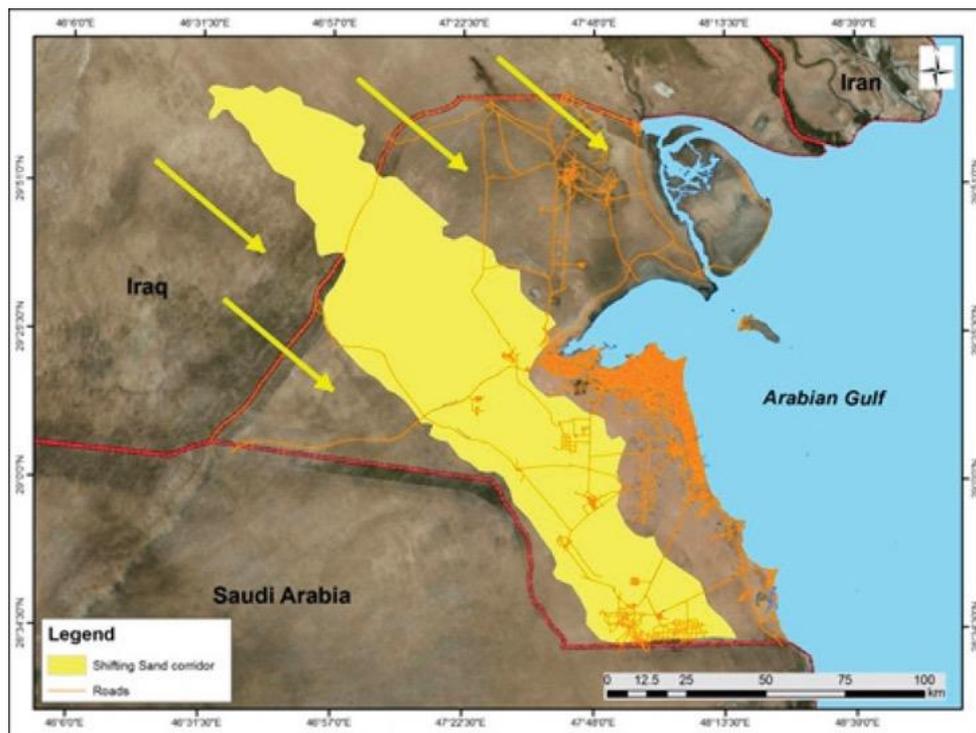


Figure 3.4: An image showing the corridor of shifting sands
 Source: Misak et al. (2019).

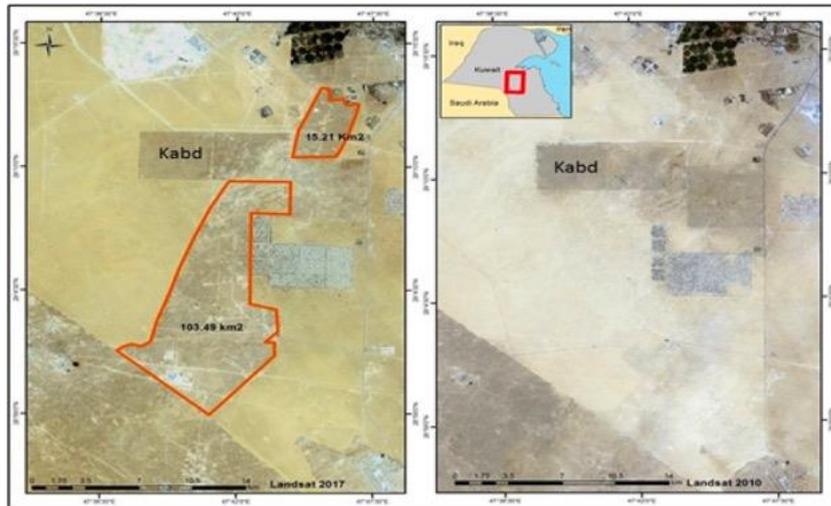


Figure 3.5: Changes in land use (2010 – 2017).
Source: Misak et al. (2019).

During the period between 2010 and 2017, positive changes in the land use /land cover were noticed (see Figure 3.4). The changes include fencing and protection of two areas of about 119 km². These areas which cross the main natural corridor of shifting sands, resulted in its dissection into two portions (Figure 3.5).

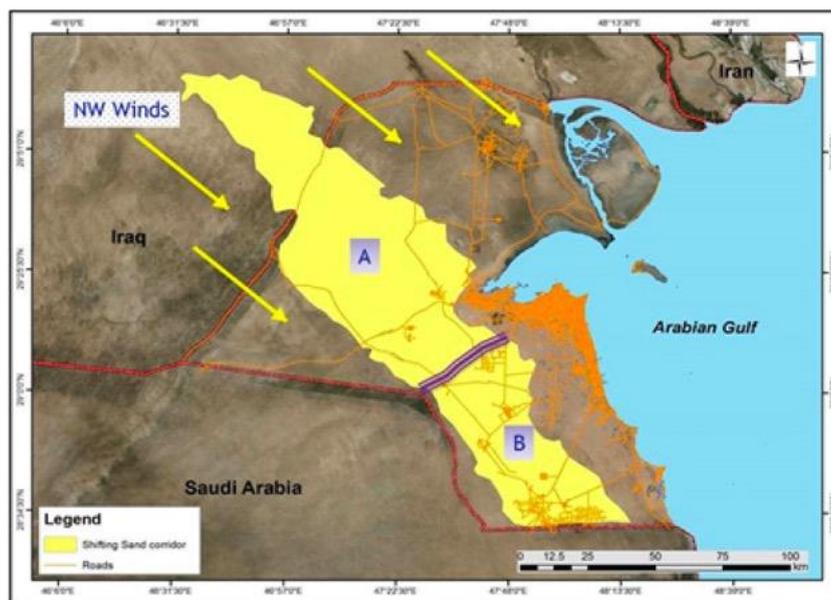


Figure 3.6: Dissection of the corridor of shifting sands into two portions.
Source: Misak et al. (2019).

Yassin et al. (2018) identified specific air mass trajectories for each season and concluded that Shamal winds from southern Iraq and Syria act as the main contributor to Kuwait’s SDSs, which typically

prevail between February and April.

Kuwait's economic losses from SDSs are expected to be largely associated with oil and gas operations. The losses are because SDSs affect major transportation between oil fields and halt major extraction operations. Accumulated sands can also impact negatively on many machineries essential for the production and results in the loss of many working hours by employees. Oil and gas sector accounts for about 40% of the country's Gross Domestic Product (GDP) and about 92% of export revenues. Oil reserves in Kuwait make up 8% of the oil reserves in the world, and it is Organization of the Petroleum Exporting Countries (OPEC's) third largest oil producer and estimated to hold approximately 101 billion barrels (OPEC, 2017). Oil companies in Kuwait are:

1. Kuwait Oil Company (KOC), which in 1938 drilled the country's first commercial oil well in the Burgan oil field and began its commercial export of crude oil in 1946; and,
2. Kuwait Gulf Oil Company (KGO), which was established in 2002 and shares the natural resources of oil equally with Saudi Arabia in the neutral zone between the two countries. Most of Kuwait's oil reserves are located in the 70-billion-barrel Greater Burgan field situated in the southeastern part of Kuwait, which is the second largest conventional oil field in the world and is operated by KOC.

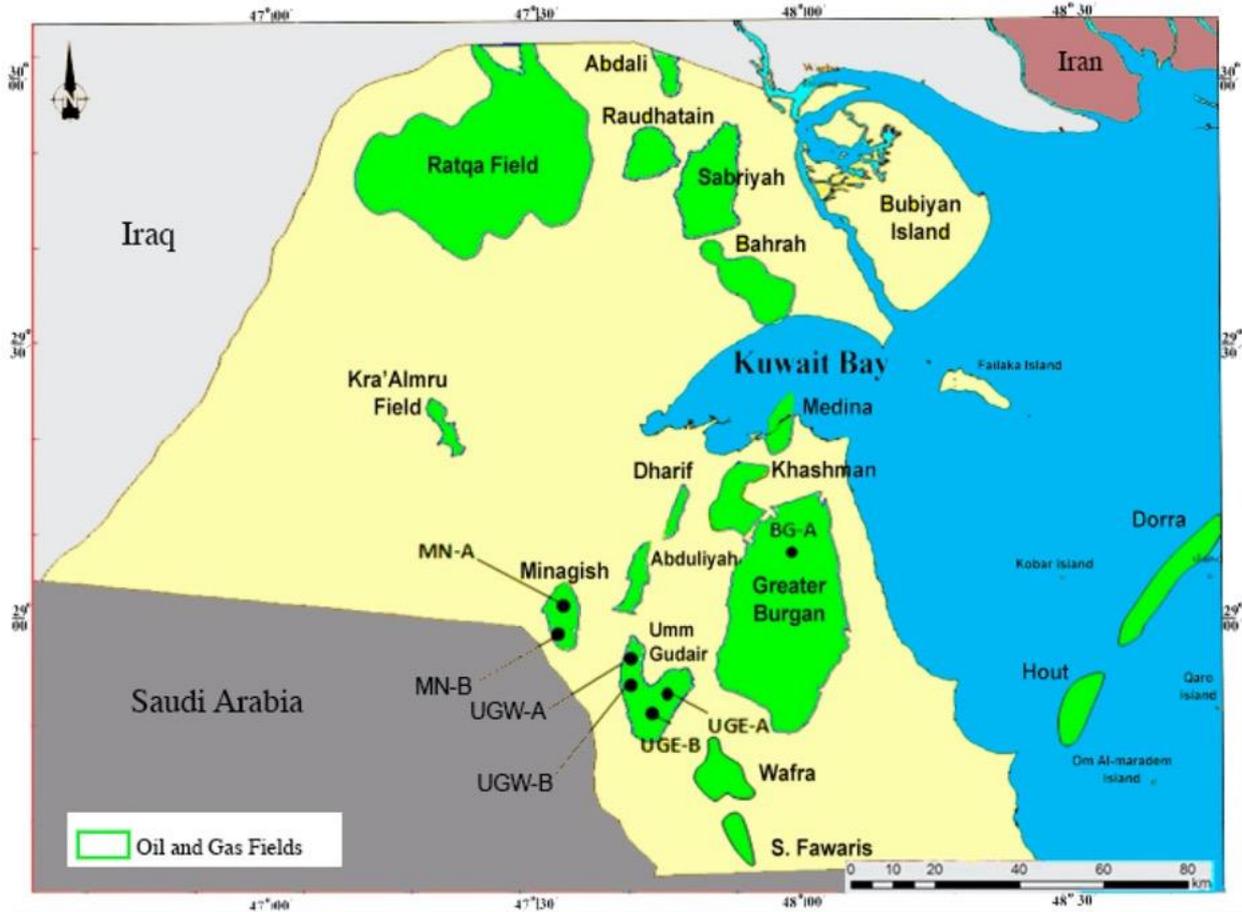


Figure 3.7: A map of Kuwait showing the locations of oil and gas fields (green color)
 Source: Al-Hemoud et al. (2019)

Al-Hemoud et al. (2019) adds that the main direction of the wind in Kuwait is the north-northwest, with 19%, 15%, 21%, and 28.5% for the fall, spring, winter, and summer, respectively. Fine surface particles need 0.2ms^{-1} of wind velocity to be set in motion. Significant sand movement was observed during the spring and fall for the Minagish and Burgan areas, respectively, with a total amount of sand drift of 8701 kg m^{-1} and 6264 kg m^{-1} , respectively, in which sand drift from the north-westerly direction was dominant (Al-Hemoud et al. 2019).

3.3 Conclusion

There is quite a reasonable research and governmental reports on the impact of SDSs in Kuwait and as this chapter showed there is also some research reports on the sources of SDSs and their pattern of occurrence. However, there is little or no research on preparedness for SDSs in Kuwait and indeed in other gulf countries as well. There are several reasons for this. One is the lack of expertise in this region and lack of funds for this type of research. Indeed, research on response to all emergencies including health emergencies is lacking in the gulf region. The second reason was the lack of statistics and

information on preparedness which limit the ability to identify priorities and allocate resources to respond to and mitigate the impact of SDSs.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

Collis and Hussey, (2014) suggested that the aim, objectives and research questions are key elements in guiding and informing the suitable methodology. Likewise, Saunders, et al., (2016) explained that the research methodology is the process that the researcher carry out to discover issues in an organised manner, thus increasing their understanding of the investigated topic.

Therefore, it can be concluded that the research methodology is the systematic approach that the researchers follow to deal with the topic using appropriate techniques and practical steps to collect data then analyse it to achieve the aim of the research.

4.2 Research Design and Philosophies

The research design is the most important aspect of the research topic as it is considered as the grand plan that directs the researcher in conducting the research appropriately. In order to achieve this, the researcher needs to be well informed by gathering information through critically appraising various literatures. Literature on research methodology and on studies related to the topic needs to be examined and digested. This engagement with literature provides ideas to adapt and used in the research to meet the pre-planned research objectives.

Literature on the area of research methodology reveals that there are many models of research procedures. Among these procedures which are referred to as models, Saunders' onion model is considered the best because it provides a comprehensive outline that inspires the researcher to analyse each step systematically. So, in accord with Saunders' model, the research process applied here is taking the following order: understanding the research philosophy, choosing the appropriate research approach, establish a strategy, consider time horizons, investigate the logistic values of the methodological choices, and embark on data collection using the appropriate methods. The subsequent sections are discussing these research steps.

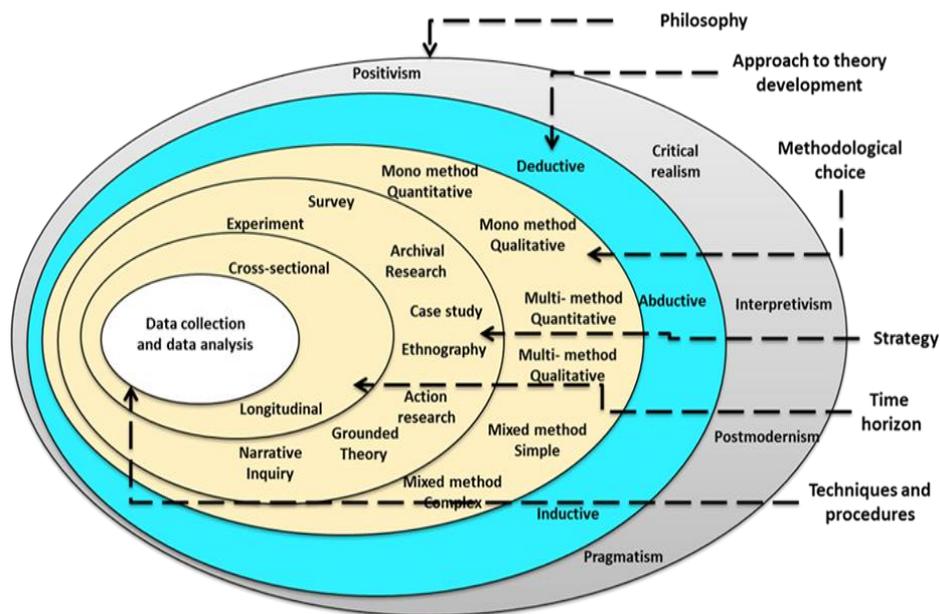


Figure 4.1: The research onion. Source: Saunders et al., 2016

4.2.3 Research Philosophies

According to Saunders et al. (2016), research philosophy relates to the development of knowledge, the nature of reality, its characteristics and how it is viewed by the researcher. It is the researcher's "personal view of what constitutes acceptable knowledge and the process by which this is developed" (Saunders and Tosey, 2012).

The main research philosophies in the literature are positivism philosophy and interpretivism philosophy (Saunders et al, 2016; Collis and Hussey, 2014; Maylor and Blackmon, 2005). These two main philosophies were differing in their beliefs and assumptions about the nature of the knowledge (reality). Such assumptions and beliefs will underpin the strategies and methods employed by the researcher.

There are many ways for thinking about research philosophy, of which the most prominent are ontological assumption, epistemological assumptions and axiological assumption. Ontological beliefs are concerned with the nature of reality and whether it is stable or changing, unitary or multiple (Cresswell, 2009). This philosophy considers two aspects which are Objectivism and Subjectivism. The aim of this programme of research is to investigate and develop a preparedness plan for Kuwaiti community in relation to SDSs. In order to arrive at a suitable household's preparedness plan, the involvement of community and governmental decision makers are required with the understanding of SDSs and its impact on community in Kuwait. In other words, this process implies different reactions

of involved actors that lead to their ‘subjective’ perceptions about the subject matter. Therefore, the ontological aspects of this research will lean towards subjectivism.

Epistemological beliefs are concerned with what is possible for one to know. It is about how to answer, “what is considered acceptable knowledge” and “how we know it” (Saunders et al., 2016). The researcher who is concerned with observable and predictable outcomes is said to have a positivistic position. This type of researchers adopts what Saunders et al., (2016) call a scientific method to test theories with highly structured and measurable data. From a positivist standpoint, research is not influenced by values the researcher holds. Positivistic research usually involves large samples and is associated with quantitative data and statistical analysis (Holden and Lynch, 2004).

By contrast, interpretivism refers to the study of the social phenomenon in its natural setting with the researcher interacting with what is being researched. According to Saunders et al. (2016), interpretivism requires a small sample and data collection and analysis often involve in-depth qualitative data obtained through investigations. As this research concerns with subjective issues, the details of situation, and a reality behind these details, the epistemology philosophy of this research will lean towards interpretivism.

Researchers also need to consider their values and answer these questions “what researcher values go into it” and “what is the role of values” (Saunders et al., 2016). In other words, the researcher needs to consider the axiological assumption of the research as the analysis process of research is highly affected by the researcher’s values that are means: the researcher is completely involved with what is being investigated (Collis and Hussey, 2014). Thus, the axiology assumption of this research will lean towards value laden. Table 3.1 provides a brief summary of these philosophies and its assumptions.

Table 4.1: Summary of philosophies and their assumptions. Source: Collis and Hussey (2014).

Philosophy assumption	Positivism	Interpretivism
Assumption about ontology (the nature of knowledge or reality)	nature of reality is objective	nature of reality is subjective
Assumption about epistemology (knowledge (reality), how it is obtained and accepted)	Investigator is independent of what is being investigated	Investigator is interacts with what is being investigated
Assumption about axiological (the role of values)	The research is neutral in its value and is unbiased	The research is laden in its value and may biases

As the overall aim of the studies in this PhD programme, is to examine *What are existing methods of SDSs mitigation globally and regionally; to investigate the current level of preparedness for SDSs within Kuwait; and to answer the question “What is possible approach to integrate community based approaches within existing disaster mitigation frameworks within Kuwait?”.* Using the Kuwait city as a case study and agreeing with the perspective, views, and thoughts of the top officials working in the government services related to the topic of the research, so the research is considered as a social science and the conception of the real-world practice, therefore, the interpretivism philosophy is accepted for this study, even though, the quantitative approach was also used in terms of survey questionnaire to validate and confirm the collected data from interviews.

This research considers the ontological assumption that reality is socially built and the epistemological assumption is that knowledge achieved through examining the interpretations of the persons working in the government services related to SDS and the axiological assumption were value laden, as a result biases may be existing via researcher and/or participants, consequently the researcher require to study how to avoid this biases. Figure (4.2) demonstrate the philosophical stance of this research.

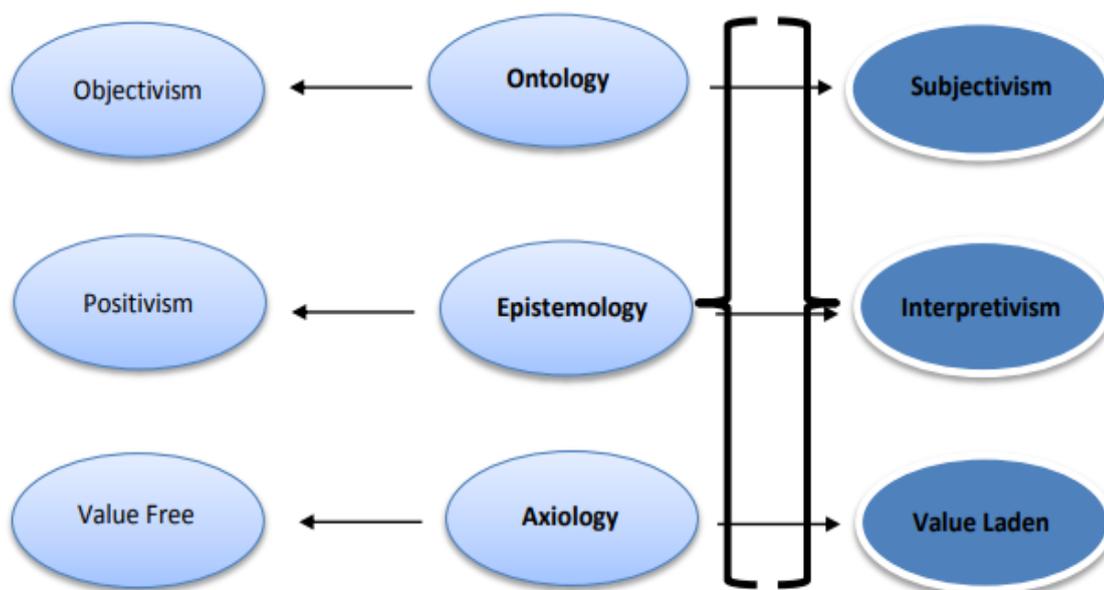


Figure 4.2: Philosophical Stance of this Research

4.4 Research Approaches

Having identified the philosophies that best suit the purpose of their research, the next step is to identify the most suitable approach or reasoning. In the literature, the two main approaches are identified are the inductive approach and the deductive approach.

Deductive approach is used by researchers who rely on existing theory and studies to develop the conceptual framework. This approach allows the researcher to test the hypothesis and answer the research questions. As pointed out by Zalaghi and Khazaei (2016) deductive approach begins with specific objectives and the pattern is to move from general to specific. The flow of deductive approach begins with literature to empirical with the aim of testing the conceptual framework; identify causal relationship and testing the hypothesis.

The inductive approach on the other hand begins with empirical data collection and then moves to designing the theory. The researcher observes specific cases to derive conclusions. Another difference compared to deductive approach, is that, inductive moves from specific to general as the researcher is initially limited to observing specific cases or circumstances (Zalaghi and Khazaei, 2016).

However, there is another third approach, which is abductive. The abductive approach is a logical procedure where the research chooses a guess or hypothesis that would most fit the given facts. It starts with the facts finding and then proceeds with major explanations about phenomenon. A medical diagnosis and criminal investigation are the most area of application of abductive reasoning (Saunders et al., 2016).

Nevertheless, Martin and Cepeda, (2005), specify that all empirical work is built on some basic ideas because there is no research without theory (theory-free). These authors believe that all researchers start with some kind of theoretical background and that it would be unworkable for them to participate in the research process with no frame or idea about relevant thoughts in the area of concern. Furthermore, Sekaran (2003) and Saunders et al., (2016) endorse that a combination of both approaches the deductive and inductive is not only possible in the same research but is often a valuable process.

Based on the specific nature of the research, that goes to build a theory and not testing a theory, therefore the researcher has first start reviewing the exist literature about SDS in Kuwait in order to understanding all issues that surrounding this subject and after that deals with it in the practical side. According to the above explanation both the deductive and inductive approaches were adopted to achieve the stated aim of this research.

4.5 Research Methodological Choice

The third layer in the research onion model that has been adopted for this research is the research methodological choice. In quantitative research the collection of data involves a numerical and/or statistical data; characterized by usages of large samples, attention on facts, and care about hypothesis testing. It is commonly connected to the deductive reasoning. This approach is acknowledged as the scientific method and objectivism in the ontological attitude and positivism in the epistemological position (Naoum, 2007). However, the qualitative research tends to manifest reality consideration of individuals' views and defines the reality in natural states (Collis and Hussey, 2014). This approach is subjective in terms of ontological attitude and interpretive epistemologically. In this regard Saunders et al., (2016) indicate three types of methodological choice namely: mono, mixed and multi-methods.

In this study the mixed methods will be adopted, using the qualitative and quantitative approach, interviews will be used to engage top management in different government services relevant to the research area. In addition, a survey questionnaire will be conducted on a representative sample of members of the Kuwaiti community.

4.6 Quantitative and Qualitative Research

A distinction is usually made between two research approaches, the quantitative and the qualitative methods of data collection. The first is associated with numeric data, large samples, and the deductive approach. On the other hand, qualitative research is associated with non-numeric data, small samples and the inductive approach (Cresswell, 2009). Different types of data collection tools are usually utilised by each approach (e.g. questionnaire surveys for quantitative research and interviews and observation for qualitative research). However, the two research approaches do not necessarily work in isolation. Rather, it is often argued that combining both in one study (i.e. the mixed approach) will result in rich and more in-depth data.

In this research the quantitative method was used for collecting data from members of the Kuwait community, and the qualitative method was used to collect data from the top officials in government services related to the topic of research.

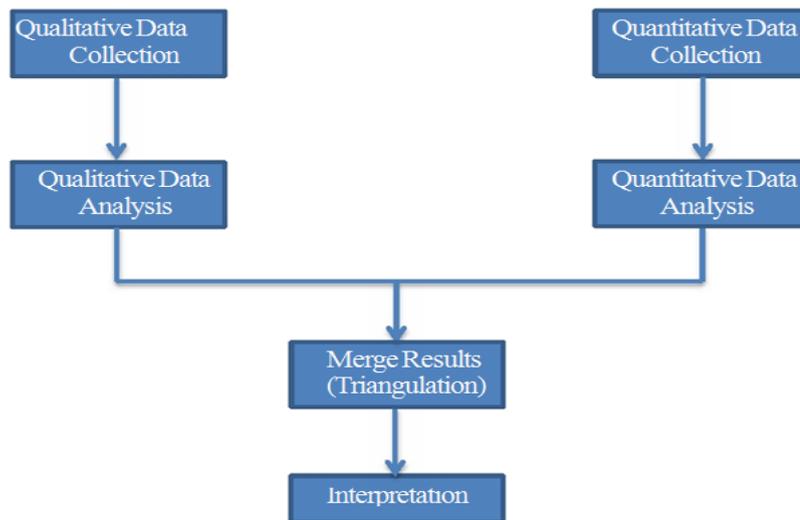


Figure 4.3: The Methodological Choice for this Research.

4.7 Research Strategies

A research strategy is meant to act as a plan of action that informs the techniques and procedures by which data are collected and analysed (Saunders et al., 2016). In the literature, a range of research strategies are identified such as experimental, survey, archival analysis, case studies and a historical analysis of archival information (Yin, 2013). Yin (2013) specified three principles that can be used to select the best appropriate strategy for research. These principles include;

1. The form of research question;
2. If the researcher control over behaviour events;
3. The events are contemporary

Table 4.2 Present the most research strategy and its link to these principles.

Table 4.2: Kinds of research strategy. Yin, (2013).

Type of Strategy	Kind of research question	Needs control over behaviour events	Focus on contemporary events?
Experimental,	How, Why	Yes	Yes
Survey	Who, What, Where, How many, How much	No	Yes
Archival analysis	Who, What, Where, How many, How much	No	Yes/No
History	How, Why	No	No
Case study	How, Why	No	yes

Hence, in this research the case study strategy has been accepted in order to achieve in-depth understanding of the issues under investigation and explore emergency preparedness plan and develop a conceptual framework to help research and practice for Kuwaiti community during Sand and Dust Storms. In addition, this approach will engage in answering research questions.

Furthermore, many experts in methodology including: Amaratunga (2002); Velde et al. (2004); and Saunders, et al. (2016) affirmed that the case study strategy is suitable if the researcher needs rich explanations and descriptions as well as deep understanding of the context of the research; it is a valuable approach of exploring present theory and allow the researcher to examine the real life. In addition to, the case study allows the researcher to use many sources and evident as part of the examination. The case study strategy is ideal for the researches that have a qualitative element in their research.

Case studies can be a multiple case studies or a single case study, besides; it can be holistic or embedded design (Yin, 2013). More general, the multiple case studies are further common and usually used to replicate finding and to increase the generalisations along with external validity of the result (Ibid). Figure 4.4 shows the designs of case study.

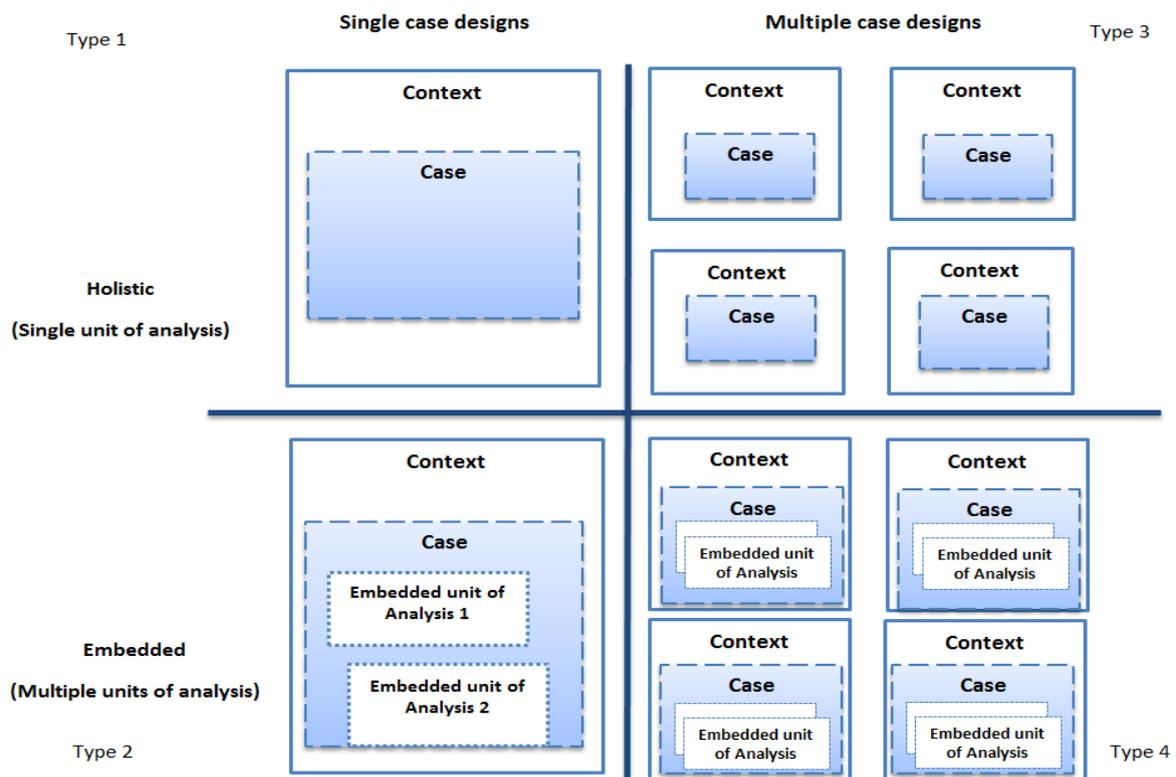


Figure 4.4: Types of case study. (Yin, 2013)

Yin (2013) believed that the single case study can be used once the case is representative case or a typical case. This means that the case represents a typical project or venture among several different projects, or a manufacturer thought to be typical of many other manufacturers in the same industry. The lessons and practices learned from all these cases are expected to be useful and increase the experiences of the typical individuals or association.

Based on the above discussion, this study implements a holistic single case, where the context is the Kuwaiti city. Selecting of single case will offer full benefits since the study wanted a holistic perspective to understand the preparedness plan for Kuwaiti community in relation to sand and dust storms. It is also clear that the events under investigation are contemporary, and the research will not control the events but collect data to understand reality. It is a case study because of the specified area and community and the findings could be extrapolated to wider areas in the MENA region and beyond.

4.7.1 Justification of the Choice of Kuwaiti city as a Case Study

Kuwait in general is a small desert country and the climate does not vary between all cities in Kuwait, so choosing of Kuwaiti city ‘the Capital of Kuwait’ is representative of other cities in the country. Additionally, Kuwait as a whole is a good example of countries in the MENA region, especially in the Gulf area and results of this research can be generalized in other similar countries. Search of literature suggested that research on SDSs preparedness in the MENA region is scarce at best. There were also no published reports on the existence of preparedness frameworks for SDSs in these countries.

Furthermore, and from research perspective, no previous studies having been investigating the SDSs in Kuwait. This assumes that the suggested framework of Emergency Preparedness Plan for SDSs can be applied to other cities in the Kuwait, and other countries in the region, since all cities have similar climate and topography structure, and administrative systems.

Kuwaiti city is the most sophisticated city in the Kuwait and its position as the capital offers great chances to provide its services to large numbers of citizens and different communities as well as different institutions. Thus, there can be several public implications in Preparedness Framework for SDSs which may be revealed by using the city as the case for this study.

For logistics reasons selecting Kuwait City as the case study is ideal as the researcher is from this city and he has the resources and connections needed to conduct this research. Social relationships in

Arabic culture plays significant role in facilitating access to people and places.

4.7.2 Case Studies Design Protocol

The case studies design protocol (CSDP) represents the approaches that has been taken in conducting this research. The CSDP is sequential and it begins with the problem that has been identified that leads to the aim of the research and literature search. This research is deductive as it begins with the reviewing the literature and identifying existing theories and development of the framework. This leads to the designing of questionnaire for the survey and preparing prompting questions for the interviews.

The preliminary empirical data collection is from Kuwait community and subject matter experts. Data is collected from Kuwait community through survey using self-administered questionnaire and analysed using SPSS. The data from subject matter experts is carried out through semi-structure interviews. The information is transcribed and then analysed using NVivo and according to thematic analysis approach as per Braun and Clark (2006). The literature, and findings of survey and interview are used in designing the framework for this research. The framework will then be tested further in a small focus group study to validate it. Figure 4.4 provides the schematic view of CSDP.

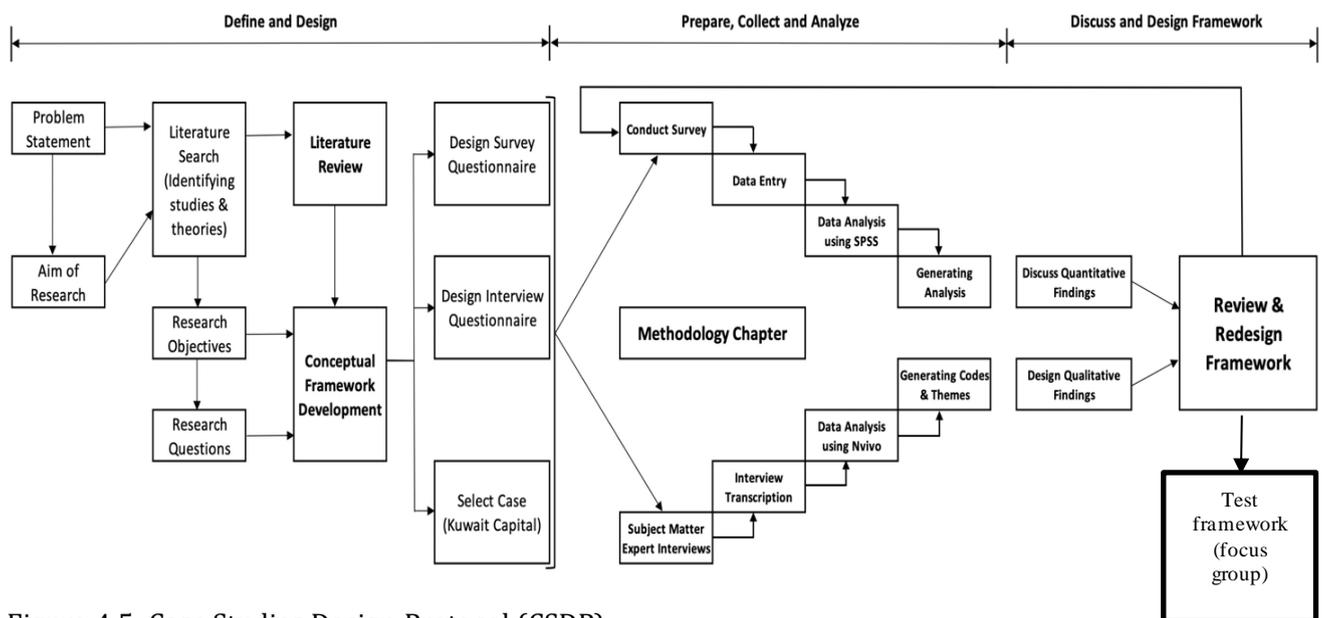


Figure 4.5: Case Studies Design Protocol (CSDP)

4.7.2.1 Unit of analysis

The unit of analysis is referring to who is being examined; it can be country, organisation, groups and/or individuals (Yin 2013). In this research the units of analysis are members of the community and governmental services involved in SDSs preparedness and response. Selecting Kuwait City as the study area will help in providing a rich data and full insight of the preparedness for SDSs.

4.7.2.2 Research strategies

Yin (2009) classifies research strategies into explanatory, exploratory, and descriptive. **The explanatory research** focuses on answering the how and the why and is associated with deductive reasoning approach and quantitative method. Researcher designs the research questions are designed prior to data collection, which are later answered based on the findings. However, this type of research is associated with experimental or causal studies and analysing via statistical techniques (Yin, 2013).

Exploratory research is related to case studies and investigative studies. the research begins with data collection and therefore explanatory research is associated with inductive reasoning approach and qualitative research method. According to Demetriou (2009) like explanatory research, the exploratory research formatting of the framework begins in the initial stage. **The descriptive research** is also a common strategy in social science researches. It is established on a theory which is then tested on cases. Descriptive research can be associated with both deductive and inductive approaches and therefore is a combination of explanatory and exploratory strategies. The research presented here, being explanatory and exploratory, attempt to understand a common framework for successful emergency preparedness plan for community in relation to sand and dust storms.

Another likely strategy for the studies in this PhD programme is the survey questionnaire. The survey strategy seeks to find answers to the “what”, “where”, “how much”, and “how many”. It is used when a large amount of data is needed to explain the phenomenon under investigation. Hence, it is associated with quantitative research and deductive methods (Clark & Badiee, 2010). It usually uses the questionnaire data collection technique and adopts a cross-sectional time horizon. This means that data are obtained under time constraints and over a short period of time. The main disadvantage of the survey strategy is that it does not allow for in-depth information.

The case study is most widely used in exploratory research. It is linked with qualitative data and the inductive approach. It can also employ multiple tools for obtaining information, with interviews being the most widely used.

4.8 Time Horizon

There are two types of time horizons in the research onion which are longitudinal and cross-sectional. In the cross sectional type the research are limited to an exact time frame. While, in the longitudinal type are time consuming even though it is providing a clearer picture of the reality on the ground by Saunders et al., (2009). Consequently, this research is adopted the cross-sectional time horizon due to the limited time structured by the regulations surrounding PhD study. This research tries to develop an

emergency preparedness framework for Kuwaiti community in relation to sand and dust storms and is consequently a cross-sectional study.

4.9 Application to The Present Study

As the aim of the research is to develop a SDSs preparedness framework for Kuwaiti community, literatures were investigated in two stages. In stage one, the aim had been to establish what research tells us about SDSs, their nature, sources, causes, impacts, as well as the measures employed to cope with this phenomenon and reduce its negative impacts. Result of the search had been nearly one hundred articles and research papers. In stage two, when focus of the study was shifted, the word “preparedness” in conjunction with the following terms: hazard, disaster, education, exercise, awareness, assessment, public, households, citizens, community, measures, surveys, and planning. The result was nearly over 300 publications. Most of the peer reviewed articles were on household disaster preparedness related to all types of hazards and disasters, and no survey was found on household preparedness for SDSs.

4.10 Data Collection Methods

Saunders et al., (2016) thought that interviews can be allocated on three classifications that is: unstructured interviews, structured interviews and semi-structured interviews. Each one of these interviews has its features. In case of the unstructured interviews there are no determined questions to work through as well as the interviewee feels free to talk about their point of view, opinions, and attitudes related to the topic of the research in general (Saunders et al., 2016).

In case of structured interviews, the questions considered as the same phrasing and order of questions, Also, this type of interviews might contribute to gaining uniform data, which guarantees the comparability of information (Oppenheim, 2000).

However, the semi-structured interview has several advantages of both unstructured and structured interviews such as the flexibility in giving rich and in-depth data. As well as gives the researcher the chance to tailor the questions to the continuing. Thus, it is allowing to clarify the complexity or improved incomplete answers whereas, the structured interview does not permit this (Oppenheim, 2000). For this reason, the semi-structured interviews were chosen for this research.

The semi-structured interviews were conducted with 26 top emergency management experts from different departments.

The interview questions were developed according to the following steps:

- Design the first draft of questions from the literature review with accord to the conceptual framework for community preparedness during sand and dust storms.
- Conducting a pilot study with different respondents in relation to the SDS;
- Revising questions and reorganization the content based on the feedback from the pilot studies;

The interviews were carried out in person and on individual basis. The objective of the interviews was to understand the preparedness of the respective departments in the event of SDS. The interviews were semi-structured. Questions were prepared prior to the interview and the same sets of questions were asked from all participants. This helped in following a pattern and in also comparing the responses. A semi-structured interview also provides opportunity for both the interviewer and interviewee to ask and provide more information related to the questions.

Interviews focus was around the current state of disaster preparedness in the country and obstacles for establishing a disaster management unit and disaster preparedness framework for effective plan. The interviewees' perceptions of existing emergency preparedness plans are also explored. Data will be collected independently, beginning with the qualitative data followed by quantitative information. In order to better understand the research problem and find credible answers to research questions, both types of data are then integrated.

Regarding survey, the researcher conducts a questionnaire survey on a random sample of Kuwaiti community (700 questionnaires were distributed out of which 398 were completed and returned). Online sample size calculator¹ was used to determine the required sample size based on the following parameters:

Margin of error

This is the level of precision required. The value of this margin of error was 5% meaning that accuracy of results will be in the margin of $\pm 5\%$.

¹ <https://select-statistics.co.uk/calculators/sample-size-calculator-population-proportion/>

Confidence level

The confidence level is the probability that the margin of error contains the true proportion. If the study was repeated and the range calculated each time, we would expect the true value to lie within these ranges on 95% of occasions.

Population size

This is the total number of distinct individuals in your population and because the population is large, 100,000 was used as the sample size doesn't change much for populations larger than 100,000.

Sample proportion

As I was not sure what proportion would answer favourably or unfavourably to any question this value was put at 50%.

Sample size

This is the minimum sample size needed to estimate the true population proportion with the required margin of error and confidence level. The required sample size was 384 and therefore 700 questionnaires were distributed to cover lost mail and non-responses.

The selected participants were based on the geographic location (inner city, close to or in open desert). For the selection process, assistance will be sought from the Ministry of Housing and/or municipalities to identify addresses. Only adults aged 21 years or over will be required to answer questions.

In addition to demographic information (age, income, house type, education, nationality, number of children), questions asked need to establish: impact of sand storms on the health, safety, social relations, property and daily life routine of all members of community surveyed, and also, the impact on the house parts, type, structure, contents, exterior and interior. The questionnaire also seeks to establish: respondents' perceptions of SDSs, the precautionary measures they employ during a sand storm event, the type and quality of information they may hold or seek about SDSs hazards and emergency services as well as the source or sources of that information, whether a supply kit is kept at home, whether a neighbourhood watch or care group has been formed, and whether arrangements have been made to protect self and property. A total of 398 responses were received which is 56.86% response rate.

4.11 Pilot Study

The questionnaire was first subjected to pilot test to ensure that the questionnaire is understandable by larger population, for the ease of answering, and the overall structure. The pilot sample included 45 respondents that were randomly selected. Feedbacks from the pilot sample were received regarding grammatical recommendations and other changes for ease of understanding. The changes pertained to rephrasing and shortening the length of the statements. Once the changes were carried out, the questionnaire was distributed to the larger sample population.

4.12 Data Analysis

The quantitative data are tabulated in a spread sheet and checked for mistakes. Once finalized the data was entered in Statistical Package for Social Sciences (SPSS) (Version23) and all analysis performed in this programme. SPSS Statistics is a powerful statistical software platform. It allows management of numerical data or data coded as number (e.g. 1 for male and 2 for female). Data then can be transformed or calculated in different ways through user friendly interface to understand large and complex data sets quickly with advanced statistical procedures. The analysis approach consisted of both descriptive statistical analysis and inferential data analysis. Describing and summarizing data as means and describing the variation within data as standard variation were the most common descriptive statistics used for continuous variables (such as age or income). Non continuous data (such as gender, categorical or ordinal data) was also described in terms of proportions or percentages. Inferential statistics was used to compare between variables using t-test to compare between two variables. A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups, which may be related in certain features. The t-test is one of many tests used for the purpose of hypothesis testing in statistics. Analysis of Variance (ANOVA), which is similar to t-test, was used to compare between more than two variables when appropriate. Chi square test was used to compare between proportions (percentages).

In all these tests p value is calculated. A p-value is a measure of the probability that an observed difference could have occurred just by random chance. The lower the p-value, the greater the statistical significance of the observed difference. P-value can be used as an alternative to or in addition to pre-selected confidence levels for hypothesis testing. In analysis the level of P value to be significant was set at 0.05. Any p value over this cut point means that the differences investigated are not statistically significant. P value is calculated according to the test statistics and depends largely on the magnitude of the difference between two means or two proportions and the sample size. Low p value (below 0.05)

mean s the differences in the tested means or proportion are not due to change and are actual representation of the truth.

The Interviewees in the qualitative study must be an employee of a senior status in an emergency department or a governmental or NGO organization that have experience in dealing with SDSs emergency. The qualitative data analysis was carried out using Nvivo software. NVivo was used to import, organize and explore data (written transcripts of interviews), all in one place and run different queries and visualizations help you discover connections between different texts that it is difficult and tedious to do it manually, and produce findings such as word queries or relationship between texts in a meaningful way. NVivo made coding of different texts easier and was used to locate text relevant to the codes. NVivo guided by the thematic analysis approach described by Braun & Clark (2006). NVivo allow easy handling of interviews' transcripts. Coding of different texts is then carried out and arranged in themes (concepts) and finally a thematic map summarizing the findings are drawn. The findings are discussed in the qualitative chapter.

Table 4.3: the research process. adopted by the researcher

Research m Methodology	Type	Adoption
Research methodology	Epistemology	Lean towards Interpretivism
	Ontology	Lean towards Subjectivism
	Axiology	Lean towards Value Laden
Research Approach	Inductive/Deductive/ Abductive	Inductive and Deductive
Research Strategy	Mixed method	case study/survey
Research Method Data Collection	Qualitative	Semi-structured interviews with ten experts of SDS
	Quantitative	Questionnaire survey with 398 (Kuwaiti community)
Research Method Data Analysis	Qualitative	Nvivo software - Thematic Analysis
	Quantitative	SPSS and critical analysis

4.13 Outline of The Research Objectives Achievement

The aim of this section is to summaries the key research methods used in addressing the research objectives. It shows the research objectives headed for attainment of the research aim. It specifies the methods used for collecting data in in reaching each specific research objective in this

study. Table 4.4 below shows how each research objective will be achieved.

Table 4.4: Research objectives with corresponding to data collection methods

Research Objectives	Research Strategy	Techniques of Data Collection
To critically review literature on the emergency management, the nature and trends of SDSs in Kuwait	Literature review of relevant articles and documents	Relevant data from the literature are described and discussed
To investigate the global best practices of preparedness during SDSs	Literature review of relevant scientific published articles on SDSs	Relevant data from the literature are described and discussed
To study the impact of SDSs on community in Kuwait	Literature review Survey of the members of the community and emergency service personnel	Semi-structured interviews with 26 experts and 398 questionnaires to members of the Kuwaiti community
To explore the current preparedness plans in Kuwait during SDS.	Literature review Survey Interviews	Semi-structured interviews with 26 experts and 398 questionnaires to Kuwaiti community
To critically evaluate barriers to implementing preparedness plan for addressing SDSs in Kuwait.	Survey Interviews	Semi-structured interviews with 26 experts and 398 questionnaires to Kuwaiti community
To develop and validate a preparedness framework for SDSs.	Focus group	Semi-structured interviews with Executives in emergency departments to validate the framework resulted from the survey and interviews

4.14 Ethical Considerations

Before carrying out the field study, ethics forms were completed and presented to the supervisor for assessment. Participants in the study were presented with an information sheet highlighting the purpose of the research and explaining what participation in the study entails. The information sheet states clearly that the confidentiality and anonymity of all participants will be observed. It also states that participation in the study is voluntary and that the participant can withdraw at any stage during the research even without giving an explanation. Those who agree to take part in the study should be 21+ years of age, and they were asked to sign a consent form. All studies have been granted ethical approval from the University of Salford ethics committee. Participant Information Sheet and template of consent form can be found in the appendices of this thesis.

4.15 Conclusion

This methodology chapter have informed the design and organization of this research to meet the objectives highlighted in earlier chapters. This will be mixed methods with a survey and interviews

which should generate enough data to develop the preparedness framework.

CHAPTER 5: QUANTITATIVE DATA COLLECTION AND ANALYSIS

5.1 Introduction

To meet the research objective a survey study was planned for where a structured questionnaire was designed and administered to collect the required data (Appendix 2). A pilot sample of 45 individuals were chosen first to check the reliability and the validity of the questionnaire. The pilot sample was analyzed where the reliability of the questionnaire was calculated. Some minor correction on the first draft of the questionnaire was made by rephrasing some of words or shorten some of the statements. Finally, the revised version of the questionnaire was ready. The questionnaire measures 4 dimensions:

1. Personal Characteristics
2. Community awareness of natural disaster
3. Degree of community satisfaction with the concerned organizations
4. Evaluation of concerned organizations support in case of emergency.

5.1.1 Population and Sample:

A sample of 700 individuals, were randomly chosen to answer the questionnaire. Simple random sampling was applied on the telephone directory of Kuwait using a computer random number generator on last three digits of the telephone number. Equal number of participants were drawn from different regions of the city and then contacted and given the questionnaire. Simple random sampling is a probability sampling technique which is chosen because of its simplicity and effectiveness (Sharma, 2017). 398 questionnaires were returned in complete forms to make the response rate of 59%. The Cronbach α Coefficient of reliability was calculated using the Likert scales scores of all items. It is basically the correlation between the scores of the different items (questions). It came out 93.6%, which is an excellent indication of very high internal consistency (correlation) between items.

In the following section, the statistical analysis of the questionnaire is presented. First, the demographic information about the participants and their properties is presented; then a data collected on the research questions regarding SDS phenomenon in Kuwait is presented.

5.2 Characteristics of Participants

5.2.1 Age distribution of the respondents

One criterion was that the respondents must be 21 years old and over. However, as the questionnaire was distributed to household some of the returned questionnaires were of young people under that age. It was decided to keep these questionnaires.

As shown in Table 5.1, 2.5% of the respondents were less than 19 years old, 15.8% were in the age group 20- 29, 31.2% were in the age group 30 – 39, 28.9% were in the age group 40 – 49, 16.3% were in the age group 50-59, and 5.3% 60 years and above.

Table 5.1: distribution of age categories

		Count	Percent
Valid	<19yrs	10	2.5
	20 to 29yrs	63	15.8
	30 to 39yrs	124	31.2
	40 to 49yrs	115	28.9
	50 to 59yrs	65	16.3
	60 to 69yrs	21	5.3
	Total	398	100.0

5.2.2 Educational Levels of the respondents

Regarding their educational levels, among the sample 2.3% of the respondents were secondary school graduated, 9.5% held high school certificate, 26.6% of them have Diploma, 46.2% are university graduated, 8.0% have Master’s degree, and 7.3% are Ph.D. holders.

Table 5.2: Level of Educational

		Count	Percent
Valid	Secondary School	9	2.3
	High School	38	9.5
	Diploma	106	26.6
	Bachelor’s degree	184	46.2
	Master’s degree	32	8.0
	PhD	29	7.3
	Total	398	100.0

5.2.3 Properties and Ownership

When respondents were asked about the number of years they have stayed in this neighborhood, 6.6% replied less than a year, 16.8% stayed between 1-10 years, 17.1% stayed between 11-20 years, 25.4% stayed between 21-30 years and 34.2% have stayed 30 years and more.

Table 5.3: How many years have you lived in this part of Kuwait City

		Count	Percent
Valid	Less than 1 year	26	6.5
	1 to 10 years	67	16.8
	11-20 years	68	17.1
	21-30 years	101	25.4
	30 years and above	136	34.2
	Total	398	100.0

The participants also responded to the question of property ownership and indicated that 31.4% of them own their property while 68.6% rent their houses.

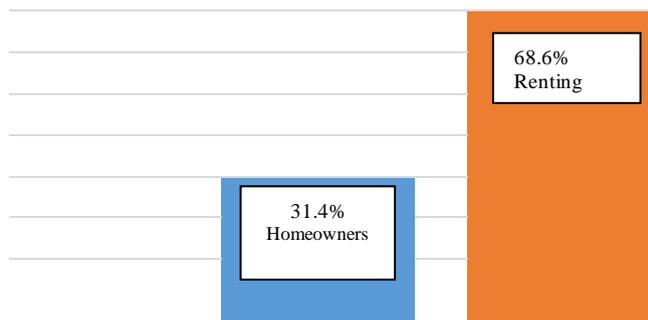


Figure 5.1: Type of Ownership. Difference is significant at $p=0.001$ Chi-square.

In addition, the questionnaire investigated the type of property owned, as shown in Figure 5.2, 26.6% of the respondents were single family, 4% live in a duplex house, 27.9% live in Villas, 8.5% live in apartment 3-4 units, 5% live in apartments 5 units and more, 24.4% of households live in manufactured houses, where 3.5% of respondents claim they live in different types of properties.

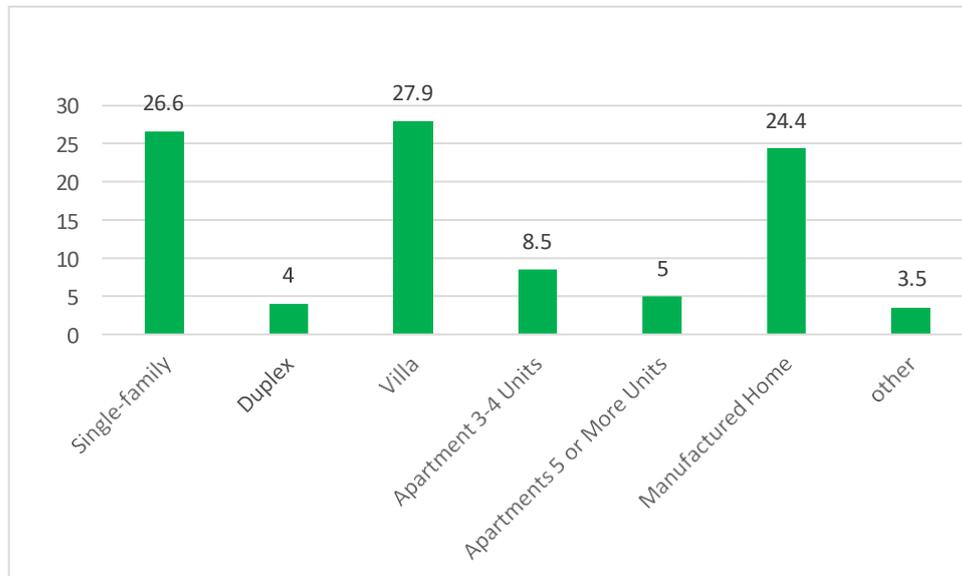


Figure 5.2: Percent of the type of Property. Differences are significant at $p=0.001$ Chi-square.

5.3 The Awareness of Community of the Severity of Different Natural Disasters

As indicated in Table 5.4 community are aware of the severity of the SDS (average = 3.18, p -value = 0.000) on 5 Likert scale, 1-5 Likert scale, with 1 is not severe and 5 very severe, however they are less aware of the severity of Floods (average= 2.58, p -value = 0.007), of Thunderstorm (average = 2.56, p -value = 0.000), and of Earthquake (average = 2.69, p -value=0.000).

Table 5.4: Severity of Natural Disasters

Natural Disasters	Percent of responses					Mean of Likert scale	SD	P-value ^a
	Not Severe	Less Severe	Neutral	Severe	Very Severe			
SDSs	16%	15.1%	33.9%	10.3%	26.6%	3.18	1.361	.000*
Floods	41.2% ^b	12.3%	16.6%	7%	22.9%	2.58	1.608	.007*
Thunderstorms	42.7% ^b	13.1%	13.3%	7.3%	23.6%	2.56	1.634	.000*
Earthquake	38.4% ^b	13.3%	15.3%	6.3%	26.6%	2.69	1.647	.000*

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

5.4 The awareness of community of the effect of severity of SDS on several issues

Table 5.5: Effect of SDS on Different health and Property Issues

Effect of SDS on	Percent of responses					Mean of Likert scale	SD	P-value ^a
	Not Severe	Less Severe	Neutral	Severe	Very Severe			
Health	7.0%	5.3%	19.6%	26.4%	41.7% ^b	3.90	1.205	.000*
Security and Safety	8.8%	9.0%	34.2% ^b	25.9%	22.1%	3.43	1.183	.000*
Social Ties	16.1%	19.8%	36.4%	13.8%	13.8%	2.89	1.235	.089
Ownership	15.1%	17.1%	29.1%	18.1%	20.6%	3.12	1.330	.071
Daily Activities	5.0%	10.3%	32.4% ^b	25.1%	27.1%	3.59	1.138	.000*

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

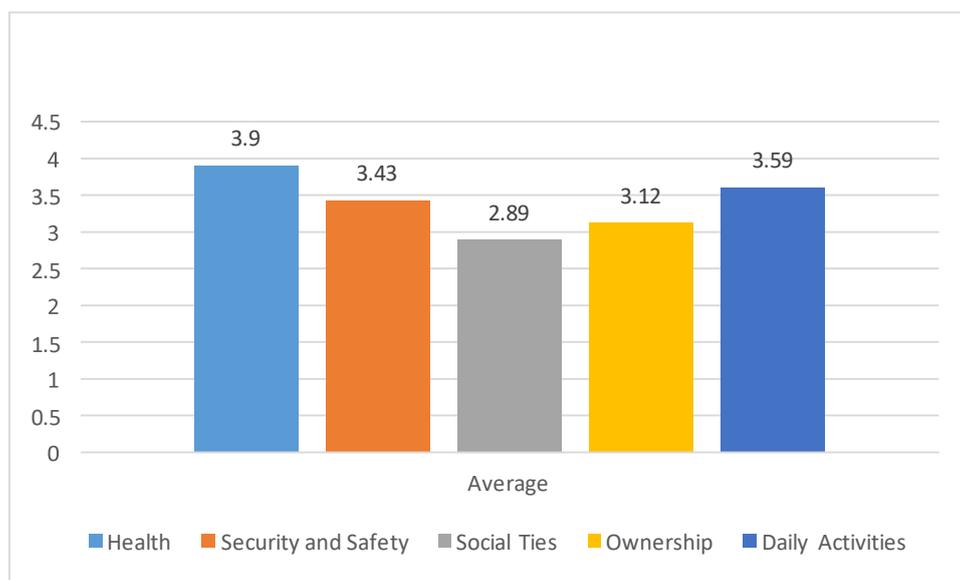


Figure 5.3: How severe is the impact of SDS measured on a Likert scale (5 is the most severe).

As illustrated in Table 5.5, respondents are very much aware of the severity of SDS on health conditions (average = 3.9, p-value = 0.000) on 5 Likert scale. They are also aware of the severity of sandstorm on security and safety of people (average = 3.43, p-value = 0.000), and they are very much aware of the severity of sandstorm on daily activities (average = 3.59, p-value = 0.000). However, communities are not aware of the effect of sandstorm on social ties (average = 2.89, p-value = 0.089), and they are not aware of the effect sandstorm on ownership and property damage (average = 3.12, p-value = 0.071).

Table 5.6: Effect of Respirator System Problems on the general health conditions

Effect of Breath Problems on Health	Percent of responses					Mean of Likert scale	SD	P-value ^a
	Not Severe	Less Severe	Neutral	Severe	Very Severe			
Pneumonia	12.6%	10.6%	23.9%	21.4%	31.7%	3.49	1.361	.000*
Trachealis	18.1%	8.8%	11.3%	18.6%	43.2% ^b	3.60	1.540	.000*
Aspergillosis	15.1%	6.5%	18.6%	20.9%	38.9% ^b	3.62	1.433	.000*
Desert lung syndrome	13.8%	13.1%	29.9%	17.8%	25.4%	3.28	1.343	.000*

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

Presented in Table 5.6, the respondents' attitude towards a very important question regarding their awareness of the consequences of the respiratory problems on their general health conditions which includes:

- Pneumonia
- Trachealis
- Aspergillosis
- (Desert lung syndrome)

As shown in Table 5.6, the t-test supported the degree of awareness of members of the community of the above diseases. The households are very much aware of all respiratory symptoms.

5.5 Knowledge of Community to Handle SDS

To check the readiness of the Kuwaiti community to handle SDS, the questionnaire asked about the degree of knowledge they have to face the SDS, the following Table 5.7 gives their responses to the question: How do you rate your knowledge in terms of preparation and dealing with sand and dust storms?

Table 5.7: Knowledge of Handling SDS.

Knowledge of Handling SDS	Percent of responses					Mean of Likert scale	SD
	Very bad	bad	intermediate	good	Very good		
Traditional (based on experience)	12.3%	15.3%	42.5% ^a	15.8%	14.1	3.04	1.170
Modern (Learnt at school or via Organizations)	22.9%	19.8%	37.2% ^a	11.1%	9.0%	2.64	1.207

^a proportions are significantly different ($P < 0.05$, Chi-square).

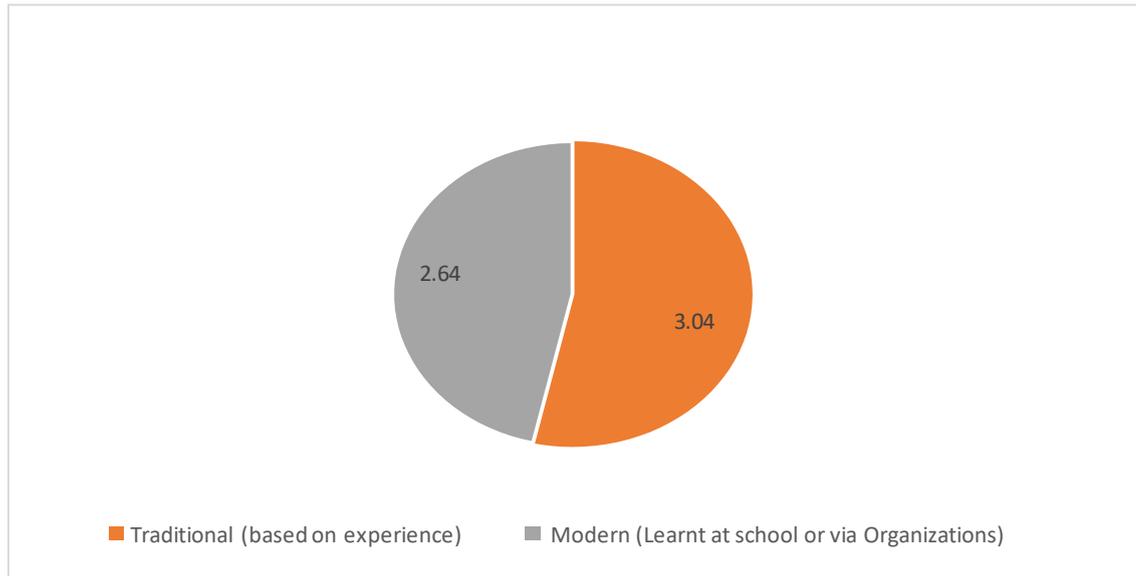


Figure 5.4: Knowledge of Handling SDS as an average of Likert scale (5 is very severe).

From Table 5.7, 42.8% of respondents claim that they earned their knowledge of handling SDS by experience and 45.2% earned their knowledge by training and learning through organization and school. While 7.6% claimed they got their knowledge from both and 4.4%, they got their knowledge from different sources. When the questionnaire asked about how long ago since they house hold receives information about SDS, 47.2% of respondents replied less than 6 month, 18.6% of respondents said between 6- 12 months, 9.35 claimed that between 1-2 years, 7.8% suggested between 2-5 years, and 17% replied about 5 years or more.

5.6 Degree of Satisfaction with Concerned Organization

5.6.1 Satisfaction with Organization Performance

Table 5.8: The degree of satisfaction of community with concerned organization performance

Satisfaction with Organization Performance	Percent of responses					mean	SD	P-value ^a
	Very Unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Very Satisfactory			
Civil Defence	20.1%	12.1%	25.6%	25.4%	16.8%	3.07	1.361	.321
Fire Department	15.6%	10.6%	26.9%	25.9%	21.1%	3.26	1.329	.000*
Emergency Services	15.6%	10.1%	32.2%	21.1%	21.1%	3.22	1.317	.001*
Red Cross	37.4% ^b	16.8%	20.6%	14.3%	10.8%	2.44	1.391	.000*
Health Organizations	14.8%	16.6%	29.1%	24.9%	14.6%	3.08	1.260	.218

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

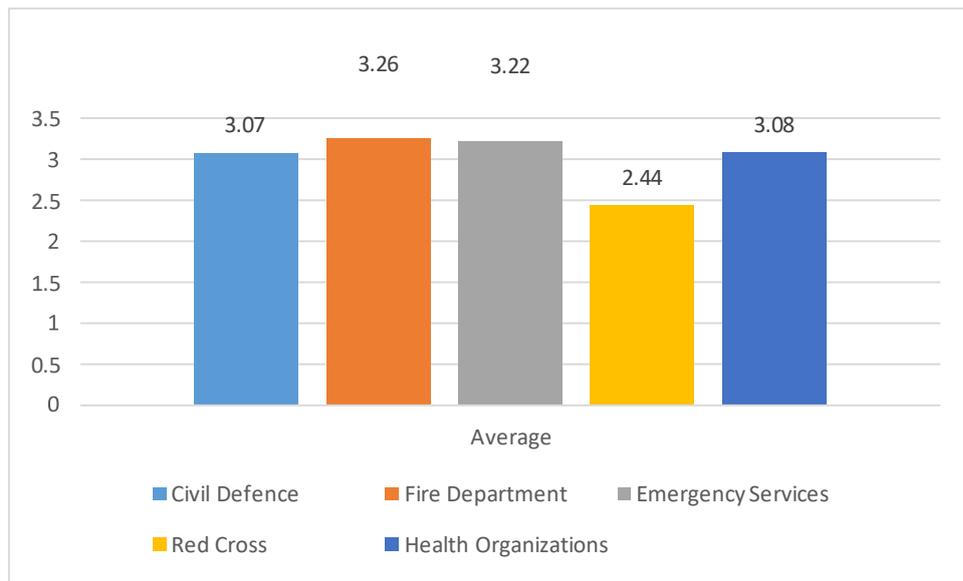


Figure 5.5: The degree of satisfaction of community on a Likert scale with concerned organization performance (5- very satisfactory)

As shown in Table 5.8, the respondents are neutral about the performance of both Civil Defence department and Health Organization (average=3.08, p-value=0.218), (average=3.07, p-value=0.321), respectively, during SDS. Meanwhile the respondents are satisfied with Fire Department (average =3.26, p-value=0.000), Emergency Services (average=3.22, p-value=0.000). In the contrarily, respondents are unsatisfied with Red Cross performance during SDS (average = Red Cross (average =2.44, p-value= 0.000) during SDS.

5.6.2 Community Satisfaction with Organization Reaction Time

Table 5.9: Satisfaction with reaction Time

Satisfaction with Reaction Time	Percent of responses					mean	SD	P-value
	Very Unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Very Satisfactory			
Civil Defence	14.6%	12.3%	30.7%	21.9%	20.6%	3.22	1.306	.001*
Fire Department	10.8%	10.3%	27.9%	24.4%	26.6%	3.46	1.280	.000*
Emergency Services	9.3%	11.6%	34.7% ^b	25.4%	29.1%	3.33	1.182	.000*
Red Cross	37.7% ^b	14.1%	22.9%	11.8%	13.6%	2.49	1.435	.000*
Health Organizations	16.6%	8.3%	34.7% ^b	22.9%	17.6%	3.17	1.286	.010*

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

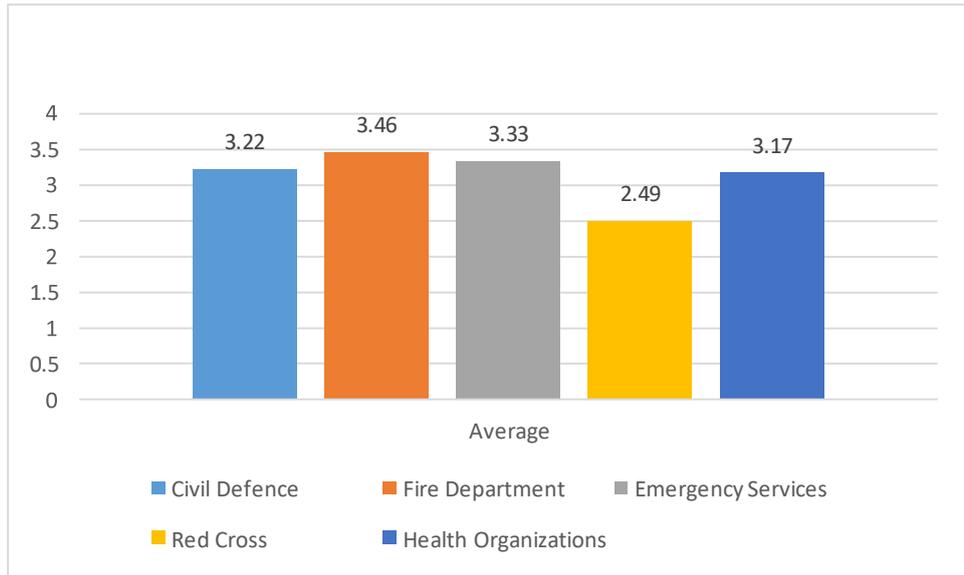


Figure 5.6: Satisfaction with reaction Time. Likert scale (5=very satisfactory)

Table 5.9 shows the average perception of each department regarding their reaction time to SDS. As indicated, respondents are satisfied with Civil Defence (average= 3.22, p- value=0.001), Fire Department (average= 3.46, p-value=0.000), Emergency Services (average=3.33, p-value=0.000), Health Organizations (average=3.17, p-value=0.010). However, respondents are less satisfied with Red Cross reaction time (average=2.49, p-value= 0.000).

5.6.3 Satisfaction with Published (Availability) Information about SDS

Table 5.10: Availability of Information about SDS

Satisfaction with Reaction Time	Percent of responses					Mean of Likert scale	SD	P- value ^a
	Very Unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Very Satisfactory			
Civil Defence	19.6%	14.8%	30.2%	16.3%	19.1%	3.01	1.365	.942
Fire Department	16.6%	14.1%	31.9%	21.6%	15.8%	3.06	1.286	.350
Emergency Services	16.3%	14.1%	30.4%	21.6%	17.6%	3.10	1.307	.126
Red Cross	44.2% ^b	15.1%	20.4%	10.6%	9.8%	2.27	1.372	.000*
Health Organizations	19.1%	14.3%	33.9%	17.3%	15.3%	2.95	1.302	.489

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

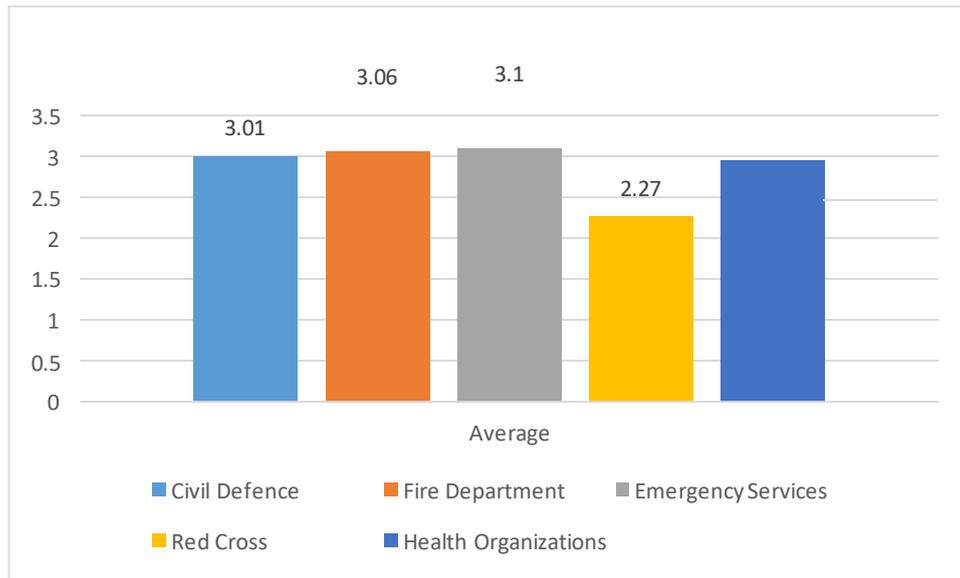


Figure 5.7: Availability of Information about SDS. Likert scale (5= very satisfactory)

As exhibited in Table 5.11 and Figure 5.7, respondents are neutral about the information about SDS published or made available by Civil Defence department (average = 3.01, p-value = 0.942), Fire Department (average = 3.06, p-value=0.350), Emergency Services (average = 3.10, p- value=0.126), Health Organizations (average = 2.95, p-value = 0.489). But, people are less satisfied with Red Cross available information about SDS (average= 2.27, p-value =0.000).

5.6.4 Satisfaction with Sources of Information about Property Preparation against SDS

Table 5.11: Trustfulness of Information to Prepare Properties to Face SDS

Satisfaction with Reaction Time	Percent of responses					mean	SD	P-value ^a
	Very Unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Very Satisfactory			
Civil Defence	19.1%	12.6%	21.4%	17.1%	29.9%	3.26	1.481	.000*
Fire Department	19.3%	14.6%	23.9%	20.1%	22.1%	3.11	1.413	.119
Emergency Services	16.6%	17.1%	25.9%	19.6%	20.9%	3.11	1.363	.106
Red Cross	45.0% ^b	18.8%	17.1%	8.3%	10.8%	2.21	1.373	.000*
Health Organizations	16.1%	13.6%	23.6%	22.4%	24.4%	3.25	1.385	.000*

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

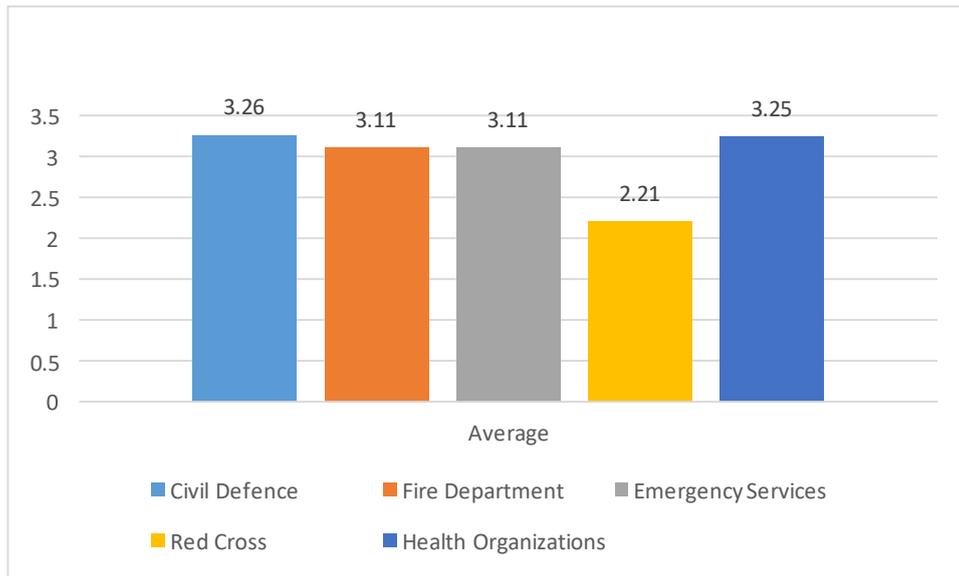


Figure 5.8: Trustfulness of Information to Prepare Properties to Face SDS. Likert scale (5= very satisfactory)

As illustrated in Table 5.11 and Figure 5.8, respondents the information prepared by the following departments to prepare properties against SDS including Civil Department (average= 3.26, p- value =0.000), Health Organizations (average = 3.25, p-value =0.000). While, respondents are neutral about the information made available by Fir Department (average= 3.11, p- value=0.119), and Emergency Services (average = 3.11, p-value=0.106). In the contrary, respondents are less trustful with information made available by Red Cross (average = 2, 21, p-value =0.000).

5.6.5 Sources of Effective Information to Face SDS

Generally, the respondents are satisfied and trust following sources of information is including TV news (average = 3.95, p-value=0,000), Internet (average = 4.20, p-value= 0.000) and T.V. Ads (average = 3.42, p-value =0.000). While, respondents are neutral about the school as a trustful source of information (average = 2.87, p-value=0.084). Meanwhile, the respondents are less trustful with Mail (average =1.95, p-value=0.000), Newspapers (average= 2.52, p- value = 0.000), Brochures (average = 2.18, p-value= 0.000), Fire Department (average= 2.82, p-value = 0.015), Workshops (average = 2.57, p-value = 0.000), Research Centers (average = 2.76, p-value = 0.000), Outdoors adds., (average = 2.59, p-value = 0.000), and Newspapers adds (average 2.83, p-value =0.023).

Table 5.12: Trustful Sources of Information about SDS.

Trustful Sources of Knowledge to Face SDS	Percent of responses					mean	SD	P-value ^a
	Very Unsatisfactory	Unsatisfactory	Neutral	Satisfactory	Very Satisfactory			
T. V. News	9.3%	5.3%	16.1%	19.3%	50.0% ^b	3.95	1.308	.000*
Mail	64.8% ^b	7.3%	9.0%	6.0%	12.8%	1.95	1.461	.000*
Newspapers	38.4%	15.1%	19.3%	10.3%	16.8%	2.52	1.497	.000*
Brochures	50.8% ^b	10.8%	19.3%	7.8%	11.3%	2.18	1.415	.000*
Internet	10.6%	1.8%	9.8%	13.1%	64.8% ^b	4.20	1.316	.000*
Fire Departments	26.4%	15.3%	26.1%	13.8%	18.3%	2.82	1.433	.015*
Schools	26.1%	16.6%	21.9%	14.8%	20.6%	2.87	1.474	.084
T.V. Adds.	15.8%	17.3%	10.3%	22.1%	34.4%	3.42	1.495	.000*
Workshops	30.9%	20.4%	23.9%	11.1%	13.8%	2.57	1.385	.000*
Research Centers	27.9%	17.3%	24.4%	11.6%	18.8%	2.76	1.451	.001*
Outdoors Adds	33.9%	17.3%	22.6%	8.3%	17.8%	2.59	1.470	.000*
Newspapers Adds.	28.4%	17.3%	20.4%	11.1%	22.9%	2.83	1.520	.023*

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

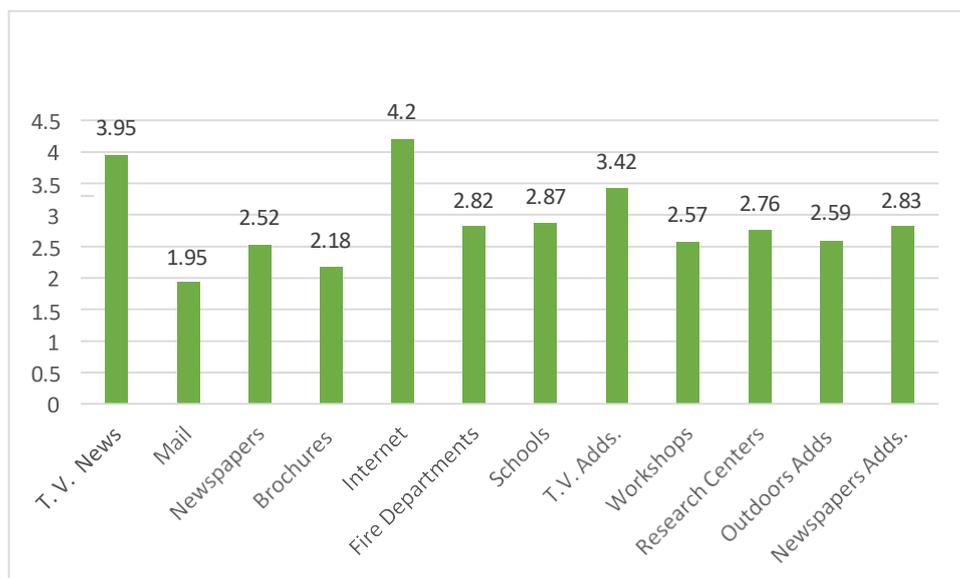


Figure 5.9: Satisfaction with source of Information on SDSs. Likert scale (5= very satisfactory)

5.7 Evaluation of The Amount of Support and Facilitation from Concerned Organizations

5.7.1 Organizations Support after the SDS

Table 5.13: Support provided after SDS

Satisfaction with Reaction Time	Percent of responses					mean	SD	P-value ^a
	Very Poor	Poor	Neutral	Very good	Excellent			
Civil Defence	15.6% ^b	17.3%	20.4%	21.4%	25.4% ^b	3.24	1.405	.001
Fire Department	11.1% ^b	18.3%	21.9%	20.1%	28.6% ^b	3.37	1.357	.000
Emergency Services	12.1%	20.1%	20.9%	24.1%	22.9%	3.26	1.333	.000
Red Cross	36.4%	21.9%	16.3%	12.3%	13.1%	2.44	1.418	.000
Health Organizations	14.1%	15.3%	25.4%	20.9%	24.4	3.26	1.355	.000

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

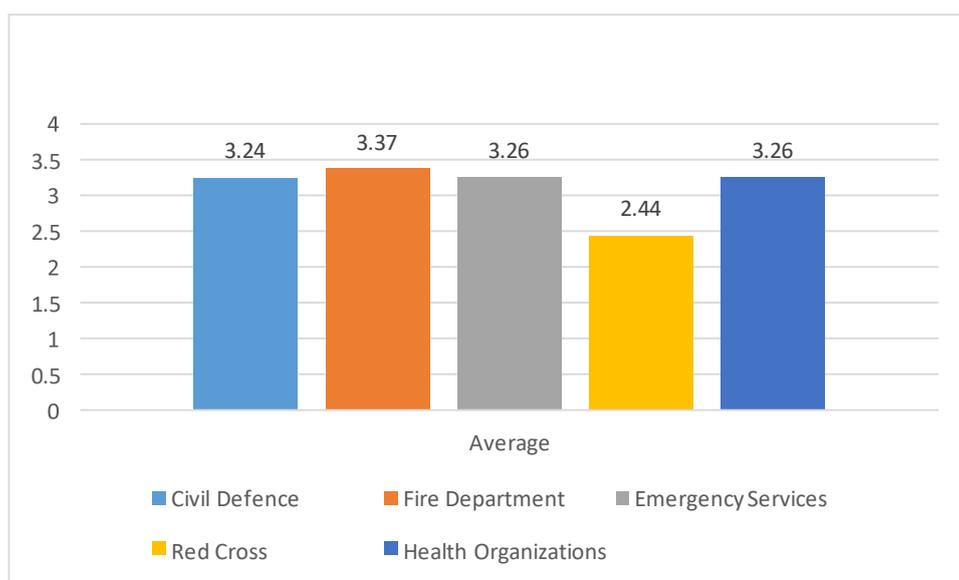


Figure 5.10: Support provided after SDSs. Likert scale (5=very excellent).

According to the results in Table 5.13 and Figure 5.10, the respondents rated the following departments very good including Civil Defence (average = 3.24, p-value = 0.001), Fire Department (average = 3.37, p-value = 0.000), Emergency Services (average = 3.26, p-value = 0.000), and Health

Organizations (average = 3.26, p-value = 0.000). While the respondents rated the Red Cross support after SDS as poor.

5.7.2 Obligation of Organization to React and Support community against SDS

Table 5.14: Obligations of Organizations to React and Support Community in Case of Emergency

Satisfaction with Reaction Time	Percent of responses					mean	SD	P-value ^a
	Extremely Disagree	Disagree	Neutral	Agree	Extremely Agree			
Civil Defense	12.1%	5.3%	9.5%	18.6%	54.5% ^b	3.98	1.393	.000
Fire Department	11.8%	7.3%	16.1%	18.1%	46.7% ^b	3.81	1.396	.000
Emergency Services	11.8%	5.3%	12.1%	16.6%	54.3% ^b	3.96	1.393	.000
Red Cross	29.1%	12.1%	18.8%	12.6%	27.4% ^b	2.97	1.585	.705
Health Organizations	9.0%	8.0%	12.1%	17.6%	53.3% ^b	3.98	1.339	.000

^a mean of Likert scale is significantly larger than 3 ($P < 0.05$, t-test).

^b proportions are significantly different ($P < 0.05$, Chi-square).

The results in Table 4.16 suggested that the following department should react as fast as possible in case of emergency Civil Defence (average 3.98, p-value 0.000), Health Organizations (average=3.98, p-value=0.000), Emergency Service (average = 3.96, p-value=0.000), and Fire Department (average = 3.81, p-value =0.000) in that order. However, respondents were neutral about Red Cross (average = 2.97, p-value =0.702).

5.7.3 The Obligations of Community or Family Members to Bear Responsibility

Table 5.15: Sharing Responsibility. Differences between proportions are significant at $p < 0.05$, Chi-square.

Task	Percent of responses			
	Have Done	Plan to Do	Not Done	Unable to Do
Attending Meetings	10.8%	9.0%	68.3%	11.8%
Talk with Family Members	52.8%	19.8%	24.1%	3.3%
Develop Emergency Plan	28.1%	19.1%	50.5%	2.3%
Prepare Emergency Supply Kit	24.6%	22.1%	49.7%	3.5%
Training a Family Member	10.8%	9.0%	68.3%	11.8%

As shown in the Table 5.15, the respondents don't perform emergency task to bear responsibility of acting positively in case of emergency.

5.7.4 Distribution of Time that the Community want to Spend to get ready.

Table 5.16: Get Ready to SDS

		Count	Percent	Valid Percent	Cumulative Percent
Valid	0-1 hour	157	39.4	39.4	39.4
	2-3 hours	137	34.4	34.4	73.9
	4-7 hours	67	16.8	16.8	90.7
	8-15 hours	17	4.3	4.3	95.0
	16+ hours	20	5.0	5.0	100.0
	Total	398	100.0	100.0	

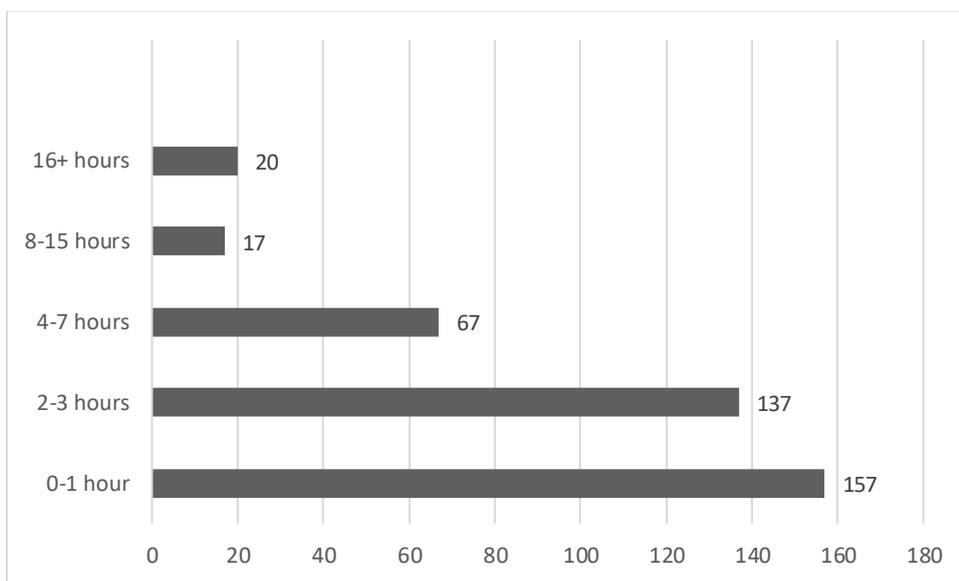


Figure 5.11: Number of hours are willing to spend per year on personal and household preparedness for SDS

The average number of hour's an individual or family member is willing to spend per year to prepare the house against SDS is around 2 hours. The questionnaire also inquired about the Safety Measures the community has taken to prepare against the SDS. The following Table 5.17 gives the percentage of respondents who have accomplished these tasks.

Table 5.17: Safety Measures against SDSs

Issues	Count	Percentage
Smoke Detector	34	8.5%
Batteries	136	34.2%
Fire Extinguisher	90	22.6%
Medical Supplies	135	33.9%
Battery-Powered Radio	91	22.9%
Food	172	43.2%
Water	179	45%
Received First Aid Training	78	19.6%
Made a Fire Escape Plan	48	12.1%
Discussed Utility Shutoffs	241	60.6%
Developed a Reconnection Plan	133	33.4%

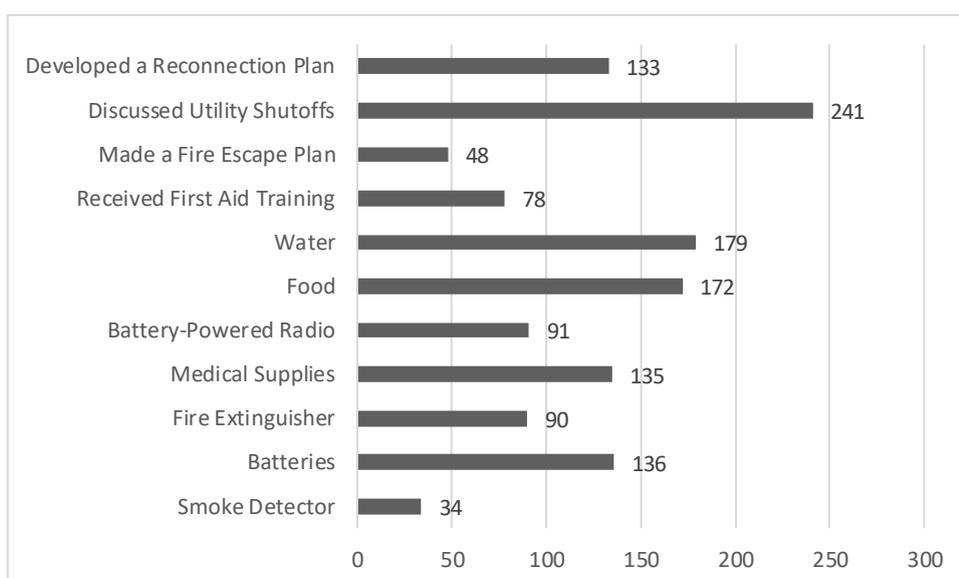


Figure 5.12: Safety Measures against SDS

As shown in Table 4.19, see also Figure 4.18, 60.6% of respondents are aware of the utility shutoff during or after SDS, 45% of respondents think about water storage, 43.2% think of food storage, 34.2% think of Batteries, 33.9% think of medical supplies, 33.4% think of developing a connection plan, 22.9% think of Battery-Powered Radio, 22.6% think of fire extinguisher, 19.6% have received first aid, 12.1% made a fire escape plan.

5.8 Conclusion

This survey focused on the awareness of the community towards natural disasters such as SDS, floods, thunderstorms, and earthquakes. The findings showed that people in Kuwait consider SDS to be very severe compared to floods, thunderstorms and earthquakes. With regards to the severity of SDS on

health issues, the finding showed that SDS was very severe to health issues compared to other factors that were studied. The health issues were mainly related to respiratory conditions. SDS also had very severe impact on daily activities. The findings showed that the awareness of SDS related to health issues and carrying out daily activities were high. However, when it came measures that need to be taken due to SDS the Kuwait community were unaware on what needs to be done.

These are indeed interesting results and showed that the community in Kuwait because they are not exposed to emergencies other than SDSs they think that SDSs are more severe than other emergencies. These findings are also due to the frequencies of SDSs. The members of community are used to have endured more than 6 or 7 occurrences of SDSs and probably never experienced an earthquake for example. The results showed also what they think about the impact of SDSs with health and security impact ranking among the top of their worries about SDSs.

Another significant finding which showed the lack of information on preparedness was the respondents' opinion that information about how to deal to SDs was mostly based on experience rather than information from the concerned department or the government. Indeed, this finding was also reflected on studies on other health emergencies as reported by Al Ghafri (2018).

The survey also focused on the satisfaction with concerned organization (responders) in the event of SDS. The responses with regards to performance of emergency services, fire department, and red cross were significant. However, the responses were distributed across the scales indicating that members of the community accept that there is more to be done by these agencies/responders. Surprisingly, health organization was not significant in any preparedness according to members of the community. Similarly, civil defense participation during SDS events were also not significant. With regards to the reaction time of civil defense, fire department, emergency services, red cross, and health organizations, all five were significant. However, the responses were more spread across and more in the neutral scale indicating that the responses of these agencies during SDS events need to be increased. The finding also showed that these responders also need to change their approaches to improve their reaction time during SDS events. The Kuwait community was also not satisfied with the information that was published on SDS. And adding to this the sources of information was also very unsatisfactory.

On the evaluation of concerned organizations support in case of emergency. The Kuwaiti community was not particularly happy with the support that was provided by civil defense, fire department,

emergency services, red cross, and health organization. With regard to the obligation to react and support community against SDS, the Kuwait community strongly agreed on the need to react for all the five agencies (civil defense, fire department, emergency services, Red Cross, and health organization).

The findings also showed the Kuwait community did not attend or get involved with aspects related to SDSs, such as sharing knowledge and responsibility through attending meetings, developing emergency plans, preparing emergency supply kits, or training others.

Information about age, education and type of properties was used to describe the community. In total more than 60% of the respondents were between 30 to 50 years and more than 80% of them had tertiary education. Distribution of property types had no clear trend. Therefore, it was not possible to compare between different age groups, education level and property type.

Another major finding from this survey suggested that the members of community were consistently not satisfied about the performance of Red Cross. While there is no data in this survey to show why there is such a trend the literature suggested that limited human resources and technical expertise are affecting the performance of all governmental and non-governmental health care systems and health emergencies department including the red cross (Al Ghafri, 2018). Local non-governmental organizations often lack resources and their staff are not well trained in SDSs emergencies.

In general, the findings are in accordance with global reports on the awareness of communities in the Middle East about SDSs and their involvement in the preparedness plans to respond to SDSs and mitigate their impact. In an international report by UNEP, 2016 it was concluded that a much better prioritization of strategic goals in managing SDSs is essential and in particular tackling how to best develop preparedness and emergency response procedures and the need to involve local communities.

The findings of this survey will inform the preparedness framework and in particular how would community involvement improve preparedness. Specifically, how the community members think are their obligations are to bear responsibility during an emergency and their specific action during SDSs illustrates an essential requirement to include education on SDSs as a major aspect in the framework.

CHAPTER 6: QUALITATIVE DATA COLLECTION AND ANALYSIS

6.1 Introduction

As stated in Chapter four, the questionnaire survey and the semi-structured interviews could provide credible and reliable data to understand the impact of SDSs within the Kuwaiti context. In the previous chapter the findings obtained from the questionnaire survey were presented. This chapter presents the semi-structured interviews which are analyzed thematically, and findings are described in different formats using NVivo 12 software. These formats include cloud map, a map presenting the most frequent terms and codes used, word frequency table, cluster map organizing the similar interviews beside each other and text search queries. The thematic analysis presented here is inductive in nature and based on conclusions drawn from data obtained through face-to-face semi-structured interviews. These interviews were conducted with 26 participants who were selected purposefully and included heads of several departments in the public sector. The next section describes the profile of those participants.

6.2 Profile of the Interviewees

The 26 interviewees selected for qualitative study were from top management of different governmental departments, community services and other relevant organizations including an Oil company and a Health Sector firm which is part of the critical medical supply chain. Full list of the participants is presented in Table 5.1. This list includes senior managers and experienced personnel from all different departments and companies involved in managing SDSs and their impacts. The knowledge and professionalism of respondents allowed the researcher to draw upon their experience to provide rich data and accurate perceptions about all aspects of the Kuwaiti community response to sand and dust storms. Specific departments in transportation and health were also selected to investigate the impact of the storm on the community.

The sample from emergency departments should be able to reflect on the preparedness plan for Kuwaiti community before the SDSs and procedures applied during the storms and how to deal with the storm aftermath. Needless to say, validity of the study was enhanced by soliciting different points of view of various governmental and non-governmental bodies that are responsible to deal with, or impacted upon with, one or all aspects of the SDSs. In agreement with the ethical approval for this study, all participants were required to provide consent forms and their anonymity was protected. Further details are provided in the methodology chapter.

All the interviews were conducted in Arabic, transcribed and then translated into the English language. The participants are shown in Table 6.1 and they have comparable experiences and are from a closely related departments that deal with SDSs and their impacts.

Table 6.1 Codes, departments and organizations the 26 Participants.

Participants	Government and other agencies
P1	Civil Defense
P2	Fire Brigade
P3	Police department for Transportation
P4	Emergency services (Ambulance)
P5	Kuwait Institute for Scientific Research (KISR)
P6	KISR: Dust Storms department
P7	Meteorological department
P8	Kuwait Red Crescent Society
P9	Civil Aviation
P10	Environment Protection
P11	Fire Department
P12	Jahra Contract Manager
P13	Kuwait National Guards
P14	Kuwait Oil Company
P15	Medical Equipment and Pharmacy
P16	Ministry of Commerce and Industry
P17	Ministry of Health
P18	Ministry of Media
P19	Ministry of Municipality
P20	Ministry of Transportation 1
P21	Ministry of Transportation 2
P22	Ministry of water and Electricity
P23	Ministry of Works 1
P24	Ministry of Works 2
P25	Ports
P26	The Army

6.3 Analysis of the Interview Findings

The analysis of the data obtained from the semi-structured interviews were conducted through thematic analysis following Braun and Clark (2006) approach and by using the NVivo 12 software for Windows. Using this software help manage the data collected through the interviews and allow efficient coding and provide a several word queries functions (Zamawe, 2015). All English transcripts were created as documents in NVivo and different word query were conducted. This included: Word Cloud to capture the most frequent terms appeared in the interviews and Word frequency table to quantify the reoccurrences of different words. Similarity between different interviewees was also investigated by producing a cluster map. Codes and themes were created in the software and different codes and nodes

maps were produced to answer the following three main questions. The initial codes were created in a word document as comments then refined full codes were created in NVivo as nodes (appendix 5).

As was mentioned previously the thematic analysis approach that was followed during the analysis of these interviews was laid down by Braun and Clarke (2006.) These authors suggested that this type of analysis is “foundational method for qualitative analysis [which is helpful in] identifying, analysing and reporting patterns (themes) within data”. Coding is a subjective process and can only be improved if the text to be coded revisited several times to refine the codes (Braun and Clarke, 2006). The final themes can be reached through two different approaches: one is called inductive and is driven by data, the second is deductive which means it is based on theory and driven by the researcher’s own observations (Braun and Clarke, 2006). In this analysis a mix of both deductive and inductive approach was followed to reach the different themes. The steps followed were:

- 1- Familiarization with data.
- 2- Generating initial codes.
- 3- Redefine codes and search for themes (nodes).
- 4- Review themes.
- 5- Define and finalize the names of themes.
- 6- Produce the report of analysis using thematic maps and relevant quotes and discuss the finding.

The subsequent sections representing findings of the interviews under each interrelated theme of the context.

6.4 Experience of the Interviewees

Work experience in any career promotes knowledge and understanding of everyday duties and practice thus, the opinions of experienced people usually reflects their reality as it is. So, to explore the experience of the interviewees in this study, the researcher asked an open question in regard to: How many years do you have experience in emergency management?

The results reveal that all the participants were of Kuwaiti nationality, and their relevant experience ranging from five years to thirty three years, all the interviewees were senior managers and have long relevant experience, thus they have sufficient knowledge of the SDS issues, and future plans etc., to be able to provide an insight into the whole picture of the related organizations.

Table 6.2 Word frequency of the most used words in the interview. The software applied an algorithm to identify how many times a word or similar word (in meaning) were encountered in the transcripts.

Word	Count	Weighted Percentage (%)	Similar Words
organizations	153	1.45	administrate, arrange, arranging, coordinate, coordinates, coordinating, coordination, coordinator, direct, directed, direction, directions, directly, engineer, engineer', engineers, established, establishing, formed, forming, forms, government, governments', organization, organizations, organized, preparations, prepare, prepared, preparing, system, systems
ministry	106	1.69	ministries, ministry
people	100	1.60	people, peoples', peoples'
cases	96	0.99	cases, cause, caused, causes, event, events, example, faced, facing, types
civil	83	0.98	civil, cultural, educate, educating, education, school, schools, train, trained, training
works	82	0.73	bring, bringing, formed, forming, forms, going, makes, operating, operation, operational, operations, operative, plant, planting, plants, process, processes, solve, studies, study, working, works
department	78	0.95	department, departments, going, leave, leaving, parts, sections, start, started, starting
health	75	1.20	health
effects	75	0.81	consequences, effect, effective, effects, efficiency, established, establishing, event, events, impressive, issue, issues, result, resulted, resulting, results, strength
storms	67	1.07	storm, storms
country	65	0.65	areas, countries, country, national, nationalities, state, states
houses	64	0.84	families, family, homes, house, households, houses, signs
emergency	59	0.90	emergencies, emergency, issue, issues
Kuwait	57	0.91	kuwait
agencies	57	0.68	agencies, agency, authorities, authority, authorizes, means
interior	57	0.58	homes, inside, interior, internal, international, national, nationalities
public	51	0.77	issue, issues, public, publish
services	50	0.58	availability, available, helped, helpful, helping, helps, service, services
responsible	37	0.59	duties, response, responsibilities, responsibility, responsible
asthma	35	0.56	asthma

6.6 Similarity between Interviews

The cluster analysis in Figure 6.2 shows the similarity between different interviews. Two major groups emerging from the analysis include: a) emergency department which deal with SDSs and its impact and b) other departments which contribute toward dealing with SDSs.

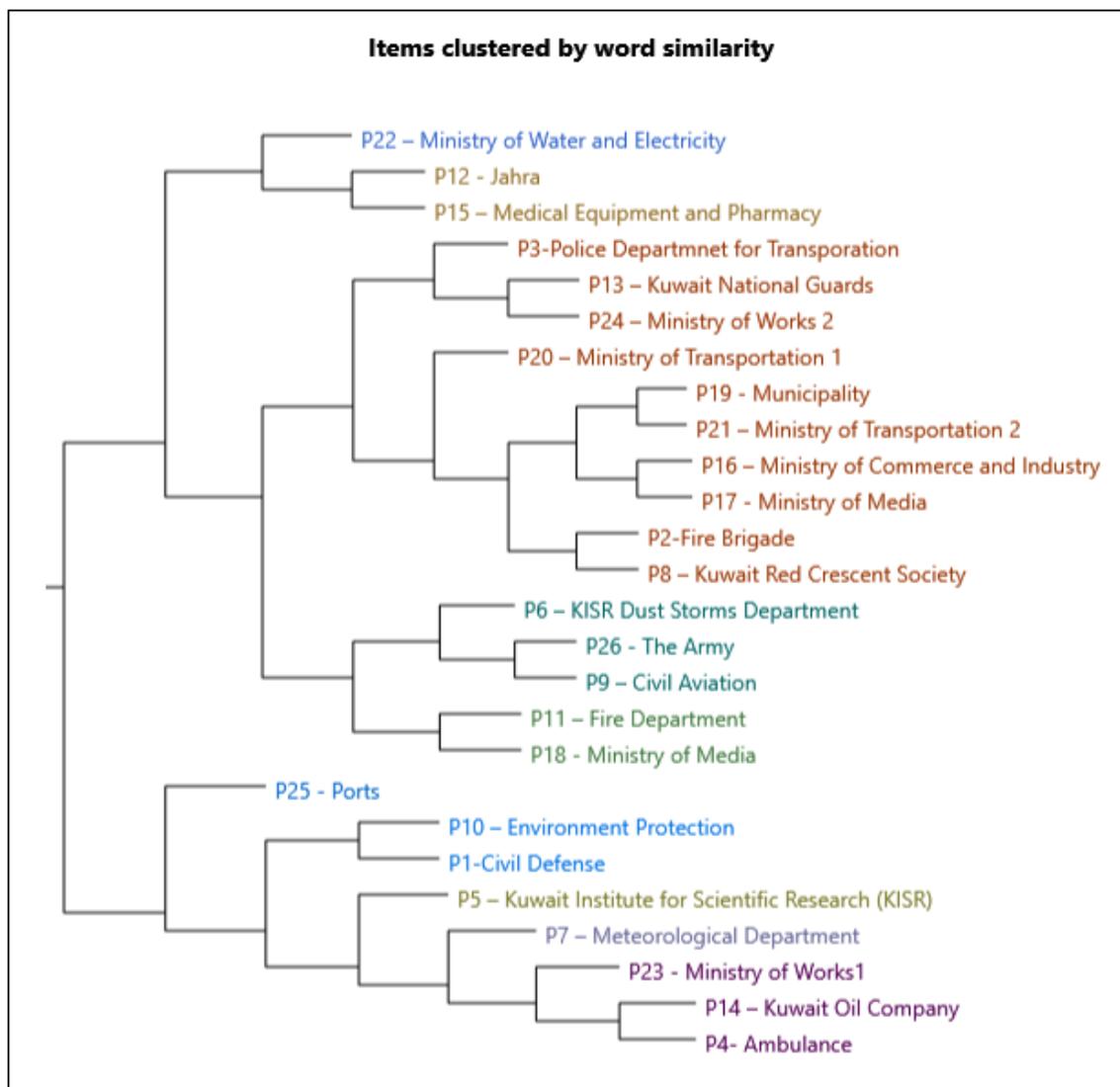


Figure 6.2 Similarity between different participants.

6.7 Source of SDSs

With regards to the question about source of SDSs, the researcher explored the views of participants on the causes of the SDSs in terms of its nature and trends. Thus, the interviewees have been asked an open-ended question: “In light of your experience, what is the nature and trends of SDSs?”

The results of this theme present different views regarding the origin and causes for the SDS in Kuwait, these reasons can be divided into three major categories: 1) origin of the storms (North was more significant in this respect); 2) Topography of the Country (nature of land; flat or otherwise); 3) Type of Climate. Figure 6.2 illustrates how all respondents reflected on these themes.

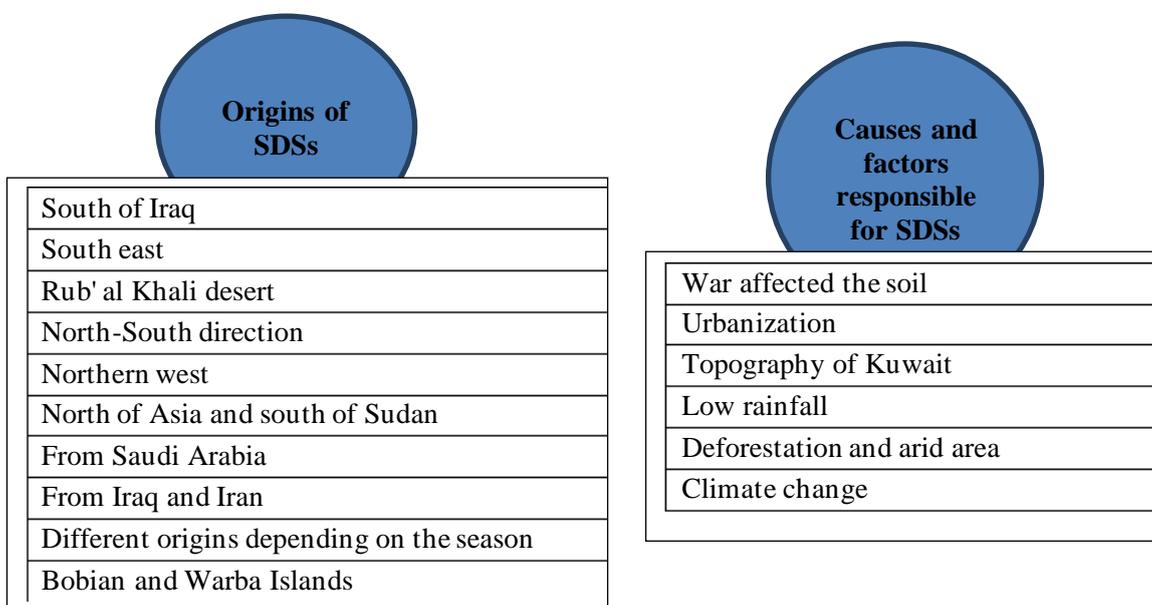


Figure 6.3 Origins and causes of SDS in Kuwait

Regarding the location of the country, most of the participants believed that the geographical position of Kuwait has affected the occurrence and severity of the SDS. In this context, a participant from the Civil Defence mentioned that as Kuwait and surrounding regions are deserts thus, the winds bring large quantities of dust. Furthermore, a participant from the Metrological Department stated that the nature of SDS in Kuwait is trans boundary, most of it comes from outside of Kuwait. The same participant further describes:

“ there is a sand storm and dust storm, the sand is local but dust comes from southern of Iraq as the trend of wind in Kuwait is from north-west (20%) in most season, in winter is comes from south east. Winter storms come from Saudi Arabia. Mostly according to studies [originated from a region] between three Iraqi cities: Nasryya, Samaweh and Diwanyeh in the southern area of Iraq”.

In this respect, a participant from The Red Crescent Society with similar views said that SDS comes from the north of Kuwait and other storms come from Iraq and Jordan. In relation to the topography of the country, there is agreement from all respondents that the geography and structure of the country affect the existence of these sand and dust storms.

A respondent from Kuwait Institute of Scientific Research affirms that the main reason for dust storms (locally known as *Al-bwareh*) is the flat topography in general. This storm occurs more in the northern parts of Kuwait during June and July and the speed of wind could surpass 70km/hour. He further added:

“The nature of sand and dust storms refer to the desert nature of Kuwait as well as low rainfall rates. As a result, the vegetation cover or green areas are very small and this leads to soil disintegration resulting of dust erosions when winds blow”.

Likewise, a senior manager in the Fire Brigade mentioned that the Kuwait is a desert area and is exposed to SDSs coming from the desert. He mentioned specifically Rub' al Khali desert and the southern area of Iraq. Sands of these deserts could travel far due to deforestation. Impact of SDSs will become bigger and more severe.

A respondent from the Metrological Department noted that the internal arid areas in Kuwait are important sources of SDSs in the country as well.

“Internal arid areas are sources of SDS”

Understandably the Metrological Department have more information than others on the type of storms in Kuwait as this respondent went on to describe these storms:

- *“Dust Storms- the most violent ones, with a rate of 17.3% (16 days).*
- *Deposited dust- The lowest in affecting the environment but the most dangerous on public health, with a rate of 45% (58 days).*
- *Suspended dust- the least one with effects on environment as it is in the higher atmosphere, with a rate of 35.9% (63 days).*

- *The Nebula (Sadeem)- exists all the year, giving sky a white unclear colour. It is in 95% of the year”*

Some respondents blamed very far countries for the storms in Kuwait. A respondent from Medical Equipment and Pharmacy said:

“The Sand storms [come] from the north of Asia and south of Sudan”

In terms of type of climate, the mainstream of respondents refers to this challenge. In this context, a member of the Police Department for Transportation blamed SDS on the type of climate in Kuwait which is *“is a desert climate with high temperature”*. SDS, in his view, happened in Kuwait due to it being an arid region and strong winds are capable to carry dust specially from may till July. The reasons, as some respondents suggest, are the existence of *Al-saebeel* trough from the north of Asia content and hot winds from the southern area of Sudan.

Likewise, A Civil Defence official stated that the bad wind in Kuwait comes from the south as well as north. This causes high speed wind as well as deforestation in the state. When wind speed exceeds 40 to 60km/h SDS forms particles of sand become dust. Some dust come from the north (e.g. Iraq and Jordan) or south (Saudi Arabia). Sometimes we receive cross winds from the west or southern-north winds. He further specifies:

“Internal factors such as Warba and Rubain islands have low effect because of the recent rains as well as the increase of vegetation on those islands”.

In the same manner a member of the ambulance team thoughts SDS are seasonal in nature. SDS occur during summer specially if the rainfall is low in winter. Also it increases in the season of (Sarayat) and within northern dry winds (Al-bwareh).

6.8 Impacts of SDSs on The Community

In this theme the interviewees were asked a question in relation to: *“What are the impacts of SDS on the community?”* A list of impacts was mentioned by participants. This list includes: health problems (because of the effect of dust on the respiratory system); traffic accidents (because of poor vision); economic (cost to properties and goods); security and safety; and social activities (people are less likely to engage in outdoor activities). It also includes impact on the environment such as air pollution. Impact on agriculture and the sea was also highlighted.

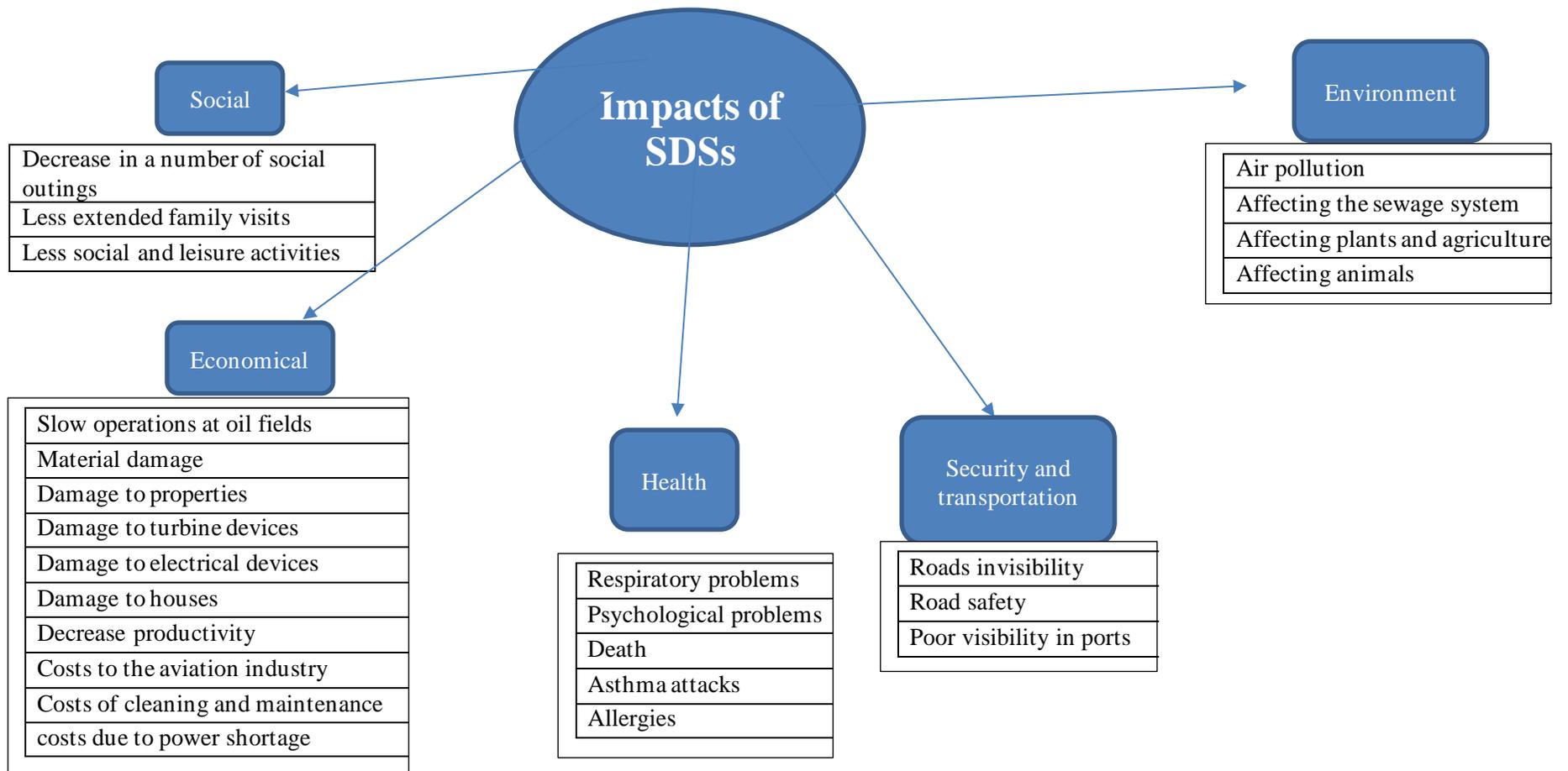


Figure 6.4 Thematic map for the impacts of SDSs on the community.

In relation to “Health problems”, it was found that participants refer to this problem as the most significant impact of SDSs. The serious health risks include an increase in the rate of asthmatic attacks and those affected are mainly the elderly people and children.

In this context, an interviewee from the Fire Brigade declared the SDS has negative impacts such as increasing episodes of asthma among people and the need to admit them to hospitals which create a huge pressure on the health services.

In the same theme, an interviewee talked in detail about his experience in related to precautions taken to protect his family:

“...I consider the storm as serious and dangerous ones; my wife and daughter suffer from Asthma; so I usually take my precautions, if you don’t deal with this case in a correct manner this can lead to death. Therefore, I watch all forecasts especially in July and I close windows and I don’t leave the house unless there is something urgent. I get my information from my department and as Para-medical specialists I can evaluate the case, there are no notices in the ambulance department to get ready for any coming events”.

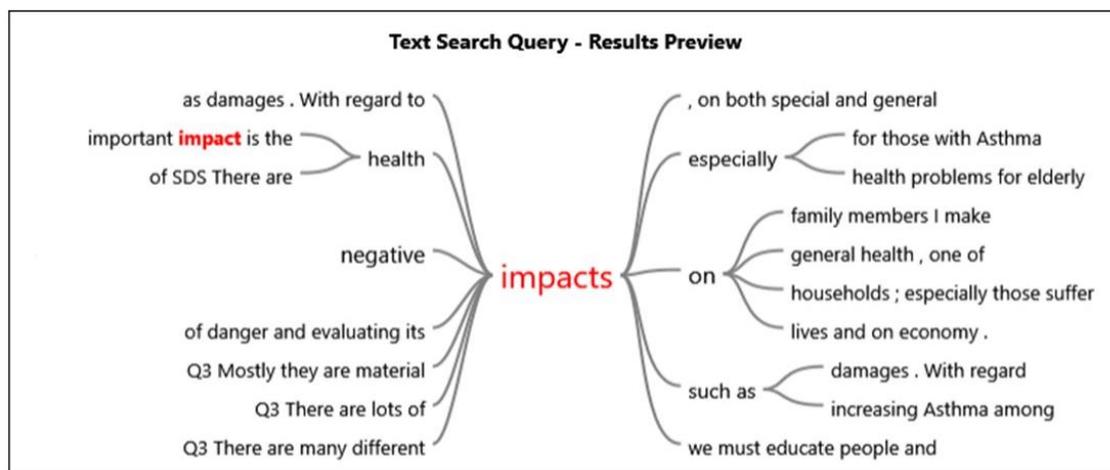


Figure 6.5 The text search tree of all participants revealed the different impacts of the SDSs. Health impact was very prominent

Even more, three of participants have the same point of view as they confirm the storm affect all the people, old and young as well as who need medical care especially for those with Asthma problems. Also, it was stated that the most effected people in addition to those suffering from the Asthma are those who are suffering from coughs, respiratory tract infections, allergic diseases and eye infections.

According to one interviewee the authorities always give advice to people to close doors and windows, but sometimes fine dust enters houses. Another instruction given was that vulnerable people should not get out of their houses.

Traffic accidents, because of poor vision and accumulation of dust and sand on the roads, are one of other impacts of SDS. Two emergencies experts; one from the Fire Department and the other from Red Crescent, emphasised the traffic accidents are a big problem during the life of a sand storm and this impact certainly makes their job very challenging. Low vision causes accidents and there are sand dunes that caused traffic problems. All this makes it difficult to reach the site in a proper time. The Kuwait agricultural authorities and local Municipalities started vegetation near the highways since to reduce sand dunes movements.

Another impact of SDS on the community mentioned by multiple participants was the economic impact on the government, households and businesses. An interviewee from the dust storm department affirmed that a huge impact of SDS was economic. Economic costs and property damages are evident aftermath of storms. Interestingly, rather than providing Kuwaiti statistics the same interviewee provides an example of the costs of storms from an Australian study:

"...an Australian study [found] that the costs of one storm was 299 million ASD (2009 red dawn). There are [additional] costs paid by the government too for cleaning roads and maintenance "

Moreover, and according to one of respondents that not all houses are prepared with dust-proof covers, dust always certainly enter some houses. Despite the cost of these covers it is recommended for people to use them for their houses they must. Also, a member of the Kuwait institute of Scientific Research specifically stated:

"In some areas, houses were buried by dust and soil, so there is high costs on the families involved"

Interviewee from Kuwait Oil Company was worried about its employees, contractors and partners during SDSs as the storms lead to unsafe working environment to the extent that some external operations are suspended. The same interviewee adds that:

"Of course, there is high impact such as deforestation, damage, stopping working in high areas. The high winds may cause the stop of our external operations, but we need the safety first for people and the staff

...the effect may not be strong on our operations but in digging we stop the operations in high places

because of wind speed as it has negative impact on our obligations and the time".

Security and safety is considered as one of significant impacts of sand and dust storms in Kuwait. It was specified by an interviewee from the oil company as:

"The damage is revolved around the speed and strength of winds, most damages are in Al-Ahmadi residential area especially in trees falling, the storm may cause the loss of some employees or contractors in desert area, and we must follow safety procedures to reduce such problems".

Moreover, an interviewee from Environment Protection has the same attitude about SDS which affects petroleum and military sites:

"...affecting the security of main, petroleum and military due to the accumulation of sand and dust besides walls reducing its height and passing it will be easier. "

Interestingly enough, only one interviewee (Meteorological Office) mentioned the social activities in indirect way as an impact of SDS on the community, that SDS are representing real risks on human health and his economic life, therefore, it restrains his social activities when occurring. He said:

"SDS are representing real risks on human health and...economic life, therefore, it restrains ...social activities when occurring".

6.9 Priorities when Dealing with Impacts of SDSs

When the interviewees were asked a question: "How do you prioritise those impacts? What criteria should be considered in prioritising such risk impacts?" their answers varied. However, they all agreed on the fact that saving life and consequences on human health are the most important priority. Advices such as Stay home and Avoid affected roads were also mentioned. There were also referrals to the need to alert different services; Awareness; and carefully organise aviation and control Airports.

Logically, saving peoples' life and health was considered by the majority of participants, regardless of their characteristics, a priority and it should be the first step taken by authorities in case of sand and dust storms. In this context, one interviewee from the Scientific Research Institute emphasised that from his point of views that:

"...the top priority is for the saving life and health effect – as mentioned in my study-. The admission rate to hospitals is high during the storms especially for Asthma patients".

Ambulance services personnel were elaborate more on this. One of them said:

“Mortalities among people are the most important priority. As Asthma patients rates are high in Kuwait and the level of awareness is low the emergency department, the ministry of health and other public organizations must warn people. I want to give you an example when I was in the USA for study and training we were in an emergency centre, that one of our roles is to spread awareness in the society in certain hours of the day especially in the season of flu vaccinations. I think in Kuwait we started this a year ago. We need medical services that contact the society to distribute awareness about SDS. Local associations can call its members for lectures given by medical staff in this field and how to deal with SDS. I think any course will not need more than two hours to cover all topics. As paramedics we can give lectures in school and universities to distribute awareness in homes; though there are such programs but it is still weak”.

Another interviewee from Meteorological society declared that the study of risk assessment, of weather in Kuwait showed that SDS is the most dangerous. The impact and frequency of SDS has the greatest negative impacts on lives and on economy. This was confirmed by another organization as a Red Crescent volunteer said: *“As Kuwait Red Crescent society; our main priority is saving peoples’ lives and human health.”*

Warning people, and keeping them informed, is one of important priorities before, during and after sand and dust storms. Social media was mentioned by several participants as an efficient way of alerting and informing people. It was also found that the authorities warn people through social Media, T.V and radio to stay in their houses and to follow safety procedures, as well as to warn people to avoid affected roads especially highways. Figure 6.6 Shows how strong people think the effect of social media is.

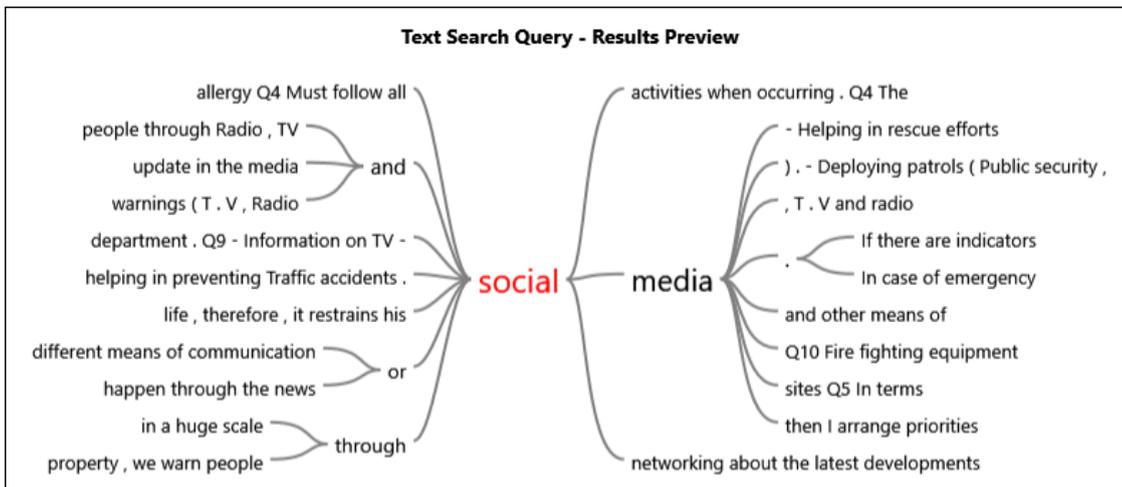


Figure 6.6 The text search tree of all participants revealed the different the significance of social media.

Participants from the different Emergency Departments considered restoring as their priorities, especially restoring all essential services like electricity and water. In this context, an interviewee from fire department specified that by stated:

"...any places or services that needs help such as the ministry of electricity or the oil company are under our responsibility, in this case we are in full alert. We have advanced preparedness plans such as calling our teams or deploying them".

Other priorities mentioned by three of interviewees was increase awareness, as a participant from Red Crescent said another priority is to enhance education of people and awareness about the riskiness of SDS.

In this context, respondent from Ambulance services stated from his experience that as Asthma patients' rates are high in Kuwait and the level of awareness is low the emergency department, the ministry of health and other public organizations must educate and warn people. The same interviewee provides an example about one of their roles in spread awareness when was in United states as a trainee in his field:

"...I want to give you an example when I was in the USA for study and training we were in an emergency centre, that one of our roles is to spread awareness in the society in certain hours of the day especially in the season of flu vaccinations". He adds in Kuwait we started this a year ago, the need medical services that contact the society to distribute awareness about SDS is crucial, and the local associations can call its members for lectures given by medical staff in this field and how to deal with SDS. The

same interviewee adds:

"...I think any course will not need more than two hours to cover all topics. As paramedics we can give lectures in school and universities to distribute awareness in homes; though there are such programs but it is still weak."

Moreover, the fire department have another priority as they stay stand by in the Kuwait international airport for any emergency cases.

The interviewee from ministry of interior affairs declared that the criteria considered in prioritising such risk impacts is helping people and ensuring providing them with all essential services.

6.10 Techniques for Dealing with SDS

In relation to the techniques that are usually used for dealing with SDS, the interviewees were asked a question: "What are the current techniques for dealing with SDS?"

The participants mentioned list of techniques used for dealing with SDS including: Training and education; Road radars and vehicles to monitor the situation; Alerts mechanism and deploying teams; E-medical and paramedics; and long term strategy to increase plants specially around the motorways. Three of participants were more negative and stated that there are no certain applied techniques in Kuwait for dealing with sand and dust storms. Figure 5.5 shows the used techniques for dealing with SDS.

Four of interviewees declared that the training and education is essential during and after SDS. In this context, a member of the Fire Brigade said that:

"The problem was in responding time, and now we are trying to find a new method. We are using road radars and new vehicles as well as advance alert from the Media and the ministry of health"

This was confirmed by the Fire Department as an interviewee said:

"In the meantime early warning is the best way to warn people. In the same time spreading protective warnings is a main demand as people follow those most of the time. With regard to solutions, planting trees is important though desert areas are big and this need a huge effort forms all Gulf countries."

A policeman said:

"There are vehicles used, for example; Bulldozers are used to remove sand dunes from roads in

addition to water tanks that are used to soil stabilization to prevent sand erosions on roads. Furthermore, advance alert from the Media and the ministry of health”.

Education and increasing the awareness of the community about SDS was considered the best way to deal with impact of SDS. While some mentioned that there is training about the dangerous nature of emergency work others complained that *“There are no preparations since this is the responsibility of other departments”* as an Environment Protection official stated.

From another point of view 3 participants mentioned that there are no certain techniques as all organizations work according to their responsibilities but without any plans.

Other techniques were mentioned by some interviewees that is plant. In this esteem, one asserts that the government has a general strategy of growing the agricultural zone in general and increasing vegetation areas. In this matter the respondent added:

“We must deal with the source of dust; must have walls or fences to prevent winds then plant special kinds of tress such as willow trees, those are tall trees, then we put a third fence to mitigate the effect”.

Some of the interviewees mentioned to the paramedic and volunteers that giving people masks, medication as a technique for dealing with SDS. In this regard an ambulance personnel explained:

“As paramedic we deal with Asthma cases, we must provide the patient with Ventolin; this medicine is available in our ambulances now. The second important thing is the correct diagnosis; the paramedic must be able to recognize all emergency cases. With regard to feedback, we don't have such things; Dr. Jamal Al-harbi adopted this idea; however, they are going to implement e-medical program in all medical organization for information about patients. We can know the asthma patient or heart diseases patients through medical check and other symptoms”.

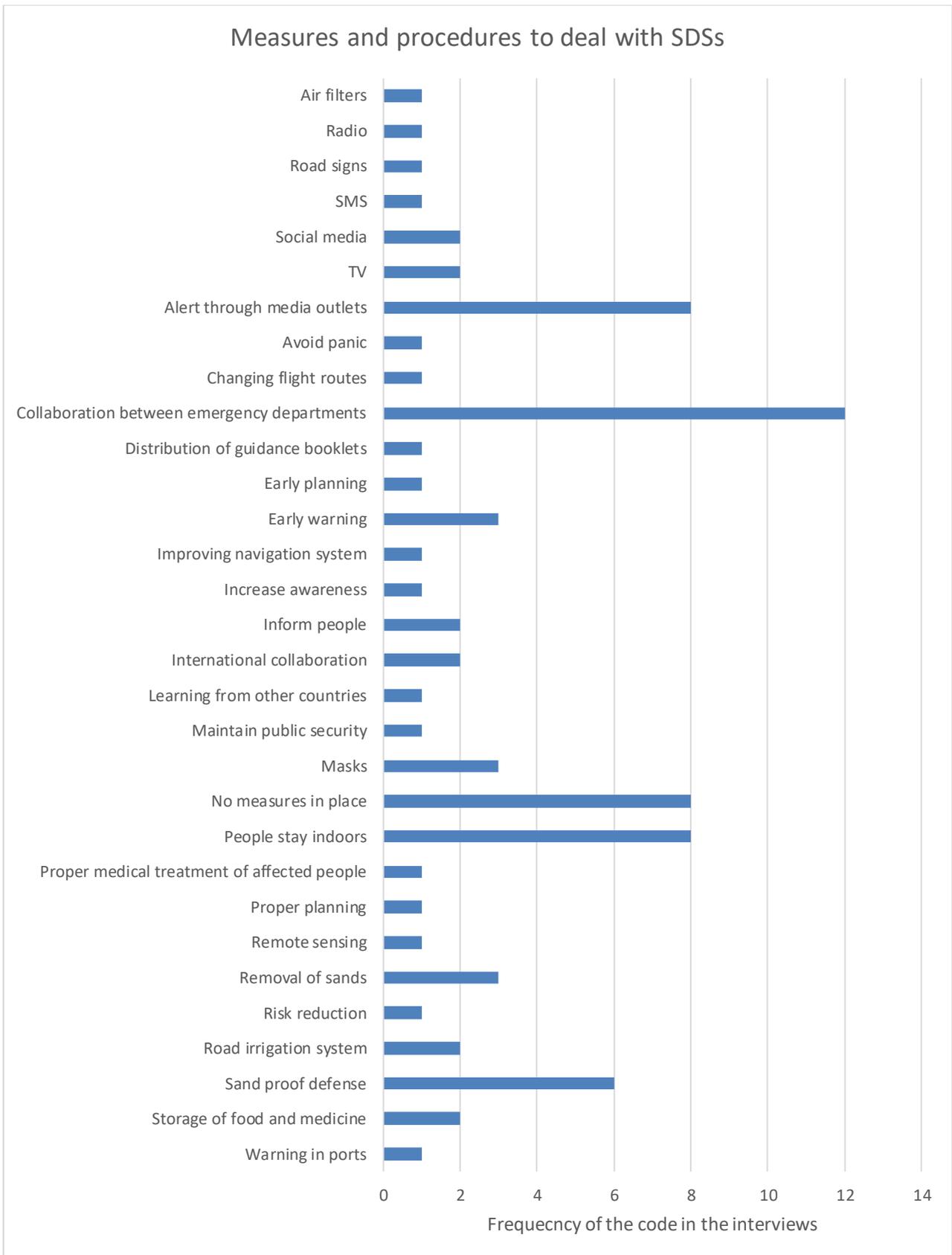


Figure 6.7 Emergency agencies techniques and procedures for preparing to deal with SDS

The interviewees were asked a question: “What are the current techniques implemented by emergency agencies for preparing to deal with SDS?”

There is a list of current techniques implemented by emergency agencies for preparing to deal with SDS which is: Strategic storage; Coordinate with other agencies; Direct link with the weather forecast; Provide services and logistics which include (Media, deploying patrol, Readiness of hospitals, Afforestation, Education).

Few participants stated that there is no technique or plan. An official at the ministry of Transportation said:

“I think there are no techniques most people listen to weather forecasts”

Two other participants were skeptical about the use of techniques in Kuwait and one of them (from the ambulance service) blatantly said: *as a technique there isn't any, since SDS events are not considered as disasters in Kuwait, but sickness cases to deal with Asthma.* The same participant adds that in some countries the disaster causes more than 11 injuries or more; we need many studies to prove that SDS are disasters and it can cause the death of many people. I think the rates of mortality due to dust storms refer to the lack of awareness and shortage of preparedness among people. Another interviewee confirmed that there is no clear plan and the works are randomly:

“The first step is receiving warnings from the metrological department then the responsible organizations such as civil defence start to notify other organizations to remove sand and help people, most of the response to clear streets. The ministry of health helps patients. There is no clear plan; we work randomly”

In relation to “Coordinate with other agencies”, it was found that half of interviewees stated it is very important as a technique for preparing to deal with SDS. Figure 6.6 shows emergency agencies techniques for preparing to deal with SDS (Coordination).

The coordination is not only with national organization, but with the neighbouring countries and United Nation as well, also the availability of higher commission of civil defence in Kuwait heading by the ministry of interior the coordinates between all participating agencies before and after the storm. In the same context, one of interviewees from the Red Crescent Society stated that:

“We are a member in the higher commission of civil defense, when other public organizations start to help people to mitigate the event we support them with our cars and teams. In the floods happened recently we opened our operations centre, we sent our volunteers in coordination with civil defence to help people who were affected by floods, and we helped families and rescue people with damaged houses. All our staff is qualified and trained in dealing with risks and disasters”.

Surprisingly, ‘Direct link with the weather forecast’ is considered by only one interviewee as one of the best approaches for emergency agencies to prepare for SDS. This respondent from the Fire Brigade said:

“In the main operations centre we have direct link with the weather forecast, we are updated every 3-6 hours. In any emergency case we start our procedures and then we are linked with other public organizations through emergency committees in order to respond to the emergency. In Kuwait we have the higher commission of civil defence heading by the ministry of interior. This commission coordinates all participating agencies. We have a strategic storage for more than 6 months, even water, now we are injecting water into earth for more storage”.

Services and logistics during the strike of sand storms include (Education and raise awareness of the dangers of SDSs, Media involvement in alerting and educating people, Deploying a better equipped patrols, Increase the readiness of hospitals to deal with emergencies during SDSs, tackle the arid areas and trying to increase vegetation as a long term strategy). A respondent from the meteorological department stated:

“Emergency agencies put education in the first place, then providing protection as well as safety tools and techniques in dealing with SDS according to pre-prepared programs that can be activated before and after the event”.

A senior manager of Kuwait oil company who usually has employees working in desert field said:

“Due to the dangerous nature of our work we are in high degree preparedness to respond, in SDS time we educate employees through safety and health team and we warn them. Our response unit [engage in] training to deal with any emergency”.

Other interviewees reiterated the same point of view that they educate employees and contractors about the procedures and the steps to be taken in case of SDS and how to deal with it. Some interviews mentioned a list of services and logistic that should be in full operation just before, during and after SDSs which consist of Media Notices and warnings (T.V, Radio and Social media); Deploying patrols

(Public security, police) to provide help for citizens and visitors to the country who are not used to this type of storms; Getting hospitals and ambulances ready to receive patients; and Increasing afforesting efforts especially in desert areas.

In the same manner, another interviewee has the same attitude and mentioned different services, as stated:

“...forming emergency teams to deal with the emergency, infrastructure and roads maintenance, paving soil areas with Carestone, changing flight routes, updating information about weather forecasts”.

Education was so prominent as a theme as indicated by the text search tree presented in Figure 6.8

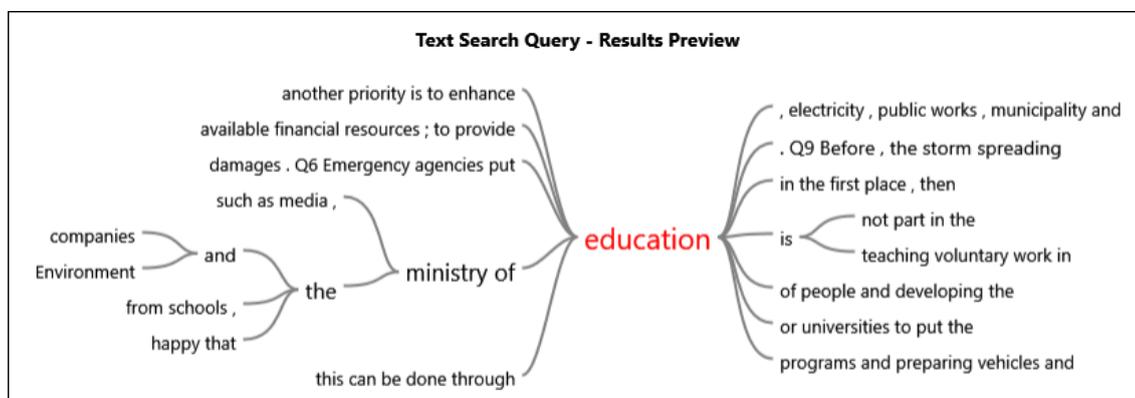


Figure 6.8 Education as a theme in how to tackle SDSs.

6.11 Responsibilities within the community to deal with SDS

In order to know the responsibilities of different members of the community and the organization during the incident of the SDS, the interviewees were asked an open question in regard to: “How do you think the community should prepare and deal with SDS?”

The answers for this question also varied according to the place, time, circumstance and condition of the family and the individuals at the event of the SDS. In general the answers in the interviews included suggestions such as: close open spaces, precautions during driving, respiratory diseases patients must take care and use muzzles, follow media broadcasts and most importantly staying at home.

A Fire Brigade officer advised:

“It is preferable to stay at houses during SDS, covering doors and windows tightly, if it was necessary

to use cars we advise that to drive slowly and closing windows too and leaving good space between the car and other cars. Asthma patients must use muzzles and medication must be available, we called this (in door evacuation). I think our air conditioning system prevents the entry of dust. Open spaces like farms must be closed and people must make protection procedures. As firefighters we are equipped with breathing devices and dust masks, the problem we face sometimes is accidents on roads; for fires we are ready to respond in a due time especially in hot spots”.

Further ideas were mentioned during the incident of the SDS was about the patients with respiratory diseases. In this esteem, three interviewees pointed out that asthma patients must use muzzles and medication must be available all time. An Ambulance attendant further added:

“From a medical perspective; the first thing I always focus on is the knowledge regarding the symptoms and the nature of the sickness, and how to deal with it. Another aspect is preparing for dealing with resulted Asthma such as bringing Ventolin”.

The final suggestion was mentioned by the interviewees were following the media announcements and stay at home. In this esteem, one interviewee affirms that following the media broadcasts by all members of the community is the most important issue. He further added that implementing a short film showing the source and effect of storms on people and presenting them through all means of social communication, television and cinema will make a big difference in regard to the SDS.

Likewise, other interviewees claimed that following media forecasts and instructions’ as well as watching weather forecasts to get up to date knowledge will help in protection of from the impacts of SDS.

Even more, the finding of this theme revealed that the majority of the respondents prefer “the stay at houses” advice during SDS in general and in especially for sick people along with covering doors and windows tightly and using Special Curtains as well as, using wet towels under doors, plus using air conditioning to prevent dust and keep air flow, in addition to, the medical preparedness inside the house is very important.

From another point of view, a member of Red Crescent clarified that all the requirements and needs by the family such as water, food, muzzles and medications must be prepare. Whereas, another participant added that the family members must educate each other, and provide all necessary materials

to mitigate the effect of the event and coping with it till it ends. Figure 6.9 shows a text query regarding “staying indoors” which is identified as one important step people in Kuwait should follow during the SDS.

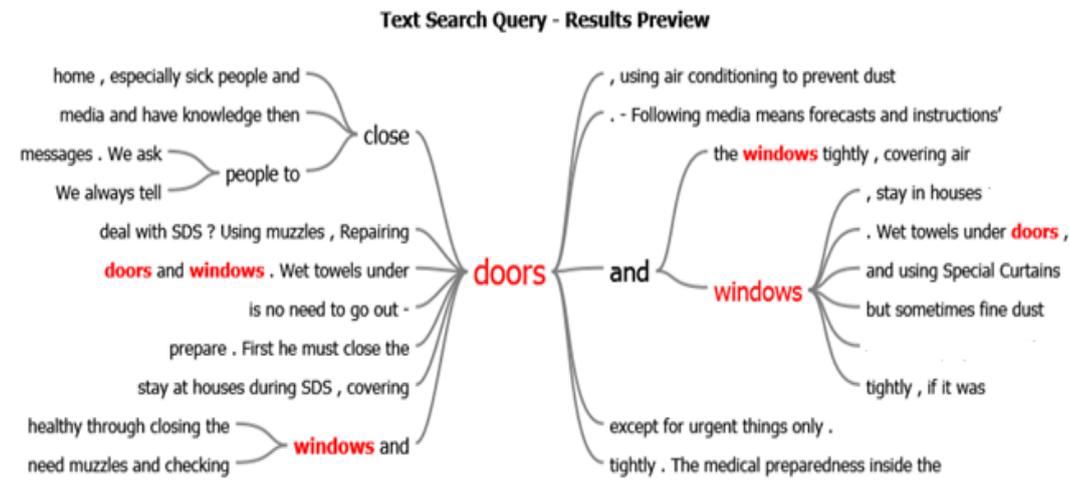


Figure 6.9 shows how frequent “staying indoor was mentioned during interviews.

6.12 The involved agencies and its responsibilities to response to SDS

The interviewees were asked a question: “In light of your experience, what agencies should be involved in dealing with SDS? Who are responsible from those agencies to response to SDS?”

6.12.1 Involved agencies in dealing with SDS

The interviewees identified a list of agencies should be involved in dealing with SDS. These agencies are: Air aviation; Civil defence; Fire Dept.; Kuwait municipality; Kuwait police; Meteorological department; Ministry of health; Ministry of interior; and others (Environment Public Authority, Ministry of Information, and Organizations of civil society). Figure 6.10 shows the list of agencies should involve in dealing with Sand Dust Storm.

Also, among those interviewees mentioned the priority in importance for agencies involved in dealing with SDS. At least three other respondents have the same point of view that they work mostly outside door as disasters happens outside, the most important agency is civil defence, and it is the main organization to deal with SDS. Another participant sees the first responsible organization is the roads commission (Highways), then the ministry of public works for internal roads and the municipality for residential areas.

Three of interviewees declared that the ministry of health and medical services operations should be

involved in dealing with SDS in the first place. In this context, one of interviewee from the Red Crescent gives the priorities to ministry of health and explains from his experience in details the situation:

“...the ministry of health deals with patients. I think in case of such events hospitals get under pressure and people even go to the private sector. I suggest that people provide their Asthma patients with the needed equipment and this will reduce accidents and reduce pressure on hospitals. We don't have equipment to help put we offered our staff to be trained by the ministry of health, they told us that training needs two years”.

Moreover, some of interviewees add to their list other agencies that should be involved in case of such event, as the special committee of Minsters council of Debris and dust removal, also Kuwait institution of Scientific Research, Environment Public Authority, Ministry of Information, and Organizations of civil society should involve.

Departments and organizations dealing with storms
The special committee of Minsters council of Debris and dust removal
The Army
Red Crescent
Ports
Marine rescue
Oil companies
National Guards
Ministry of Public Works
Ministry of media
Ministry of interior affairs
Ministry of Health
Ministry of electricity and water
Ministry of Education
Ministry of defense
Metrological Department
Kuwait institution of Scientific Research
Hospitals and clinics
General commissions of roads
Fire Brigade
Environment Public Authority
Civil Defense
Civil Aviation
All other government departments

Figure 6.10 shows the list of agencies participants think they should involve in dealing with SDSs.

6.12.2 The responsibilities of agencies to response to SDS

The findings revealed that the majorities of interviewees declared that the civil defence should be the first agency involved in dealing with SDSs and especially in coordinating with other public organizations such as fire department, Kuwait police, media, ministry of education, electricity, public works, municipality and ministry of interior.

This confirmed by many participants who agree that all organizations must cooperate; all public organizations must work together, and every one of them must fulfil his tasks, as civil defence must respond to all cases. One interviewee refers to international experience and affirms that in many countries it is called the first responder, as research institutions we give recommendations and spread knowledge about the event. The term cooperation was again captured using text word search in figure 6.11

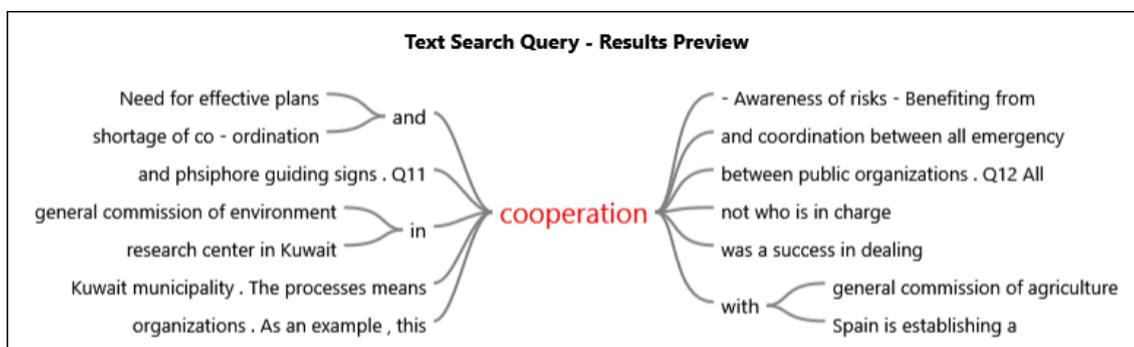


Figure 6.11 Cooperation was a main term and theme as this figure shows.

In the same matter, A manager in the Fire Brigade suggest that the best policy is for those in charge to must work collaboratively together. Every organization must complete the work of other organizations. The example was given was:

“...this cooperation was a success in dealing with the heavy rain in Kuwait this year, we closed streets and distribute tasks, the army and national guard helped, all the country was divided into sectors and all organizations carried out their tasks properly”.

The same interviewee adds that the higher commission of civil defence must take (over command), it is the bottom line of its work. The climate change must make us ready all time not for SDS only as we have other natural disasters, evaluation must be continuous. Now we have radiation committee and we start to evaluate this risk, now we have national plan for this risk.

According to another participant from the civil defence whom identified that the most important agencies are civil defence, fire station department and the medical emergency department. He adds that those agencies responsible to response to SDSs because they have the full knowledge to deal with all cases. He Said:

“You can’t face the disaster if those agencies are not well prepared. Other agencies can take part latter to deal with other issues; such as the army and the National Guard or other public organizations”.

6.12.3 The role of agencies prior and after SDSs

The interviewees were asked a question: “In light of your experience, how do you think such agencies can take apart and help prior and after SDS is happening?”

The roles of agencies are varying before and after SDS, it depends on its responsibility, natural, and assigned task to it. The finding revealed that the roles of agencies before sand and dust storm are: Warn society (SMS and Media, Meteorological department, and Instruction awareness); controlling the basic strategy; First aid; and EWS (Early Warning System). Also, it was found the participants think that long term strategies to deal with storms are more effective. Figure 6.12 show this theme.

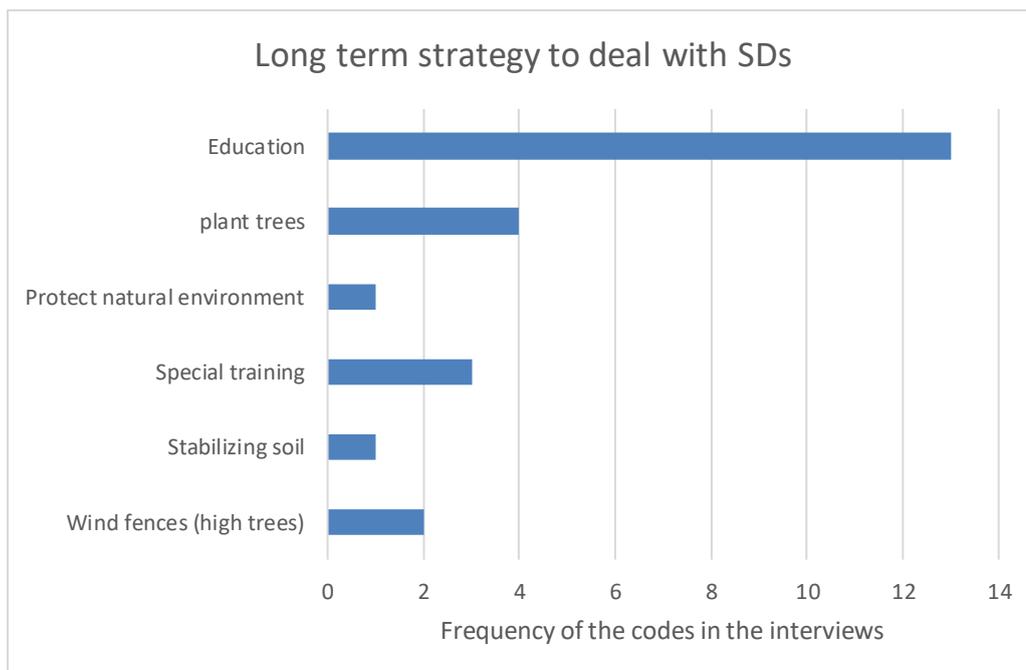


Figure 6.12 show the role of agencies in long term strategies to deal with SDS.

Education was the most frequent occurring code in this theme. Interestingly, The Fire Brigade Universities has a major role in this respect:

“This must be done through formal public bodies responsible for disasters and crises management, after knowing the sources of danger and evaluating its impacts we must educate people, and this can be done through education or universities to put the bases of educating people”

'Warn the society' is considered as an important role of agencies before and during SDS and that is through sending SMS and Media. According to one of interviewees that the basic thing is to warn people, and the agencies used SMS and media to caution people, the messages are clear and simple, and because there are more than fifty nationalities living in Kuwait, therefore the warnings must be suitable for all. He adds: *“We ask people to call in urgent cases; not calling for any reasons people must know the emergency. We must prevent panic and we make re-sure messages”*.

In the same theme, it was found that the meteorological department has a vital role to determine the kind of the disaster, and act within a suitable time frame to enable other institutions to deal with storm. This stated by one of expertise who talked from his experience *“From my experience in the United States where I witnessed many disasters; I noticed that they start with the meteorological department to determine the kind of the disaster. It must distribute awareness among society, and act within a suitable time frame to enable other organizations to act. You know – in Kuwait- they didn't alert us at enough time in the last rain fall and that caused many problems- . Alerting agencies in a suitable time will enable them to give instructions to citizens to deal with the event. Therefore, the damages will be in a minimum level and the competencies of all agencies will be very clear in dealing with risks”*.

Moreover, the majority of interviewees stated the instructions to the society and people should be before the event occurs. The need to give simple and direct instructions to help people to prepare themselves well, also, to ask people to close doors and windows, stay in houses and not using cars. Interviewee has the same attitude that the helps start with instructions and awareness to increase knowledge, and notify the family with needed procedures, households must follow up with all agencies.

In the same manner, an official from the Dust Storm Department has the same point of view as declared:

“...First of all is spreading knowledge and awareness starting from schools, the ministry of education is not part in the emergency plan. We must start from students then universities. For example earthquakes in Japan are taught for children in schools, and they are trained as well”.

Also, it was found that there are other roles and steps of agencies before sand and dust storm that the government is controlling the basic strategic storage through the ministry of trade to provide people with needed materials for response, restoration and later for recovery.

The same interviewee adds another role related to availability of early warnings systems are available, as the research centre in Kuwait in cooperation with Spain is establishing a unit to detect dust storms, this will provide an early warning system in the country. If the agencies you educate and warn people they will be ready for it. This agree with another participant who said that the Red Crescent and other agencies must educate people and companies by early warning system especially Kuwait oil company due to its type of work as it should be always ready for all risks such as SDS.

In the same context, the agencies must provide the communities training courses related to medical and first aid as affirmed by participant that family members must have medical courses for essential aid till the emergency agencies reach them. He supports his words with an example of a case:

“...I still remember the child who drawn in water, when they get him out he died because no one have knowledge about how deal with such case. We have good response time in Kuwait (12 minutes) but still first aid help I needed.”

On the other hand, ‘Notify people’ and ‘Detection damages’ is mentioned as a role of agencies to help members of the community after SDS is happening.

A participant from the mereological department has the opinion that all organizations when planning to deal with such events must concentrate on clear and solid means to contact families and to reach them easily before and after the event. This is compatible with answer from another participant who stated it is obligation from agencies to provide the individuals and the families with instructions and warnings before the event occurs and after that.

The same interviewee who was from Police department for Transportation adds that they should detecting

damages in all Sectors such as health, financial, traffic signs, trees fall and working to find the suitable solutions. Another interviewee has the same point of views, that after the event they must notify the people about the current state and affected places.

6.13 Organizational Resources and SDS

The interviewees were asked a question: “What are the organizational resources in dealing with SDS?” The interviewees mentioned a list of available resources when dealing with Sand and dust storm including: Vehicles, Volunteers, Contracts, Qualified teams, and Satellite and detection station. Also, the answers on this question include: Asking for more resources, Depending on availability of financial resources, and there are shortages in resources. Figure 6.13 shows the answers about agencies resources in dealing with SDS.

According to a top official from the Civil Defence that the government depends mainly on contracts, where there is a direct activity to deal with storms under the supervision of the government’s engineers. Also, the qualified teams were mentioned as a resource in dealing with Sand and dust storms by two other interviewees who declared they always alert their emergency teams and get them ready. Also, it confirmed that they send SMS for the volunteers to prepare them to face the events and they have suitable vehicles which are always ready. Another interviewee (Meteorological Department) has a contradictory opinion when dealing with Sand and dust storm as said: *it depends on availability of financial resources; to provide education programs and preparing vehicles and equipment to deal with such emergency”*.

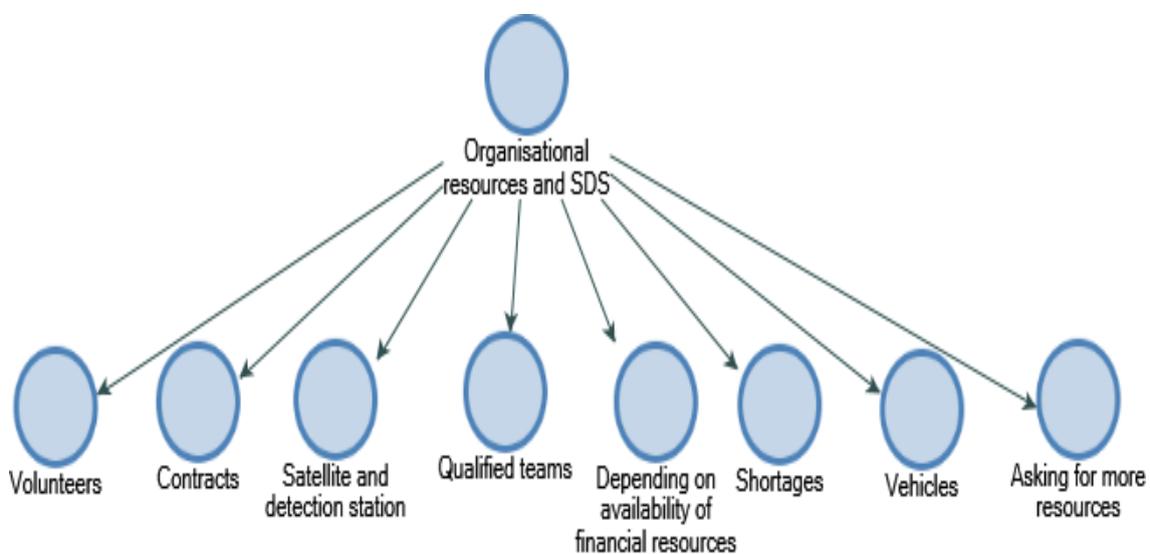


Figure 6.13 shows the answers about agencies resources in dealing with SDS

Even more, it was found that ‘Shortages of resources’ is another opinion from two of interviewees. An senior member of staff of Ambulance affirmed they have lack of ambulances, medical paramedical staff and medications:

“...There are no certain resources for SDS; for our department the availability of equipped cars and qualified paramedical staff as well as medications is very important things. There is a shortage we need to overcome here in Kuwait; in case of events we must distribute the ambulances not leave them in the canters”. The example were provided: “ Al-jahra area has the highest rates of Asthma, so; the deployment of many ambulances there is needed, by this the response time will be lower and saving lives will be higher”.

The term shortage was also linked to many other issues as, interestingly, the effect of previous wars as Figure 6.14 suggest.

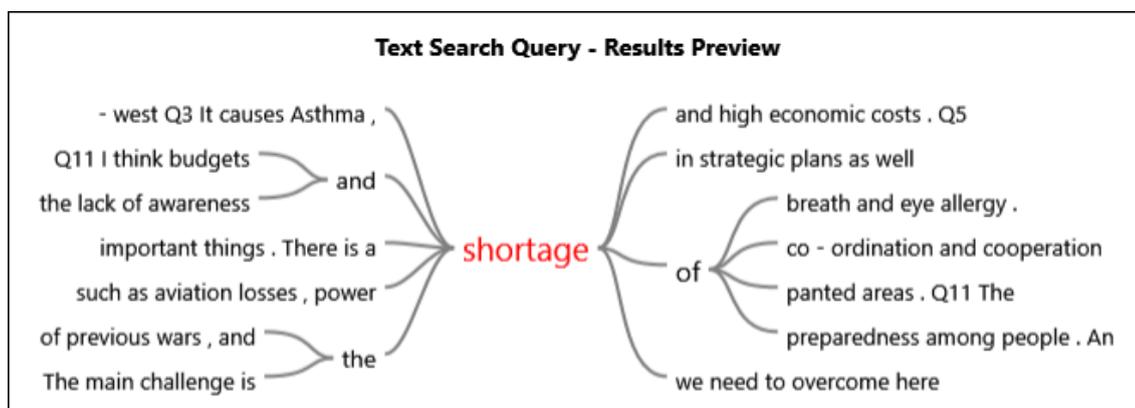


Figure 6.14 the term Shortage was associated with health, economy and even war.

In the same context, and according to another interviewee the government and its organizations as well as health agencies must provide aid, relief, food, water, medicine as well maintenance of the infrastructure.

'Asking for more resources' is declared by two of interviewees from Emergency agencies. A Fire Brigade officer after stated that they have suitable vehicles and qualified teams adds if we need more resources, we have agreements with other companies from public and private sectors, for example we used pumps from the private sector.

The support between agencies is crucial and essential, in this matter an interviewee said:

"...our role is supportive for other public agencies. For example blood bank needed our staff and vehicles to help in transporting and storing blood and we responded and helped them."

'Satellite and detection station' is another agencies resource in dealing with SDS was mentioned by two of interviewees. Two interviewees have stated that the resources they use are remote sensing; they have stations to detect dust through a Satellite, to detect the direction of dust and its sources. In addition, to data obtained from the forecasts. A participant from the dust store department adds "I think we will witness huge storms because of the climate change and due to human interventions and because of shortage of planted areas".

6.14 Challenges of the SDS

In this theme the researcher tries to explore the challenges that effect preparedness planning for addressing SDS. Thus, the interviewees were asked an open question: "What challenges do you think current preparedness planning may have for addressing SDS?"

There is agreement from all respondents that the certain key challenges including: training, traffic jam, responsibility, lack of knowledge, coordination and plan. Figure 6.15 shows a list of challenges that effect preparedness planning for addressing sand and dust storm.

The first challenges mentioned by interviewees were the training. In this respect, a participant supposed that the first challenge is the need for more professional training for our volunteers. He further added that our basic staffs are volunteers and they need more training and formal qualifications. There are 4000 volunteers but in fact there are only 1500 effective operatives.

In relation to the Traffic jam, an interviewee asserts that traffic jams are a big hinders the originations efforts to deal with the emergency.

The other challenges that have been mentioned by the interviewees were determining the responsibilities between all agencies involved in the incidence of SDS to obtain the best results to face the emergency. In this esteem, two more participants believed that there is a necessity for more authority to deal with such events as well as there is a need to conduct an agreement with the ministry of health.

Lack of knowledge as challenges has an important role in the events of SDS. In this regard, one interviewee explains these challenges as a lack of understanding of the effects of SDS on health. The lack of knowledge or ignorance of the risks of SDS and being outdoors in the events, and this create emergencies to deal with.

Some respondents highlighted that the knowledge of citizens is limited. People sometimes are reckless and do not care about the dangers of storms and its different forms such as dust and suspended dust. This causes respiratory problems and lead to a large number of people to enter the hospital. Death and injuries could also result from traffic accidents which are caused by accumulation of sands on the road and poor visibility due to hanging dust. Additionally, there are economic losses because of several reasons. Traders lose business because of the closure of shops, electrical devices and turbine could also be damaged and people will be absent from work which lead to low productivity in general. . There are other problems such as the closure of ports and airports, and there must be an awareness campaign continuously to reduce this impact on the country's economy.

According to the respondents one of the most important challenges is the coordination between different governments' organizations. In this respect one an Ambulance member of staff asserts that:

“The coordination between the governments’ organizations such as the coordination between the Ministry of Interior, the ministry of defence, the ministry of health etc. is an important issue. I think there must be a commission or a system to administrate coordination between those organizations in case of disasters. We must unify those organizations under one system or commission for effective response. For example in USA there is incident command system in the UK there is another name”.

Therefore, according to some participants, integrating between organizations and agencies under one organization is essential to ensure the existence of unified procedures to face the emergency cases.

Challenges
Slow warning system
Pressure on financial resources
Pressure on emergency agencies
Need to coordinate efforts
Need of disaster management framework
Need of better communication
Lack of special trained units
Lack of resources
Lack of proper research
lack of proper cooperation between agencies
Lack of medicines
Lack of knowledge

Figure 6.15 shows a list of challenges that effect preparedness planning for addressing SDS.

Even more, another interviewee specified that the coordination between agencies to mitigate the risk is an important step. Planning was one of the challenges that were identified by the interviewees. In this regard, a participant explained that there is no clear plan, there is only a general procedure and we need a clear plan. In the same context, another added that the plan must be clear for all people and for the organizations participated in it and must be known within different means.

In this esteem, The views from Fire Brigade officer is:

“...I wish we obtain national incidents command system to make our work more effective. It will reduce our respond time, and will enable us to carry out our tasks as everyone knows his duty. It means (we all talk same language), all work and cooperate together”.

6.15 Challenges and related organizations

The interviewees were asked a question: “Who or which organizations do you think may be responsible for those challenges?” The interviewees' answers about who are responsible for those challenges was: All organizations; Council of ministers; and Ministry of interior and many more departments. Figure 6.16 shows a list of agencies who are responsible for those challenges.

Almost half of participants declared that all mentioned organizations are responsible for the challenges. In this context it was stated that all organizations must work together. For example agriculture department must plant trees to stabilize soil, environment office should help in protecting wild life, and other organizations must work according to their duties. Some respondents also reflected on the need for more laws and regulations to protect the environment. Also, the forecasts must be updated, and research must be continuous.

Following this, another interviewee agrees that ‘All organizations and agencies’ are responsible to deal with the SDSs as every one of them is complementary to each other. The example was provided that is:

“...if I want to bring the patient to the hospital I need an ambulance and the health services and I need someone from the municipality to help or from the public works. All must carry out his tasks with coordination with others. I must add that research institutions must carry out its tasks in prediction, following up then schools and universities must educate and spread awareness. This will be helpful in risks and emergency cases. We are happy that the ministry of education is teaching voluntary work in schools, this will help us in our efforts in the future”.

Furthermore, two additional participants have the same point of view that all public institutions and organizations hold the responsibility to deal with such challenges according to its vision and plan to deal with all different types of risks. In the same manner, another respondent affirmed that:

“...We don't point figures, all are responsible, every organization must carry out its tasks, and decision makers in the government must find solutions for such challenges”.

In contrast, one interviewee indicated that the ‘Council of ministers’ is responsible for those challenges this council take decisions, therefore, the council must issue laws and coordinate all the work in case of risks. The same interviewee adds the authorities must have courage decisions to keep lives and practical procedures. Also the example was provided that:

“...the last disaster in Miami, due to the practical decisions one person died only. All must know that the government deals with risks through certain laws, regulations and procedures known by all agencies tasking part” [Ambulance].

Moreover, the ministry of interior is considered by three of the interviewees as the authority responsible to deal with the challenges. \One of the respondents stated that in the present time the ministry of interior is the head of the higher commission of civil defence, this authorizes the commission over other government organizations according to the need in the period of facing the emergency. This confirmed by another interviewee who stated the civil defence is in charge for challenges:

“...By the law the civil defence is the responsible, they are responsible for coordination; they have representatives from all organizations”.

6.16 Conclusion

The Cloud map shown in Figure 6.16 was based on what words are associated with the codes and it revealed a prominent occurrence of the words: organizations and challenges among others. This map consolidates earlier findings and lead to formatting the new conceptual framework. This framework is based on the literature and the findings here and is shown in Figure 6.17. It is clear from this conceptual framework that Challenges to management of SDSs in Kuwait are enormous. These challenges are aggravated by the nature of the storms as this was identified as a result of several factors. Sandstorms are getting worse. The impact of these storms was correctly highlighted by interviewees and is

multidimensional. The framework also showed a distinction between emergency departments and other governmental departments. Education came as a significant theme. This framework would offer a road map on how the different emergency department and the community should approach planning for SDSs emergency using both short term and long-term solution. I will also be using this framework in my last study (the focus group) and identify if the major variables here are the core of the final framework.



Figure 6.16 the cloud map of the most frequent words attached to refined codes (nodes).

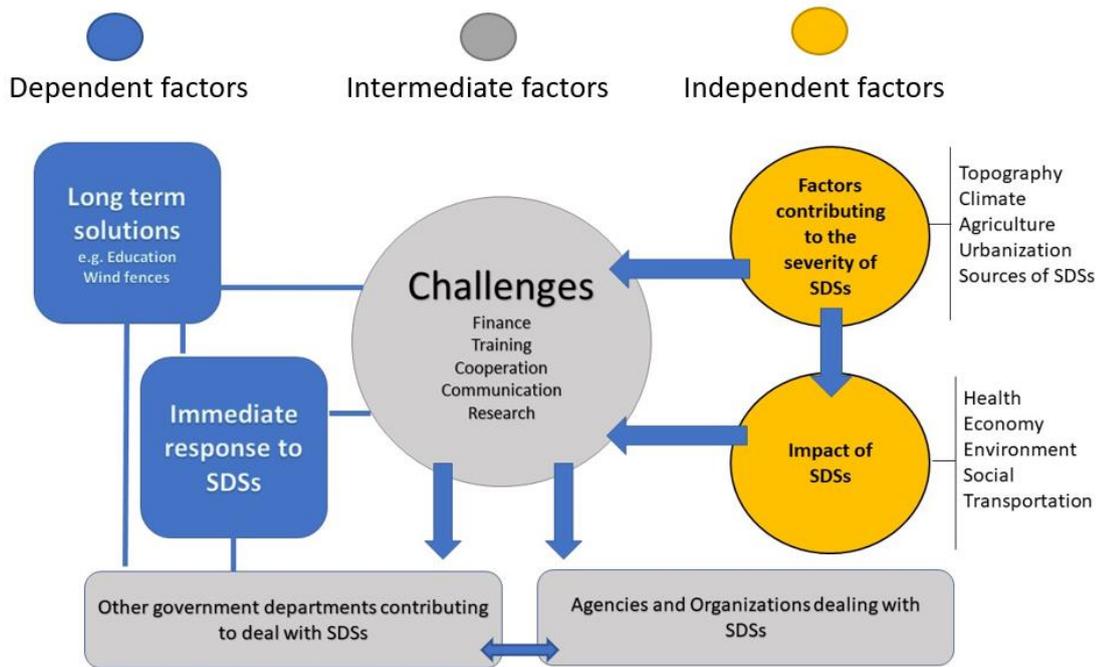


Figure 6.17 The new conceptual framework based on the findings. Arrows show relationships.

CHAPTER 7: FOCUS GROUP ANALYSIS

7.1 Introduction

Given the importance of disaster management to the social, economic and environmental wellbeing of communities and states, it is desirable that disaster management agencies strive to reach the highest level of organizational maturity for those core disaster management processes of command, coordination, communication, logistics and supply chain management. Therefore, this focus group study aims to investigate and map multi-agency disaster management coordination and communication processes and explores the organizational maturity of these processes and opportunities for their improvement.

7.2 Methods

Eleven high level managers in agencies and ministries concerned with response to SDSs participated in this focus group to discuss (see the list below). The conversation was guided by the researcher through a set of questions. The deliberations were recorded then transcribed and translated from Arabic to English. The English transcript was created as document in NVivo 12 program and analysed as described in the previous chapter.

7.2.1 Participants of the Focus Group

Participants in the focus group were Senior emergency management experts with experience in dealing with SDSs. They were:

- Head of Operations Department in the Kuwait's Fire Service Directorate (KFSD)
- An employee at the Ministry of Communications in the Technical Support Unit. He is with a Master of Technology and Innovation Management from the Arabian Gulf University
- An engineer in the Ministry of Works, Maintenance Sector - Operations Management.
- A senior manager at the Ministry of Electricity and Water - Monitoring Conservation
- Head of Kuwait Environment Protection Society (KEPS)
- A senior member of staff in the Ministry of Information.
- Head of Operations in the General Directorate of Traffic.
- An official from the Environmental Emergency Directorate
- A senior member of staff at the Public Authority for Agriculture Affairs and Fish Resources. He is a holder of PhD in Environmental Sciences and Natural Resources.
- First Lieutenant at Operations Department, Plans and Information Department
- Climate observer - meteorology department - civil aviation.

7.2.2 General Questions presented at the focus group

- What kind of disasters events are handled by the disaster management organization of Kuwait?
- What is the manpower size of the disaster management team?
- What kind of expertise does the disaster management team include?
- What is the role of the Kuwait disaster management agency?
- Does the agency have adequate resources required to handle different types of disasters?
- What is the role of the disaster management in handling the current Coronavirus COVID-19?
- Are you able to predict natural disasters? If so, what kind of disasters are you able to predict?

SDSs

Are you able to predict SDS?

If yes...

- What preparedness measures are taken in warning the community?
- What measures are taken in preparing other emergency and related agencies?

If no...

- How come SDSs prediction is not possible or not in place?
- What measures are taken about those that suffer from the after-effects of SDS?

Impact of SDSs

What lessons have been learned from SDSs events and the harm that it has caused to the country, economy, and the community?

Current Standards

Are the current environment and practices of emergency departments, up to standards?

If not, what are the improvements required to be in place?

What is the seriousness level of SDS in Kuwait?

Other Agencies

According to your knowledge and experience, what are the various emergency departments/agencies that need to be prepared in handling SDS?

- Are these agencies dedicated to natural disasters?
- Are the other agencies giving you the support required?
- What is the preparedness level of other agencies in handling SDS?

According to your knowledge and experience, what are the measure that need to be in place by

Table 7.1. Words frequency from the transcript of the focus group.

Word	Length	Count	Weighted Percentage (%)	Similar Words
disasters	9	233	2.10	disaster, disasters
Kuwait	6	148	1.33	Kuwait
management	10	147	1.32	manage, managed, management, manager, manages, managing
sds	3	141	1.27	sds
agency	6	129	1.16	agencies, agency
ministry	8	118	1.06	ministries, ministry
dust	4	102	0.92	dust
must	4	94	0.85	must
health	6	93	0.84	health
department	10	89	0.80	department, departments
plans	5	88	0.79	plan, planning, plans
level	5	80	0.72	level, levels
deal	4	77	0.69	deal, dealing, deals
works	5	77	0.69	work, worked, working, works
people	6	75	0.67	people, peoples'
emergency	9	72	0.65	emergence, emergencies, emergency, emergent
need	4	66	0.59	need, needed, needs
preparedness	12	65	0.58	preparedness
measures	8	64	0.58	measure, measured, measurements, measures
storms	6	62	0.56	storm, storms
coordination	12	60	0.54	coordinate, coordinated, coordinates, coordinating, coordination

effects	7	59	0.53	effect, effective, effectively, effectiveness, effects
awareness	9	59	0.53	aware, awareness
media	5	57	0.51	media, media'
civil	5	55	0.49	civil
crisis	6	55	0.49	crisis
prepared	8	54	0.49	preparation, preparations, prepare, prepared, preparing
state	5	54	0.49	state, stated, states, states'
warning	7	53	0.48	warn, warned, warning, warnings, warns
case	4	52	0.47	case, cases
events	6	52	0.47	event, events
country	7	50	0.45	countries, country
organization	12	49	0.44	organization, organizations, organize, organized, organizing
government	10	48	0.43	governing, government, governments
systems	7	48	0.43	system, systems
community	9	47	0.42	communicate, communicating, communication, communications, communities, community
responsible	11	47	0.42	response, responsibilities, responsibility, responsible
predict	7	45	0.40	predict, predictable, predicted, predicting, prediction, predictions, predictive, predictively
citizens	8	45	0.40	citizen, citizens, citizens'
role	4	44	0.40	role, roles

7.3.1 Main themes

Five themes were identified through analysis of the transcript. These themes were the most recurrent concepts and ideas in the transcript.

7.3.1.1 Theme One: The need to improve preparedness plan.

When plan or preparedness were used to identify the relevant text, it was clear that overall the participants were not satisfied with the preparedness plans to deal with SDSs in Kuwait. Figures 7.2 and 7.3 showed these two codes.

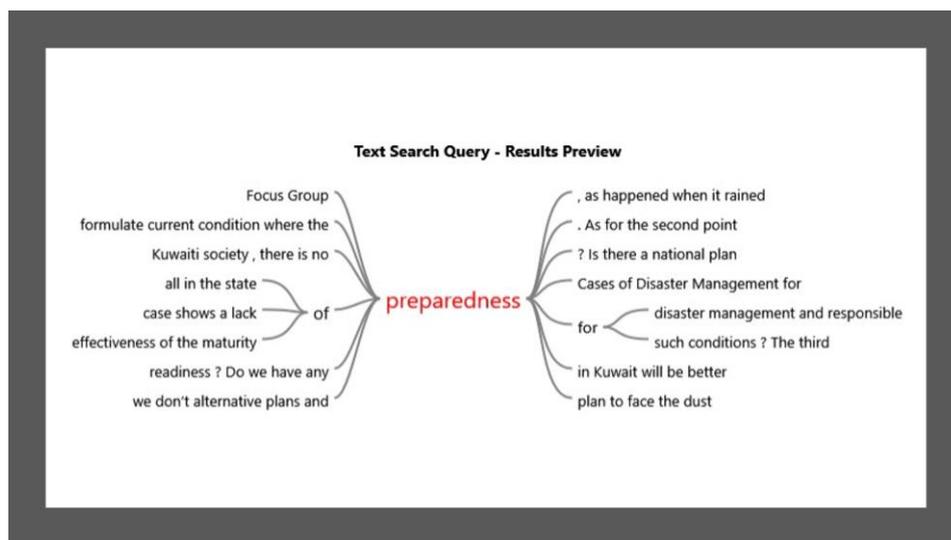


Figure 7.2: Text search query of the key word (code) preparedness.

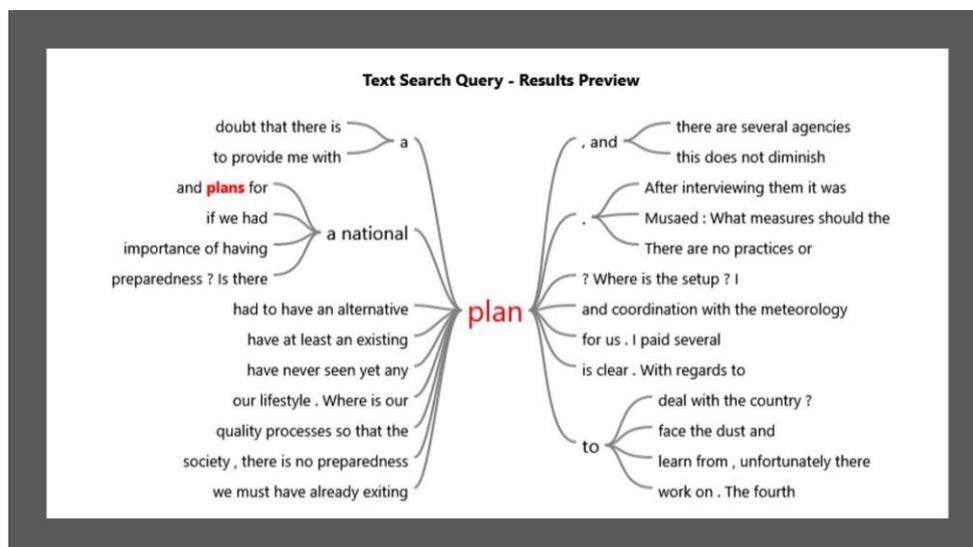


Figure 7.3: Text search query of the key word (code) plan.

When asked about the maturity level in Kuwait half of the participant said that it is at reactive level. An employee in the institute of Scientific Research said:

“Mostly, we are at reaction level. Preparedness is not strong”

This was also reflected in a statement by the representative of the environmental authority who said:

“Current environment and practices of emergency departments, not up to standards. The improvements required to be in place as following:

- 1. Legislation to set objectives, procedures and public policies for the competencies of crisis and disaster management*
- 2. Establish a specialized body or a higher advisory committee to assign crises and disaster management teams.*
- 3. Clearly identified team roles and responsibilities.*
- 4. Strategic Planning.*
- 5. Improve Emergency and disaster preparedness.*
- 6. Emergency plan and evacuation procedures by awareness and refreshing.*
- 7. Effective crisis management team communication.*
- 8. Effective Incident Action Planning (IAP) skills.*
- 9. Improve Emergency Response and employ formal incident assessment team and process.”*

This detailed assessment suggests a frustration of officials in this department about how Kuwait is prepared for sandstorms.

An officer in the Fire brigade just confirmed this frustration with how the country is prepared for dealing with sandstorms and said that there is a need for a central organization to coordinate the response to sandstorms. He said;

“There is no clear organization or umbrella for disaster management in the country, and if any, it is not eligible for this work due to the lack of specialists in this field.”

There are, however, positive comments in improving the maturity level in Kuwait as one official said:

“A high ministerial committee has been formed, headed by the MOH, to start urgently the drafting of the emergency plan, with the participation of 10 primary bodies concerned with the State of Kuwait, in cooperation with other complementary bodies from the public and private sectors”

7.3.1.2 Theme Two: Need for Education

This theme which was clearly identified in the previous chapter is clearly emphasized in this focus group analysis. See Figure 4 for text query. Education and training was reflected in the transcript in two different approaches. One is educating and training staff to deal with SDSs and the second is general education to the public. In the second approach one participants said:

“Our society lack the education in this matter. In Japan, for example, when an earthquake breaks out, we find individuals behaving by sitting under the table and placing their hands above their head. The reason for this is that the child they have at the age of 4 years acquires this culture in school, unlike us where we do not have a social education about dealing with disasters”.

Another participant highlighted the need of training of emergency personnel:

“There is young staff but there is not enough awareness and they need more training courses and more awareness to reach high levels”

An official from the fire brigade clearly stated:

“We need an integrated program or curriculum [about SDSs] taught in schools”

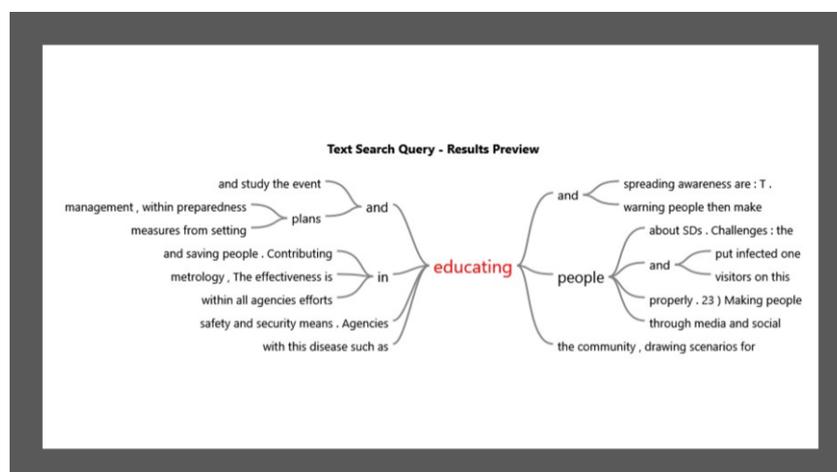


Figure 7.4: text search query of education and education.

7.3.1.3 Theme Three: Need for better coordination between agencies

To improve the preparedness plan and raise the maturity level to deal with SDSs management in Kuwait there was a consensus between participants that better coordination between different agencies and ministries. A participant suggested that at the present time this coordination is weak and needs to improve. He said:

“...there are government, private sectors and voluntary work from public of civil society and NGOs and social associations, They work according to their competence in responsibilities and tasks, other hand there is overlap and conflicts of competence and policies, there is no prior coordination or periodic meetings to coordinate between the authorities and there is no legislation governing the authorities in this regard”

Another participant (from the Environment agency) suggested the creation of a central body to facilitate this cooperation.

“While there are a lot of ministries, governmental bodies, and public benefit societies whose competencies and functions are to manage crises in disasters (MCD), but there is no competent authority responsible for integrated management in this regard to coordinate and follow-up with the rest of the authorities in the government and private sectors, therefore a specialized government body should be established or A higher advisory committee based on legislation organizing and contributing to achieving sustainable development and merging the concept of management with advanced planning and policies”

7.3.1.4 Theme Four: Early warning systems and better Communication (specially with the community)

Answering the question of Can you predict SDSs an official from the meteorological department said:

“Yes, we can predict SDSs

- We warn the society before the disaster within 72 hours; all media are used as well as all social media sites.*
- We can help others through warning forecasts then receiving the suitable treatment during and after the SDS storm by the health organizations.”*

All participants were adamant the early warning system and better plans to deal with the community prior, during and after SDSs are essential in raising the maturing level in Kuwait to neutralise the impact of SDSs. The text search query in Figure 7.5 shows similar trends,

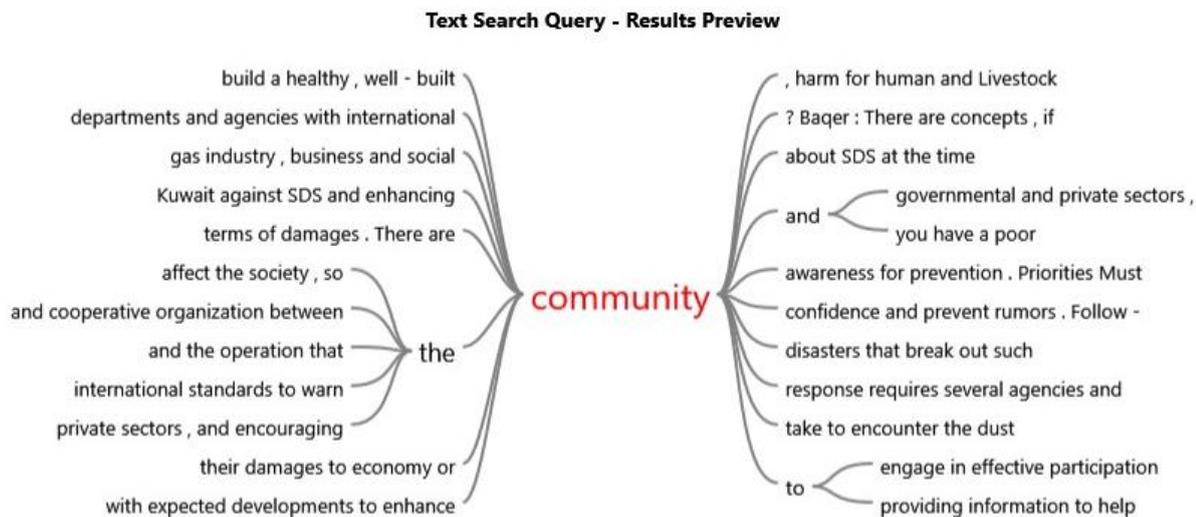


Figure 7.5: Text search query of community (code).

7.3.1.5 Theme Five: Long term solutions

This theme which was also clear in the previous chapter is again prominent in the transcript of the focus group. One strong concept was solid consolidation and creation of natural barriers. The text query of soil seen in Figure 7.6 reflected two major concepts:

- Degradation of soil could aggravate the impact of SDSs.
- The consolidation of soil is one of the most significant long-term solutions.

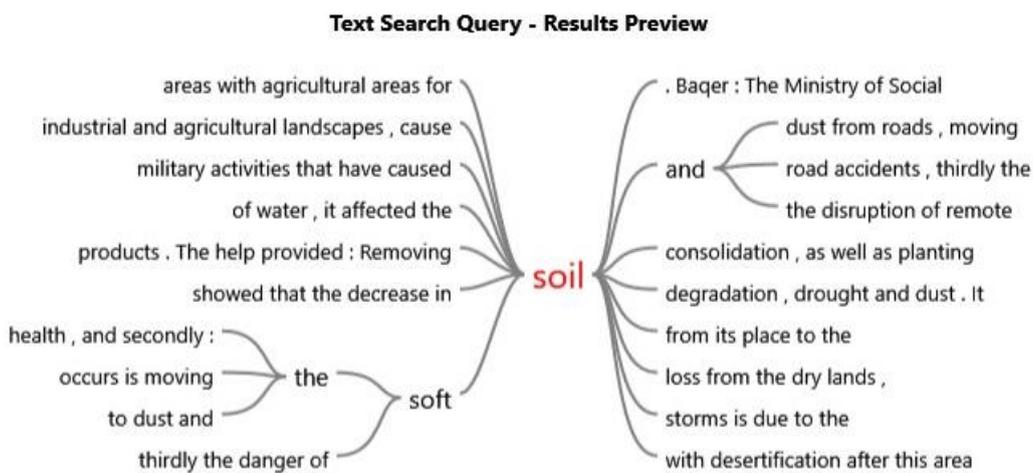


Figure 7.6: Text search query of the code (soil).

While some blamed human actions (climate change and wars) on the degradation of soil the participants were positive in going forward and improve the quality of soil. One participant from the Fire Brigade said:

“military activities that have caused soil degradation, drought and dust”

7.4 Changes to the Preparedness framework

The conceptual framework which is presented in Figure 7.7 was based on the conclusions derived from the focus group and the initial framework presented in the previous chapter. There were no changes on the impact of SDSs or the sources of the storms but the preparedness was shown to be in need of much improvements if the maturity level of emergency departments in the countries need to be raised.

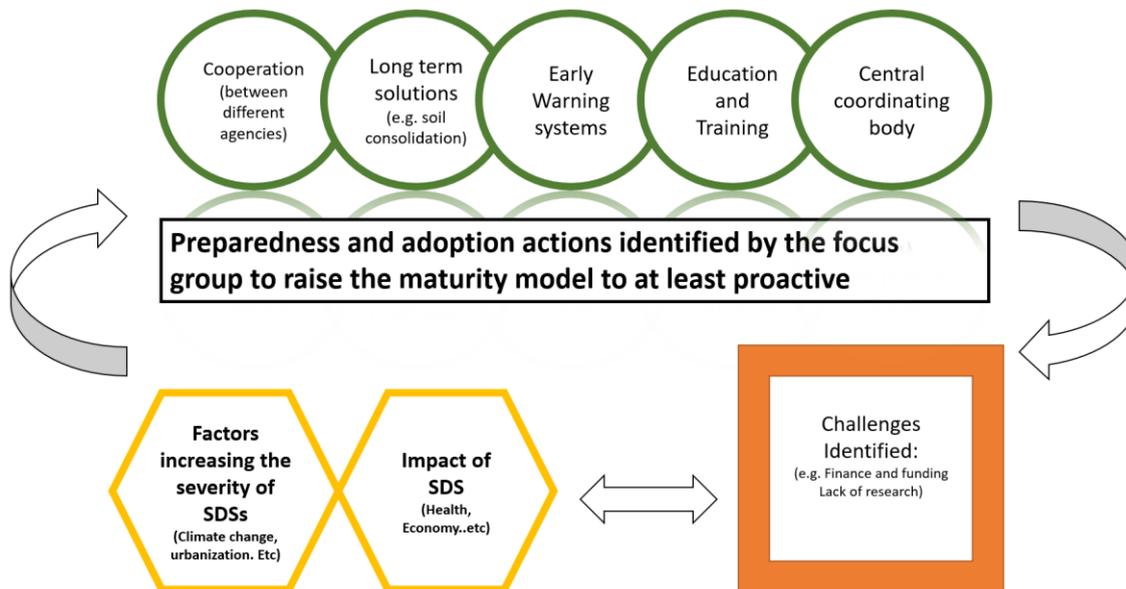


Figure 7.7: The final conceptual framework showing the five main actions required by organizations and ministries dealing with SDS to raise the maturity level. (green= independent factors, orange= intermediary factors, yellow= dependent factors)

7.5 Conclusion

The preparedness plan in Kuwait is in need of improvement and the main points raised in this focus groups are the need of establishing an authority to coordinate the effort of the different departments to deals with SDSs and the need of a broad and specific education and training plans to improve both the governmental departments response and the community based response. These elements will be used in the next chapter to design a scheme for the final holistic framework to raise the maturity level of the preparedness plan.

CHAPTER 8: GENERAL DISCUSSION AND CONCLUSION

8.1 Introduction

This chapter will present the final framework and suggest future work. The research began with the literature review to understand the concept of natural hazards and preparedness measures that are taken by the country, its government, and the citizens. Different studies related to natural hazards such as tornado, earthquakes, floods, and such could be found in the literature search. However, few studies related to sand and dust storms (SDSs) were identified. This leaves a gap in academic studies in this area. Moreover, the case study is Kuwait where the topography of the land and the climate plays a major role in frequent SDS events has been highlighted. The neighboring countries also have similar climate and desert land, that leads to frequent SDSs events making the findings of this thesis generalizable, with modifications, to their emergency preparedness plan.

Kuwait has hot and dry climate with major land covered by dessert sand. Its topography is characterized by scanty vegetation and light-textured topsoil which cause frequent SDS events (Al-Dousari and Al-Awadhi, 2012). These authors also point out to that the SDS events are more frequent in the summer. The peak seasons for SDSs events are between the months of April and July as of a data studied between 2000 and 2010. The health issues related to dust storms in Kuwait were studied by Thalib and Al-Taiar (2012). They stated that during the last five years (2007-2011) there were 569 days of dust storms which created respiratory problems and increased health related issues for asthma patients. The findings also indicated that asthma attacks were on the same day of the SDS events, indicating the immediate impact on SDS on health issues.

The literature evidences argued for the need to in-depth SDSs investigations. However, the academic attention on the studies in Kuwait so was on the effects of SDSs rather than the preparedness plans to mitigate its impact. There has been little, or no attention received on the precautionary measures before and during SDS events.

8.2 Conceptual Preparedness Framework

A set of assumptions were used to draw a preparedness framework based on the literature review (Chapter 2). The literature shed light into the need to any country having preparedness plans. An initial preparedness plan from Ramsbottom et al. (2018) on preparedness cycle was considered as the conceptual preparedness plan. The preparedness cycle has eight stages – (1) identify risks; (2) prioritize risks; (3) understand prioritized risks in details; (4) identify preparedness options; (5) design

preparedness strategies; (6) implement preparedness strategies; (7) monitoring or evaluation (past or current events); and (8) update preparedness strategies. Ramsbottom et al. (2018) has categorized these eight stages into three sections. The first four stages (1-2-3-4) are related to anticipation. The next two stages (5-6) are related to responses. And the last two stages (7-8) are related to recovery. At the same time the eight stages can also be viewed in the sense of risks, preparedness, monitoring and updating. For example, the initial three stages (1-2-3) are related to risks. The next three stages (4-5-6) are related to preparedness. And the final two stages (7-8) are monitoring and updating. The process indicates that its continuous effort that needs to be undertaken by necessary authorities to provide safer environment and better quality of life to its citizens.

To understand the preparedness in Kuwait, empirical data was collected from the community and the concerned people. The community represents the citizens of Kuwait. The concerned people are subject matter experts forming researchers and practitioners. Further, a focus group study design was used to finalize the practical framework of preparedness which is the contribution to knowledge of this thesis.

8.3 Empirical Findings

8.3.1 Survey: Community Perception

The empirical data collection from the Kuwait community was done through survey method where closed-ended questionnaire was used. Kuwait Capital city was selected as the case study for this research. The methodology outlines the details on the selection of Kuwait Capital city. The survey data was analyzed using SPSS. The initial section of the questionnaire focused on the demographic characteristics of the respondents and the type of property that they were currently living in. Further questions revealed that people in Kuwait consider SDS to be very severe compared to floods, thunderstorms and earthquakes which reflects their own experience. They understood SDSs impact on health, daily activities but more importantly they were not aware of what should be done. This means that there is a need to educate the community in order to boost any preparedness plans. In general members of the community insisted that there is a need to improve response and recovery during SDSs events. The respondents demanded best reactions from the following emergency departments: civil defense, fire department, emergency services, Red Cross, and health organization.

Significant finding from this survey was that the members of the community said that they are not involved in any of the preparedness plans or the responses and are they are not involved in any wide discussion about the topic. This finding highlights the need to create a mechanism to get all the members of the community involved in preparing for any future SDSs event.

8.3.2 Interviews: Subject Matter Experts

Interviews were also carried out with subject matter experts. These were people heading these departments or having senior positions and responsible in taking decisions. The interview data was translated into English, transcribed into Word documents and then entered into NVivo software for easy management and then codes and categories/themes were generated. These experts were able to confirm that the source of SDS is the location of the country, its topography, and the climate. Due to the desert climate of the country and lack of vegetation. The experts also confirmed that SDS has strong health issues and is very harmful for people who have respiratory problems. In addition to health-related issues, the experts also stated that SDSs creates low visibility and leads to traffic accidents. Low visibility during SDS also creates hurdles for emergency teams to arrive on the location and respond to emergency calls quickly. SDSs also impacts on social activities as people cannot venture outside safely. It was also understood that SDSs has various negative economic impacts such as damages to houses and properties, damages to infrastructure, health issues, and all of these increases the costs in handling the issues caused by SDS.

The experts indicated that their priorities included saving life, provide warning to people in staying at home and in avoiding roads that are particularly affected due to SDS; managed issues related to air traffic; and provide any types of services to the general public. It is also the responsibility of the emergency teams to create awareness among the people in taking measures during the event of SDSs. But as pointed out by the Kuwait community in the survey results, these are not being implemented effectively and to their satisfaction. At the end of this study a preparedness framework was designed based on the findings and was mainly focused on the challenges recognized in the two studies by both the community and the experts of emergency management (Chapter 6).

8.3.3 The Focus Group Study

The focus group study fine-tuned the new conceptual framework (presented in Figure 6.17) and identified 5 main themes that will be used in finalizing the framework (presented in Figure 7.7).

These themes were:

Theme One: The need to improve preparedness plan.

Theme Two: Need for Education.

Theme Three: Need for better coordination between agencies.

Theme Four: Early warning systems and better Communication (specially with the community).

Theme Five: Long term solutions.

The main findings from this study was that the maturity level in Kuwait as far as SDSs preparedness is concerned is only reactive. Therefore, in the following two sections the maturity model will be discussed and then the final framework based on the focus group input will be presented.

8.4 How the final framework was developed?

It is very important to understand how the final framework presented in Figure 8.1 was developed. The steps in developing this framework are summarized below:

- Step 1: Literature was used in understanding what variables contribute to a preparedness framework. Different variables were identified, and a simple schematic framework was drawn.
- Step 2: Community survey findings and interviews findings were summarized and used with the framework from the literature to inform a framework based on the findings of the studies.
- Step 3: The framework developed in step 2 was presented to participants in the focus group study and a third simple framework was drawn.
- Step 4: Discussion of the framework developed in step 3 with the supervisory team and further discussion with high profile EM experts from Kuwait lead to a decision to expand the framework to make it more useful. In addition, a report from WHO (WHO, 2017) on a strategic framework for Emergency preparedness was consulted. While this WHO framework was essentially a framework to deal with health emergency, the outlines and the rationale underpinning this framework could be applied in any emergency including response to SDSs. The three major elements identified in WHO framework and was also implemented in the final framework here as data suggested them are:
 - 1- Governance: including policies and legislation at the national level to deal with emergency. In the framework in Figure 8.1, Government of Kuwait and its Parliament are key to contribute to preparedness for SDSs. More is explained in section 8.6.
 - 2- Capacities: increasing the preparedness level and use of both long-term and short-term solutions. This includes improving research, communications and warning systems.
 - 3- Resources: financial and logistic support is essential.

The framework presented here is based on a holistic approach which the WHO framework put as:

“A whole-of-government, whole-of-society approach” (WHO, 2017, P. ix)

8.5 The Kuwait SDSs preparedness Framework

As mentioned in section 8.5, the data gathered in the three studies (chapters 5, 6 and 7) presented here allowed for improving the framework provided in the literature review. The new framework (8.1) is a flexible roadmap that could if implemented improve the preparedness plan for dealing with SDSs in Kuwait. In preparing this framework the main themes found in the focus group study were observed and feedback loop were created to allow for a learning process. Two more authorities of significant

contribution were added to the framework. These are the higher Government body and the Parliament. It is recommended that The Government creates a central coordination authority for SDSs and for the Parliament to issue the required legislation to deal with SDSs. This is a direct response to findings from the interviews and from the focus group study. Involvement of the community in the preparedness plan was also a result found from Chapter 5. In this new framework both The Government and the Parliament direct the Ministries that are concerned with parts of the preparedness. These Ministries are listed in table 8.1. The Central SDS Coordinating Authority (CSCA) which will receive direction from and be monitored by the Ministries will report back to Ministries and provide funding for further research through Universities and KISR. Media should interact with CSCA and receive information to disseminate from it.

Most importantly, CSCA should improve early warning systems and coordinates globally and regionally to do this as this research confirmed that most sources of SDSs are from outside Kuwait. CSCA should also be responsible for developing the best EM response model and provide resources and training to improve response.

Educating the community through schools, Mosques and different civic societies is essential to raise the awareness of the community to actively engage in response efforts and get ready when SDSs occurs. The community, Research Units and CSCA with other Ministries and Departments should engage in developing long term solution to deal with SDSs. Some other specific recommendations are highlighted in table 8.1.

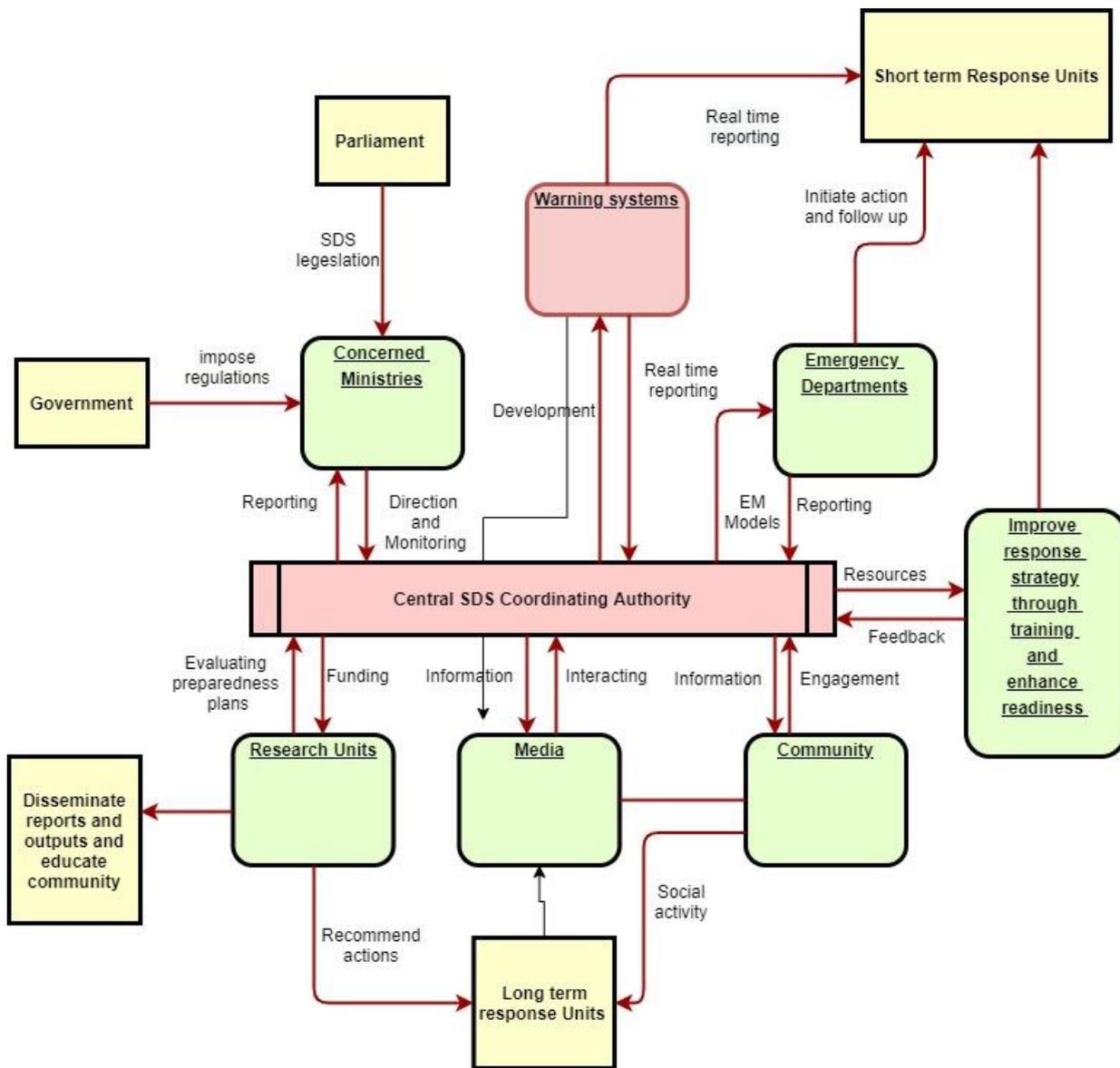


Figure 8.1: The holistic preparedness framework to deal with SDSs in Kuwait.

Table 8.1 Suggested actors and their recommended actions in the Kuwaiti SDSs preparedness framework.

Actors	Recommended Actions
Concerned Ministries	
Ministry of Public Works	Through SDSs bespoke governmental regulations and the relevant legislations the response to SDSs has to be improved according to research findings and expert views and recommendation from global organizations of concern such as WHO. For example; education of the community has to be part of a campaign to raise the readiness of the community (Ministry of Education), and update recovery process of roads (Ministry of Transportation) and improve early warning system. CSCA should be created and coordinate all actions on the preparedness plan as per the framework. Continuous feedback and dissemination of information between different Ministries and Department is essential.
Ministry of Education	
Ministry of interior affairs	
Ministry of media	
Ministry of electricity and water	
Ministry of defense	
Ministry of Transportation	
Oil companies	
Ministry of Health	
Emergency Departments and agencies with some SDSs rescue duties	
Civil Defense	Offer full resources and provide training for all these departments is essential for them to act swiftly when SDS events are happening. However, to raise their maturity level to predictive level they have to increase their coordination with each other. One thing the findings of this research found is that they are less likely to engage with community leaders and non-Emergency departments. This has to change, and the framework provided here should be tested in the real situation and improved if needed. Global and regional cooperation is also essential.
Fire Brigade	
Red Crescent	
General commissions of roads	
Marine rescue and ports	
The Army	
National Guards	
Civil Aviation	
Police	
Metrological Department	
Emergency services (Ambulance)	
Research Units	
Kuwait institution of Scientific Research	Active research targeted at improving preparedness should be prioritise and disseminate findings and research output through media and other outputs and recommend actions based on research.
Universities	
Media	
TV	All these media outlet should be activated when early warning system provide information about an SDS event. Equally important that raising awareness of SDSs is all year activity.
Radio	
Social Media	
SMS	
Mobile announcement Units	
Community	
Mosques and other religious places	The community at large through these different actors should engage in the SDSs preparedness plan. Both long term and short term will not be sustained in the community do not raise awareness of all individuals in Kuwait including nomads and marginalised groups. NGOs and tribal leaders, in particular, should prioritise response and recovery efforts when SDSs events are likely to occur and place mechanism for continuous awareness activities.
Schools	
Workplaces	
Households	
Civil societies	
NGO	
Tribal leaders and neighbourhoods councils	

8.6 Strengths and limitations of this research

It is true that a comprehensive emergency management strategy is needed in Kuwait for mitigating SDSs and responding to and recovering from their harmful impacts, available time and resources did not allow for such a broad undertaking. Hence, emphasis in this study was mainly on the preparedness phase, which is at the center of the disaster risk and management process. Nevertheless, because this is the first study on emergency preparedness in Kuwait, it should serve a great purpose if it only succeeded at motivating Kuwaiti researchers to delve deeper into the field of disaster management, the important area of knowledge that has long been ignored. It would also inform the different government departments and the community on what is needed to be done.

The main contribution to knowledge of this thesis is the need to engage community in the preparedness phase. The need of continuous education on SDSs is required. The framework provided here serve to link the governance with the whole society. The advantages of the framework is its flexibility as plans tends to be rigid. This framework could be implemented in both research and practice. The idea of creating a central authority to liaise the emergency preparedness is also another contribution that was suggested by the findings.

Another strength of this thesis is that the survey of the community was based on probability sampling and the sample is therefore representative of individuals from all districts of the city of Kuwait. However, as a sizable proportion did not reply a suggestion of incentives for future survey is warranted here. The thematic analysis of the interviews was also a strong point of this thesis and contributed to development of the framework.

8.7 Future Direction

This research has provided a framework based on literature, preliminary empirical findings and subject matter expert interviews that needs to be tested in practice. This will strengthen the initial findings and test the framework to provide recommendations to policy makers in taking measures to improve the SDSs preparedness in Kuwait and provide better quality of life to the Kuwait community. Further research is needed to confirm the findings presented here and a real-life testing of the framework is essential. This framework and the general findings of this thesis could be generalized to countries similar to Kuwait. These include the Gulf states and other MENA region countries. An important further research topic arising from thesis is to examine the preparedness plans of these countries.

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Appendices

Appendix 1 Participant Information Sheet

Participant Information Sheet

Title of the Research Study:

A National Emergency Preparedness Plan for Kuwaiti Households for Sand and Dust Storms

Additional Information:

PhD research at the University of Salford

By:

XXX

Supervisor:

XXX

Invitation Paragraph:

You are being invited to take part in a research study as part of a doctoral research project. The present information sheet is for you to have additional information on the project and is aimed to help you decide whether or not you would like to take part in the research. There would be no payment for your participation in this research.

Aim of the study:

The aim of the study is to develop an emergency preparedness plan for Kuwaiti households in relation to sand and dust storms

Why have I been chosen?

Given your academic/professional background in emergency management, I strongly believe you would be able to provide fundamental value to the present research. This would form the first phase of the study and would be followed by the main study, which will address emergency management strategies, thus involving further relevant persons in the chosen projects. Please note that, should you decide not to participate, you do not have to necessarily reply to this request.

Should I decide to take part, what happens next?

If you decide to take part, I will explain in more detail, what the research is about by providing you with a draft interview guide, and I will also be available to answer any questions you might have. After this, we can arrange a meeting at a suitable time and location, which will be both safe and confidential.

What am I supposed to do if I become involved in the project?

Your involvement in the study would be to take part in an interview where your role in the field and concerning perspectives on the subject will be discussed. The interview will take approximately 1 hour and I will audio-record it with your permission. If you are happy to participate in this research, you will be required to read this information sheet, sign the consent form and return it to me.

Will my taking part in this study be kept confidential?

All information provided by you will be kept confidentially and locked out securely (in password protected computers and locked drawer) and your responses made anonymous. No personal information of participants will be used other than codes and numbers as required to guarantee safety and untraceable track to participants. Interview data would be anonymously transcribed and also saved in a password protected computer which would only be accessed by the researcher alone. The collected data will be part of the researcher thesis and publications, and also will be available for the supervisory team and names will be kept anonymous. All collected data would be securely stored for up to 6 years in accordance with University of Salford's data retention requirements and thereafter be destroyed months after final submission of thesis, and

certificate awarded by the University of Salford.

What if I don't/won't to continue with the interview?

You are entitled to withdraw the interview anytime during or after the interview without giving any reason. If you decided to do so all the information (both written and recorded) will be destroyed immediately and no information will be taken in any research and publication.

What are the potential benefits of participating?

You have been chosen because of your relevant role in the field; hence the information you provide would be able to contribute to the future development of the emergency preparedness planning.

What will happen to the results of the research study?

The results of the study will be used in my PhD thesis and will be presented at seminars, conferences and academic journals. Anonymity and confidentiality will be maintained even when the findings are shared with other researchers and practitioners in the field.

I hope you will decide to contribute to the project; however, in all cases, I thank you in advance for your time and consideration.

Kind regards,

Appendix 2 Questionnaire

Questionnaire

This questionnaire is designed to elicit responses on issues to the impact of sand and dust storms on Kuwaiti households. It is mainly an instrument for gathering data for PhD research on 'A National Emergency Preparedness Plan for Kuwaiti Households for Sand and Dust Storms' in the School of Built Environment of the University of Salford. Kindly tick the most appropriate answer in the boxes provided based on your perception and experiences of sand and dust storms in relation to the questions asked. All information provided will be treated confidentially, and used purely for academic purposes.

Section 1: General Information

What is your age category?

<19yrs	20 to 29yrs	30 to 39yrs	40 to 49yrs	50 to 59yrs	60 to 69yrs	>70yrs

What level of educational did you attain? Tick the most appropriate

College degree	
Some college/trade school	
Postgraduate degree	
High school graduate	
Some high school	
Grade school/no schooling	
Other	

How many years have you lived in this part of Kuwait City?

Less than 1 year	1 to 5 years	6-10 years	11-20 years	21 years and more

Who own or rent this property? Tick as appropriate

Owner-occupied housing units	
Renter-occupied housing units	

What is the property type? Tick as appropriate

Single-family	
Duplex	
Villa	
Apartment 3-4 Units	
Apartments 5 or More Units	
Manufactured Home	
Other	

What is geographical location of your house in the city? Tick as appropriate

North	South	East	West

Section 2:

Instruction: Please put a tick (✓) in the box that best represents your assessment of a question. Ranking is from 1 to 5, where 1 is very less important (or very unlikely), 3 is neutral and 5 is very important (or very likely).

What is the most hazard that affects your life in Kuwait

	1	2	3	4	5
Sand and Dust Storms					
Flood					
Hurricane					
Earthquake					
Other (Please specify)					

How do you rate the impact of sand and dust storms on

	1	2	3	4	5
Health					
Safety					
Social relations					
Property					
Daily life					
Other (Please specify)					

How do you rate the respiratory disorders affecting your health?

	1	2	3	4	5
Pneumonia					
Tracheitis					
Spergillosis					
Non-industrial silicosis (Desert lung syndrome)					
Other (Please specify)					

How do you rate your knowledge in terms of preparation and dealing with sand and dust storms?

	1	2	3	4	5
Traditional (based on experience)					
Modern (learned in school or provided by responsible organisation to emergencies)					
Other (Please specify)					

When is the most recent time you received information on sand and dust storms?

Within the last 6 months	
between 6 and 12 months	
Between 1 and 2 years	
Between 2 and 5 years	
5 years or more	

How do you rate the performance of below organisations in occurrence of sand and dust storms

	1	2	3	4	5
Civil Defence					
Fire Brigade					

Emergency service					
Red Crescent					
Health Authority					
Other (Please specify)					

How do you rate the response time of below organisations in occurrence of sand and dust storms

	1	2	3	4	5
Civil Defence					
Fire Brigade					
Emergency service					
Red Crescent					
Health Authority					
Other (Please specify)					

How do you rate the knowledge provided by below organisations for occurrence of sand and dust storms

	1	2	3	4	5
Civil Defence					
Fire Brigade					
Emergency service					
Red Crescent					
Health Authority					
Other (Please specify)					

What is the most trusted information source for household preparedness information for occurrence of sand and dust storms?

	1	2	3	4	5
Civil Defence					
Fire Brigade					
Emergency service					
Red Crescent					
Health Authority					
Other (Please specify)					

What is the most effective way for households to receive information about household preparedness for sand and dust storms?

	1	2	3	4	5
Television News					
Mail					
Newspaper Stories					
Fact sheet/brochure					
Internet					
Fire Departments					
Schools					
Television Ads					
Public Workshop/ Meeting					
University or Research Institution					

Outdoor Advertisements					
Newspaper Ads					

How do you rate the support and recovery efforts of below organisations after occurrence of sand and dust storms

	1	2	3	4	5
Civil Defence					
Fire Brigade					
Emergency service					
Red Crescent					
Health Authority					
Other (Please specify)					

Which one of the below organisations do you think should initially respond and deal with sand and dust storms?

	1	2	3	4	5
Civil Defence					
Fire Brigade					
Emergency service					
Red Crescent					
Health Authority					
Other (Please specify)					

Section 3:

Instruction: Please put a tick (✓) in the box that best represents your assessment of a question.

In your household, have you or someone in your household:

	Have Done	Plan to Do	Not Done	Unable To Do
A: Attended meetings or received written information on sand and dust storms preparedness?				
B: Talked with members in your household about what to do in case of a sand and dust storm				
C: Developed a 'Household/Family emergency Plan' in order to decide what everyone would do in the event of sand and dust storm				
D: Prepared an 'Emergency Supply Kit' (Stored extra food, water, batteries, or other emergency supplies)?				
E: In the last year, has anyone in your household been trained in First Aid or Cardio-Plumony Resuscitation (CPR)				

How many hours are you willing to spend per year on personal and household preparedness for sand and dust storms?

0-1 hour	2-3 hours	4-7 hours	8-15 hours	16+ hours	Other

What steps have you taken to prepare for sand and dust storm? Tick as most appropriate

Smoke detector on each level of the house	<input type="checkbox"/>
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Flashlight(s)	
Batteries	
Fire Extinguisher	
Medical supplies (First aid kit)	
Battery-powered radio	
Food	
Water	
Received First Aid/CPR training	
Made a fire escape plan	
Discussed utility shutoffs	
Developed a reconnection plan: Where to go and who to call	

Appendix 3 Consent form

Participant Consent Form

Title of the Research Study:
A National Emergency Preparedness Plan for Kuwaiti Households for Sand and Dust Storms

Additional Information:
PhD research at the University of Salford

By:

Supervisor:

Please tick the appropriate boxes Y N

1 - Taking Part

I have read and understood the Project Information Sheet.

I agree to take part in the project. Taking part in the project will include being interviewed and audio-recorded.

I understand that I take part as a volunteer: hence, I can withdraw from the study at any time and I do not have to give any reasons for why I no longer want to be involved.

2 - Use of data in the project

I understand that my personal details will not be revealed to people outside the project, and my name kept anonymous.

I understand that my words may be quoted in publications, reports, web pages, and other research outputs.

Name of participant [printed]Signature Date

Researcher [printed]Signature Date

Project contact details:

Appendix 4 Interview questions

Draft Interview Questions

Title of the Research Study:

A National Emergency Preparedness Plan for Kuwaiti Households for Sand and Dust Storms

Additional Information:

The aim of the study is to develop an emergency preparedness plan for Kuwaiti households in relation to sand and dust storms

PhD research at the University of Salford

By:

Supervisor:

1. How many years do you have experience in emergency management?
2. In light of your experience, what is the nature and trends of SDS?
3. What are the impacts of SDS on households?
4. How do you prioritise those impacts? What criteria should be considered in prioritising such risk impacts?
5. What are the current techniques for dealing with SDS?
6. What are the current techniques implemented by emergency agencies for preparing to deal with SDS?
7. How do you think households should prepare and deal with SDS?
8. In light of your experience, what agencies should be involved in dealing with SDS? Who are responsible from those agencies to response to SDS?
9. In light of your experience, how do you think such agencies can take apart and help households both prior and after SDS is happening?
10. What are the organisational resources in dealing with SDS?
11. What challenges do you think current preparedness planning may have for addressing SDS?
12. Who or which organisations do you think may be responsible for those challenges?

Appendix 5 Refined codes and their frequency

Name	Files	References
Origin and causes of the storms	3	3
War affected the soil	2	2
Urbanization	1	1
Topography of Kuwait	2	2
South of Iraq	1	1
South east	1	1
Rub' al Khali desert	1	1
North-South direction	2	2
Northern-west	6	6
North of Asia and south of Sudan	1	1
Low rainfall	1	1
From Saudi Arabia	1	1
From Iraq and Iran	1	1
Different types	1	1
Different origins depending on the season	3	3
Deforestation and arid area	4	4
Climate change	1	1
Bobian and Warba Islands	1	1
Long term solutions	1	1
Wind fences (high trees)	2	2
Stabilizing soil	1	1
Special training	3	3
Protect natural environment	1	1
plant trees	4	4
Education	13	15
Impact on transportation	1	1
impact on ports	2	3
Impact on social life	1	1
Disturbance of daily routine	1	1
Impact on security	2	3
Roads invisibility	2	2
Road safety	2	2
Poor visibility in ports	2	2
Impact on health	6	9
Respiratory problems	4	4
Psychological problems	1	1
Death	3	3
Asthma attacks	3	4
Allergies	1	1
Impact on environment	1	1

Air pollution	1	1
Affecting the sewage system	1	1
Affecting plants and agriculture	1	1
Affecting animals	1	1
Impact on Economy	2	3
Slow operations at oil fields	1	2
Material damage	2	2
Damage to properties	1	1
Damage to turbine devices	1	1
Damage to electrical devices	1	1
Damage to houses	1	1
Decrease productivity	1	1
Costs to the aviation industry	1	1
Costs of cleaning and maintenance	1	1
costs due to power shortage	1	1
Departments and organizations dealing with storms	2	2
The special committee of Minsters council of Debris and dust removal	1	1
The Army	1	2
Red Crescent	1	1
Ports	1	1
Marine rescue	1	1
Oil companies	1	1
National Guards	1	1
Ministry of Public Works	1	1
Ministry of media	1	1
Ministry of interior affairs	1	1
Ministry of Health	1	1
Ministry of electricity and water	1	1
Ministry of Education	1	1
Ministry of defense	1	1
Metrological Department	1	1
Kuwait institution of Scientific Research	1	1
Hospitals and clinics	1	2
General commissions of roads	1	1
Fire Brigade	1	1
Environment Public Authority	1	1
Civil Defense	3	3
Civil Aviation	1	1
All other government departments	2	2
Procedures to deal with storms	1	1
Warning in ports	1	1
Storage of food and medicine	2	2
Sand proof defense	6	6

Road irrigation system	2	2
Risk reduction	1	1
Removal of sands	3	3
Remote sensing	1	1
Proper planning	1	1
Proper medical treatment of affected people	1	2
People stay indoors	8	9
No measures in place	8	8
Masks	3	3
Maintain public security	1	1
Learning from other countries	1	1
International collaboration	2	2
Inform people	2	2
Increase awareness	1	1
Improving navigation system	1	1
Early warning	3	3
Early planning	1	1
Distribution of guidance booklets	1	1
Collaboration between emergency departments	12	14
Changing flight routes	1	1
Avoid panic	1	1
Alert through media outlets	8	10
TV	2	2
Social media	2	2
SMS	1	1
Road signs	1	1
Radio	1	1
Air filters	1	1
Challenges	17	29
Slow warning system	1	1
Pressure on financial resources	3	3
Pressure on emergency agencies	1	1
Need to coordinate efforts	2	2
Need of disaster management framework	4	4
Need of better communication	3	3
Lack of special trained units	3	3
Lack of resources	3	3
Lack of proper research	1	1
lack of proper cooperation between agencies	4	5
Lack of medicines	1	1
lack of knowledge	1	1