Journal of Environment and Earth Science
ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online)
Vol.4, No.14, 2014

Disaster Risks and Preparedness: Effects of Petrochemical Hazards on the Environment in Saudi Arabia

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The research is financed by the Saudi Arabian Government

Abstract

The impacts from disaster risks are extremely devastating and significantly affect people, environment and business organisations. This research explore disaster risks and preparedness especially the impacts of petrochemical hazards on the environment in Saudi Arabia. While the impacts vary considerably across different affected stakeholders, the environment remains the principal benefactor of such disastrous effects. Disaster risks are made manifest through incidents such as extreme weathers, droughts, climate change, flooding, earthquake, landslide, technological change, petrochemical hazards and pollution among others. United Nations International Strategy for Disaster Reduction (UNISDR) revealed that within the last 30 years, the Arab region was affected by more than 270 disasters resulting in more than 150, 000 deaths and affecting approximately 10 million people. The effects of disaster depend majorly on the level of exposures and vulnerability of the human subjects to the source of the disaster. This research anchored on the concept that disaster preparedness is crucial for effective management of disaster risks such as petrochemical hazards. Findings from the study through literature review and semi-structured interview revealed that proximity of human subjects, exposure to petrochemical hazards, disaster risk education and extent of disaster preparedness play pivotal role in successful management of impending disasters. Results of the semi-structured interview revealed the need for national and institutional supports for disaster risks education and management within the study area (Jubail, Saudi Arabia). The current research findings and existing literatures revealed that poor and uneducated people are more vulnerable to disaster effects than any other group. Thus, the research made some useful recommendations on how to better understand disaster and prepared for any eventualities. Though, the research is limited to Jubail city, Saudi Arabia; the study contributes significantly to the body of knowledge on emergency and disaster management.

Keywords: Disaster Risks, Disaster Risks Reduction, Preparedness, Hazards, Saudi Arabia

1. Introduction and Background

Hazard potentially means the chance of risk occurring which could affect the environment, health and safety, property and business and create significant cause for concerns. Though the term hazard has often been used controversially in academic literatures and among practitioners, yet there are consensuses that every hazard must be managed. Researchers on the subject of disaster management have been found in a close circle of differentiating between incident, emergency, disaster, risk, crisis, hazard and vulnerability. Some experts believed that a risk could lead to an incident but when the damage caused becomes overwhelming it is classified as disaster (Borodzicz, 2005; Boin, 2008). The choice of meaning for these terms has obvious implications for their management. In terms of classification, hazard has been classified into natural hazards, man-made hazards and technological hazards.

Empirical studies in risk and disaster management have problematically considered these classifications and there are unending arguments within the body of knowledge. Critically, the concept of "all hazards" approach has emerged in literature which recognizes that different hazards cause similar problems (Cunny, 1983; Britton, 1987; Berne, 2009). However, the focus of this research is on technological hazards which mean potential partial malfunction or total breakdown of equipment that can significantly cause negative effects to human lives, health and safety, environmental degradation and sustainable development. In the context of this study, petrochemical hazards have been considered within the scope of technological hazards. The risks which could potentially result from oil exploration and production activities within the oil and gas industry in Saudi Arabia have been referred to as petrochemical hazards in this study. Saudi Arabia is one of the main leading oil and gas producing countries in the world, therefore, it is only reasonable to explore the effects of petrochemical hazards within the country on the environment, health and safety and the level of preparedness for their management.

Truly, oil and gas companies in the country have been actively involved in the protection and maintenance of their equipment based on the Saudi Standards Metrology and Quality Organisations (SASO) standards (Al-Suwian, 2005). However, this has not been sufficient to proactively reduced cases of disasters within the country. For example, in 2005 alone, there are 36 documented oil spills in the Arabian Gulf (Al-Suwian, 2005) which meaningfully affect the environment, threaten the marine species, causes biodiversity loss and pollution. The question remains – why should disaster risks reduction and preparedness be given priority and attention? What are the possible implications for lack of preparedness and effective disaster management of petrochemical hazards in Saudi Arabia? In the event of disaster, there would be initial disorder and lack of adequate resources, variation in the number of casualties, loss of infrastructure, effects on human health and safety, adverse impacts on the communities, environment and organisations, complexity of tasks and need for multidisciplinary teams. Thus, exploring disaster risks and the level of preparedness in Saudi Arabia can help further prepared for any detrimental effects of petrochemical hazards which may harm the environment, health and safety, communities and organisations. Therefore, it is imperative that disasters are carefully planned and prepared for to reduce vulnerability and enhance sustainable development in Saudi Arabia.

1.1 Statement of the Problem

The Kingdom of Saudi Arabia is located on the Asia continent along longitude $44^0 74^{"} 65^{'}$ and latitude $44^0 28^{"} 70^{'}$ with a surface area of 2,149,690km^2 and estimated population of 29,994,300 (Table 1). The country captures larger part of the Arabian Peninsula and principally divided into thirteen (13) provinces which are further divided into governorates. The main economic mainstay of Saudi Arabia is oil and gas including petrochemicals products which generate about 70 to 80 per cent of the revenues for the country. The activities of oil and gas industry in the country are increasingly impacting on the environment and constitute, arguably, impending disasters when not properly review and manage. The petrochemical hazards resulting from the petroleum industry pose potential risks and disasters; this requires thorough investigation and evaluation for sustainable development and livelihood. Research indicates that deliberate preparedness for disasters and effective management of potential hazards are crucial towards achieving the environmental sustainability (Amendola, Linnerooth-Bayer & Okada, 2008). Therefore, this study critically explores the effects of petrochemical hazards on the environment in Saudi Arabia and examines the extent to which preparedness could help manage such risks. The United Nations International Strategy for Disaster Reduction (UNISDR) revealed that during the past 30 years, the Arab region has been affected by more than 270 disasters resulting in more than 150,000 deaths and affecting approximately 10 million people. The experiences are not in themselves what should be hoped for but there is wisdom in preparing for any disaster because it would help reduce the vulnerability and damages to the environment, health and safety of the people.

Table 1: Names, Capital, Areas and Population of Regions in Saudi Arabia

Name	Abbr.	Capital	Area A (km²)	Population C1992-09-27	Population C2004-09-15	Population C2010-04-28	Population C2013-07-01
Al-Bāḥah	BAH	Al-Bāḥah	9,921	332,157	377,900	411,888	450,700
Al-Ḥudūd ash-Shamālīyah [Northern Frontier]	HDS	'Ar'ar	111,797	229,060	279,971	320,524	351,000
Al-Jawf (incl. Al-Qurayyāt)	JWF	Sakākah	100,212	268,228	361,738	440,009	483,100
Al-Madīnah al-Munawwarah [Medina]	MDM	Al-Madīnah	151,990	1,084,947	1,512,724	1,777,933	1,962,600
Al-Qaṣīm [Al-Qaseem]	QSM	Buraydah	58,046	750,979	1,015,972	1,215,858	1,337,600
Ar-Riyāḍ [Riyadh]	RYD	Ar-Riyād	404,240	3,834,986	5,458,273	6,777,146	7,517,000
Ash-Sharqīyah [Eastern Region]	SHQ	Ad-Dammām	672,522	2,575,820	3,360,031	4,105,780	4,533,800
'Asīr [Aseer]	ASI	Abhā	76,693	1,340,168	1,687,939	1,913,392	2,095,900
Ḥā'il	HAL	Ḥā'il	103,887	411,284	526,882	597,144	654,700
Jīzān	JIZ	Jīzān	11,671	865,961	1,187,587	1,365,110	1,497,400
Makkah al-Mukarramah [Mecca]	MKM	Makkah	153,128	4,467,670	5,797,184	6,915,006	7,688,600
Najrān	NJR	Najrān	149,511	300,994	420,345	505,652	555,100
Tabūk [Tabouk]	TBK	Tabūk	146,072	486,134	691,716	791,535	866,800
Saudi Arabia	**SAU**	**Ar-Riyād**	**2,149,690**	**16,948,388**	**22,678,262**	**27,136,977**	**29,994,300**

Source: Central Department of Statistics, Kingdom of Saudi Arabia (web).

1.2 Disaster Risks and Preparedness

The disaster risks that could arise from technological hazards might include release of substances (chemical, nuclear, biological), structural failure, explosion, fire, environmental interference, among others. It is useful to state that there are controversial arguments in literature as to what the term 'disaster' actually means. In fact, a study conducted by Debacker found over 100 definitions of the term disaster in literatures (Amendola et al., 2008). For simplicity, a dictionary meaning of disaster which refer to a sudden calamitous event producing great material damage, loss and distress, has been adopted in this study. Though, more broadly, a disaster can be described as a serious disruption to nation, business organisation, community life which threatens or causes death or injury, and damage to property which is beyond daily capacity of the affected people and organisation, and requires special mobilisation, coordination, organisation of resources other than those usually available to

the affected stakeholders.

Petrochemical hazards, seismic activity and climate change are risk in the Kingdom of Saudi Arabia and have effect on the frequency and intensity of extreme weather events which affect the environment. For example, flooding in Saudi Arabia and Yemen between 2008 and 2009 cost an estimated total economic damage of about 1.3 billion USD (IRDR, 2013). Studies suggest that disaster risks of storm caused Palestine more than 50 million USD in economic damage and severely affected the environment (International Disaster Database, 2010). Natural hazards of flash flood, landslides, earthquakes, tsunami, droughts, sandstorms and tropical cyclones are increasingly driven by technological hazards such as petrochemical hazards. These hazards must be thoroughly managed for effective sustainable development.
When disaster hit, it is practically not the time to learn something different. A review of literatures suggests that the response to disaster should be consistent with normal arrangements wherever possible to avoid confusion and lack of knowledge. This further revealed the importance of preparedness in effective disaster management. While disaster preparedness and plan might not entirely guarantee successful management of disaster, it can help practitioners and rescue team to effectively coordinate the entire process and handle the disaster without panic and confusions. It has been revealed that disaster risks constitute large loss to any nation and the effects of which practically affect the nation, communities, businesses, environment, and health and safety (Hari & Yuko, 2008). There is little doubt that when disaster hits human settlements the results can be devastating. The lives of countless vulnerable people are threatened, and through the destruction of building and infrastructure, health and safety implication and destruction of the marine species are significantly affected by disaster risks. Thus, this research explores the effects of petrochemical hazards on the environment in Saudi Arabia and revealed strategic methodological approaches that could be used to manage disaster risks.

1.3 Research Objectives

This research is an investigation of disaster risks and preparedness which draw largely on the effects of petrochemical hazards on the environment in Saudi Arabia. The study reviews the literatures on disaster management and methodology for managing disaster risks. The primary purpose of the study has been to critically review the effects of petrochemical hazards on the environment and local people residing close to petrochemical plants in Saudi Arabia. The study seeks to examine to what extent petrochemical hazards could affects the environment and the local people living near petrochemical plants; and what proactive approaches could be used to manage the complexity of disaster risks.

2. Review of Literature

There is wider acceptance that disasters are not inescapable interruptions to development but are the result of unmanaged risks (Adams, 1995; Al-Suwian, 2005; Amendola et al., 2008, Berne, 2009). Studies have revealed that disasters have always happen because of the interaction between nature, technology, and other living entities (IPCC, 2001; Dhaffar et al., 2005). There are indications that disaster hinder human development, affect the environment, health and safety of the people, and impact on sustainable development. However, over the recent years, there have been considerable efforts within Saudi Arabia to thoroughly managed disaster risks. These efforts and concerns for disaster management are rather more reactive than proactive in nature. In addition, strategic efforts towards managing disaster risks are not targeted at reducing vulnerability and exposures to hazards within the country. The increasing propensity for disasters and the failure of existing development frameworks and policies to reduce the impact of disasters on society and the economy (Quarantelli, 1988a) further hamper disaster management practice in Saudi Arabia. At the international level, research showed that exposure to disasters is increasing as more people and assets are located in hazards-prone areas (IPCC, 2007; IPCC, 2012). This is particularly true regarding the current situations of people living close to petrochemical plants and oil and gas companies in Saudi Arabia. However, disaster risks can be meaningfully reduced through disaster risk management strategies that focus on how best to reduce exposure to hazards and vulnerability of people and assets. The right of the affected people must be protected and ultimate responsibility lie in ensuring proactive measures are in place before disaster hit the community and significantly affect the environment. In other words, disasters preparedness is crucial towards successful management of disaster and crisis. The need for disaster preparedness has been attributed to the expected further increase in disaster risk within the next decades due to influence of hazards on vulnerability, exposure and the frequency and severity (Britton, 1987; Berne, 2009; IPCC, 2012). Likewise, the communique from the meeting of the UN Secretary General's High Level Panel on the Post-2015 Development Agenda in Bali (March 2013) also include disaster preparedness as a prominent consideration (ISDR, 2013).

Most importantly, findings from literature showed that disasters can hinder the achievement of development

goals; reverse development gains; and often have hardest impact on poor people (IPCC, 2012; ISDR, 2002; 2009). In another instance, empirical research demonstrated that without adequate focus on protecting people and assets from disasters, development processes can also serve to increase disaster risk (Melamed, Scott & Mitchell, 2012). In this context, the petrochemical hazards resulting from the oil and gas sector in Saudi Arabia which is largely perceived as development activities can impact negatively not only on the environment, health and safety of the people but significantly contribute to impending disasters in the country. The issue that may arise would be how best should policy-makers be prepared for disasters and how should the impact of disasters be managed? This may not entirely be an issue as literature on disaster risk management (DRM) indicate that efforts should be on building resilience to disasters with a renewed sense of urgency, commitment of adequate, timely and predictable resources to disaster risk reduction and disaster preparedness (Quarantelli, 1998b; Maben et al., 2010).

Nevertheless, disasters can hamper economic growth, affect poverty levels and cause human suffering. Without significant action, research revealed that the economic and social damage associated with disaster risks are extremely devastating and could cause detrimental effect on the environment. More explicitly, disasters can have widespread impacts causing not only harm and damage to lives, buildings and infrastructure, but also impairing economic activity with potential cascading and global effects (Adams, 1995; IPCC, 2001; Ikeda, Sato & Fukuzono, 2008). The release of substances, structural failure, explosion, fire and environmental interference within the Saudi Arabia petroleum industry create cause for concerns. Researchers have indicated that disasters seem to be increasing all over the world and making deliberate efforts to manage disaster risks is integral part of the disaster risk management. Disaster risk management is a methodological approach for managing identifiable potential hazards, reduce vulnerability and increase resilience of the affected stakeholders. The options for dealing with disaster risks include avoid the risk, reduce the likelihood of the occurrence, reduce the consequences, transfer the risk and accept/retain the risk (Ikeda, Sato & Fukuzono, 2008; Hari & Yuko, 2008). However, a more comprehensive approach includes prevention/mitigation, preparedness and planning, response and recovery. Though, all the options are quite critical but this work focus more on disaster preparedness.

Disaster preparedness means arrangements to ensure that should a disaster occur, all those resources and services which may be needed to cope with the effects can be rapidly mobilized and deployed. The essence of disaster preparedness is to anticipate what problems are likely to emerge in future disaster situations and to proactively devise ways to address these problems and enhance ability to respond when a disaster occurs. While having a plan is essential this does not entirely guarantee success should a disaster occurs. In other words, the plans must be practicable, tested and respond, with personnel who are thoroughly trained to deal with disaster management. In a more critical term, disaster preparedness should include community awareness and education, disaster plans, training and test exercises, disaster communications, mutual aid agreements, warning systems, resources inventories, provision of special resources and evacuation plans. Empirical studies have shown that planning provides the opportunity to network, engage participants prior to the event and resolve issues outside of the “heat of battle” (Lockwood, 2005; ISDR, 2002; 2005). However there are issues such as lack of communication or communication failure, when should disaster plan be activated, no activation mechanism and down-toning the importance of response and when to quickly act. What this suggests is that disaster risk management requires strategic initiative and rapid response to ensure successful management of disaster risks.

2.1 Disaster Risks Reduction (DRR) in Saudi Arabia

Disaster Risk Reduction (DRR) has gradually becoming one of the emerging issues within the body of knowledge and dominated the UN Conference on Sustainable Development 2012 (Rio+20) agenda. There are yet to be consensus on the subject and little attention has been paid to DRR in Saudi Arabia. Though, the government of Saudi Arabia has always indicated political willingness following the adoption of the Hyogo Framework for Action which expires in 2015 and the Arab Strategy for Disaster Risk Reduction 2020 under the auspices of the League of Arab States. The Council of Arab Ministers Responsible for the Environment (CAMRE) and the Socio-Economic Council of the League of Arab States adopted the strategy in 2011 and by early 2013, the Gulf Cooperation Council (GCC) take proactive measure by developing a risk reduction road map. Following this, the Secretary-General of the Cooperation Council for the Arab States of the Gulf has called for strong regional commitment towards ensuring disaster risk reduction, reducing vulnerability and strengthens the resilience of nations and individuals to disasters. However, having review some literatures on DRR, the question might be how prepared is Saudi Arabia for the management of petrochemical hazards which could give rise to disasters with potential detrimental effects on the environment. While DRR is imperative and fundamental to achieving sustainable development in Saudi Arabia, there is need to understand the concept of DRR and evaluate the level of preparedness to facilitate future management of disasters.

The United Nations International Strategy for Disaster Reduction (UNISDR) defines disaster risk reduction (DRR) more broadly as the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. Though this definition of DRR as put forward by the UNISDR is broadly defined, it poses controversial debate as the term disaster has not been generally agreed upon and the same phenomenon is used within the body of the definition. In other word, the definition has technically used the same term 'disaster' to define disaster'. Nevertheless, empirical research suggests that DRR covers analysing and managing hazards to reduce vulnerability to disasters which includes actions that strengthen preparedness, prevention and mitigation. On the other hand, there is evidence that effective disaster risk reduction would help ensure sustainable development. This option has not fully gained considerable acceptance in Saudi Arabia. Studies have shown that DRR can help reduce the threat of extreme disasters such as petrochemical hazards, reduce structural vulnerability, raise the capacities to cope with disasters, and improve measures to adapt to disaster risks (IPCC, 2001; ISDR, 2002; Quarantelli, 1998b; Ikeda, Sato & Fukuzono, 2008).

3. Methodology of the Study

The research was conducted in Jubail city which is the capital of the Eastern province of Saudi Arabia. The research approach includes review of related literature, archival and secondary sources, and semi-structured interview. The Kingdom of Saudi Arabia (figure 1) takes up most of the Arabian Peninsula, and the main economic activities in the country are oil and petrochemicals products, which constitute between 70 to 80 % of the country revenues. The research scope is limited to the Eastern Province of Saudi Arabia as the entire 13 provinces cannot be feasibly covered within timeframe for this research. More explicitly, Jubail is the centre of oil and gas activities in the country and majority of oil and gas companies are situated in the city.

Figure 1 Map Showing Saudi Arabia and the Provinces within the country
Source: http://www.lib.utexas.edu/maps/middle_east_and_asia/saudi_arabia_pol_2003.jpg

3.1 Research Design and Study Area

The study is completely based on literature review of disaster risks management and preparedness and semi-

structured interviews. The research semi-structured interviews were designed to ensure that relevant stakeholders are particularly included in the interviewing process. This was to ensure that better understanding of disaster risks management and approach for managing disaster risks would emerged. The study area is the Eastern Province of Saudi Arabia which consists of 540,000 Km square with the coastal length of 1200 Km. The population of the Eastern Province of Saudi Arabia is approximately over 4 million. Jubail city in Saudi Arabia has been chosen for this study due to its peculiarity with respect to petrochemical industries. The city, is the capital of Eastern Province and hosts two major industrial areas located in the Eastern part of Saudi Arabia, lying within geographical coordinates of 27° 5' 0" N latitude and 49° 40' 0" E longitude (figure 2), and covering a land area of 1016km^2 of which about 130 km^2 is exclusive for industries and the population of the area is about 300,000 persons (Al Hagery, 1998). Likewise, the study area contains a cluster of petrochemical industries (table 2) including Saudi Aramco Shell Refinery Company (SASREF) within the Saudi Arabia's petrochemical industry producing approximately 305,000 barrels of oil per day. In clear terms, Jubail industrial city contains about 42.5 petrochemicals, around 17.7 refinery oil and approximately 9.4 Iron million tons per year respectively (Kingdom of Saudi Arabia - Central Department of Statistics, 2012).

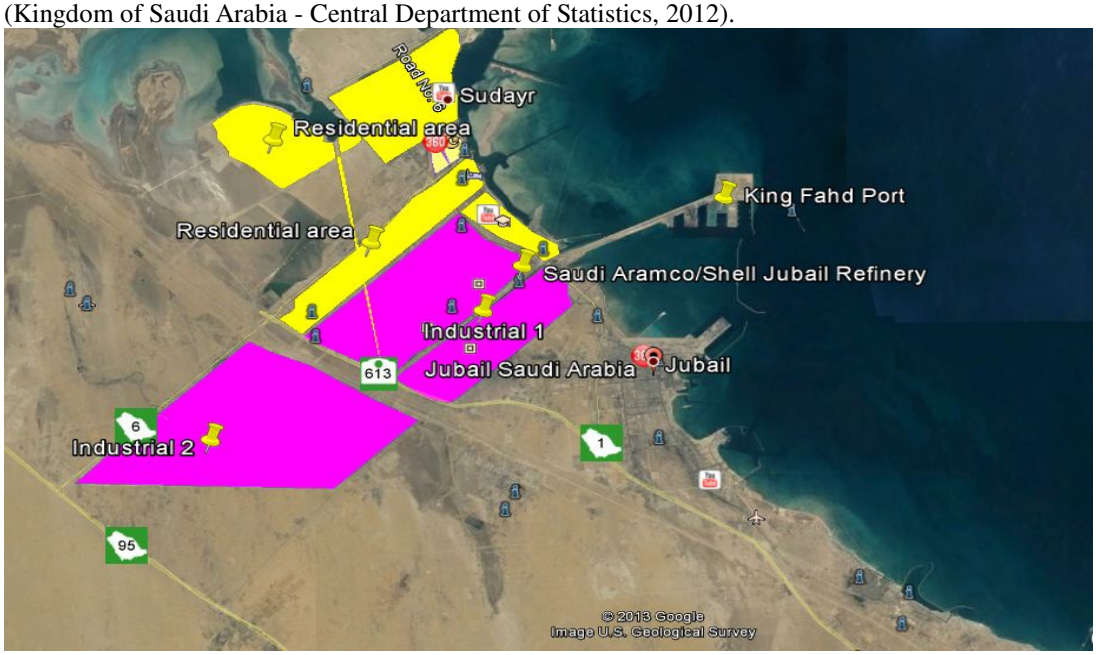

Figure 2: Google Earth map showing industrial and residential areas for Jubail

Industrial Park	Existing Industries in operation	New Industries in construction	New Industries in design planning	Total	Existing Industries in expansion
Primary	**19**	**2**	**7**	**28**	**8**
Secondary	**21**	**1**	**6**	**28**	**2**
Support	**136**	**28**	**32**	**196**	**7**
Total industries	**176**	**31**	**45**	**252**	**17**

Table 2: Types of Industries In Jubail City (Source: www.rcjy.gov.sa)

1. Primary Industries: Refining, basic petrochemicals, fertilizers, and steel plants.
2. Secondary Industries: Mainly specialty petrochemicals and plastics. Feedstock is mainly from the primary industries.
3. Support & Light Industries: Fabrication and light manufacturing to support primary and secondary industries and the community.

3.2 Data Collection and Analysis

Semi-structured interview was conducted between August and November 2013 with stakeholders within the oil and gas sector in the study area and employees of the Saudi Arabia Civil Defense Corps (CDC) responsible for the management of cases of emergency and disasters within the study area. The stakeholders were made up of the local residents, oil workers, local administrators, senior staff of the CDC, and professionals in emergency and disaster management. In clear term, the mean of the demographic data of the interviewees is 34.7 and participants range between 28 years to 56 years old. In another perspective, it was decided that only key selected leaders or managers in their respective organisations within the study area would be selected. This was to enable only strategic leaders who have practical understanding of emergency and disaster management to participate in the study. In all, the participants represent thirteen (13) different organisations within the study area. The semi-structured interview (comprising of 15 questions) was used in order to gain better understanding of stakeholders' perception of disaster risks and the level of preparedness for disaster management. This approach is similar to that used by the United Nations International Strategy for Disaster Reduction (UNISDR). However, this research differs significantly from that of the UNISDR methodological approach because the main focus was to evaluate the effects of petrochemical hazards on the environment within the study area. The semi-structured interview questions included:

a. Disaster Risks:
    1. What do you understand by disaster risk in your own opinion?
    2. Are there measures in place to cope with disaster risks?
    3. Do petrochemical hazards have any effect on the environment, and what are the effects?
b. Regulation Impact:
    1. Are there regulations in place to proactively address disaster risks?
    2. What impacts can regulation has on the management of disaster risks?
    3. Who is responsible for the management of disaster risks in the country?
c. Organisational and Corporate Support:
    1. Do corporate organisations support disaster risks reduction programme?
    2. What types of supports are available to reduce vulnerability and increase coping capacity?
    3. Do organisations operating within the environment really communicate their operations can cause disaster and what can be done to reduce such disaster?
d. Level of Preparedness:
    1. How would rate the level of preparedness for disaster risks within the country in your own view?
    2. Do you think government has adopted the right policy and frameworks to deal with disaster risks? Why do you actually make that comment?
    3. Do you see every stakeholders within the area as fully prepared for the worst case should disasters hit the environment?
e. Adaptation and Resilience:
    1. How can the affected community people and residents within the area adapt should disaster happens?
    2. What methods can the government and the organisations operating within the environment used to help local residents adapt to petrochemical hazards?
    3. Do you think the local people and residents have the require capacity to cope should disaster occurs?

The semi-structured interview questions were distributed to a total of 25 respondents (which composed of local residents, oil workers, local administrators, senior staff of the CDC, and professionals in emergency and disaster management.) within the study area. Twenty (20) interviews were fully completed within the time frame of the research, however addition information were obtain through secondary data collection methods such as literature review, archival sources and government documents containing cases of disasters in Saudi Arabia. Essentially, this study mainly aimed at re-directing the debates on disaster management within Saudi Arabia hence it does not aim to be in-depth in terms of national and global level analysis relating to disaster risks and level of preparedness. Meanwhile, the findings from the interviews have been carefully cross checked with library sources and results have been critically presented in view of best practices in disaster management across the globe.

4. Findings and Discussion

Research clearly indicate that the world is witnessing more series of crises, disasters and events characterised by diversity, speed and the element of surprise, which constitute barrier to growth and progress for individuals and communities (Britton, 1987; Cunny, 1983; Al-tukhi, 1990; Berne, 2009). Through the conceptual framework and literature reviews, one of the questions that arose during the semi-structured interview was to gain key stakeholders understanding of what disaster actually mean. The results showed that disaster can occur suddenly

and unexpectedly and capable of disrupting economic activities, affect the environment and cause health and safety concerns for people. Although the term disaster has always been controversially defined in literature (Quarantelli, 1988a; 1998b; Regester & Larkin, 1997; Borodzicz, 2005; Lockwood, 2005), several cases of disasters ranging from the terrorist attacks of September 11, 2001; the 2004 tsunami; Hurricane Katrina or the Haitian earthquake; the Bhopal disaster and Mari Disaster among others have raised concerns. Somewhat surprisingly, little attention has been paid to disaster preparedness, communities' response capacity and adaptation, resilience and state preparedness, and the effects of petrochemical hazards on the environment in Saudi Arabia. Therefore, there is need for increased public awareness on the effects of petrochemical hazards and disasters to the environment, health and safety of the people. Existing research further pointed out that petrochemical disaster can have several social and health consequences such as health and food safety, access to clean water, sanitation and hygiene among others (Pdgeon & Turner, 1997; Melamed, Scott & Mitchell, 2012).

The participants further agreed that petrochemical hazards have effects on the environment ranging from loss of vegetation, climate change, landslide, flooding, extreme weather condition, disruption of economics activities and loss of occupation for people who primarily depended on agriculture. Comparing these findings with existing literature on environmental management and disaster management (Cunny, 1983; Adams, 1990; Pidgeon & Turner, 1997; Regester & Larkin, 1997; Borodzizc, 2005; Hari & Yuko, 2008), it appears that disaster risks have the capacity to totally disrupt economics activities and severely cause hard environmental damage. This suggests the need for disaster preparedness and evaluation of the ability of the likely affected stakeholders to enhance better adaptation and build strong resilience towards the effects of disaster. More importantly, the participants have noted that there are measures in place towards managing potential disasters but yet could not verify whether such measures are indeed proactive in nature and the extent of preparedness. One conclusion that emerges from such findings is that understanding the level of disaster risks preparedness is practically imperative for sustainable disaster management and improvement of environmental performance. Studies show that preparedness involves putting a variety of means in place so that first responders to potential disasters can intervene better, as a function of the issues identified during planning. Though, several definitions of preparedness exist in literature as pointed by Simpson and Covington (2006) and McEntire and Myers (2004). In fact, McEntire and Myers (2004) report close to a dozen different definitions of preparation. However, the literature does generally agree on the need for preparation, in the context of emergency measures, to identify and implement a variety of methods so as to be better able to intervene (Borodzizc, 2005; Amendola et al., 2008; Boin, 2008; Berne, 2009). These methods generally focus on responding to a hazard in the context of a disaster, that is, a situation in which the population and its activities are severely disrupted. More conclusively, the ultimate goal of disaster preparedness is to mitigate or minimize the effects of hazard and disaster.

In terms of regulation, the research findings revealed that there are regulations in place to guide actions for disaster management in Saudi Arabia. The Civil Defence Corps (CDC) in Saudi Arabia is charged with the fundamental responsibility for managing cases of emergency, disaster and crises within the country. Respondents believed that the approach has been helpful towards the management of emergency and disaster. This perhaps serves as actions and measures in place to better guide intervention and recovery during disaster. The findings confirm that of McEntire and Myers (2004) position which assumes that accepting that disasters will happen is a key essential characteristic of preparation. On the level of national and organisational supports, there are supports and measure in place as majority of the respondents indicated. The government and organisations operating within the study area have master plan for evacuation and safety procedures in place to management cases of emergencies and disasters. However, attempts have not been made to thoroughly evaluate such master plan and safety procedures in place. The big challenge might be how effective are such plans and procedures and what exercise has been carried out to examine such effectiveness. Along these lines, Mileti (1991, p. 215) declares that "the purpose of preparedness is to anticipate problems in disasters so that ways can be devised to address the problems effectively and that the resources needed for an effective response are in place before hand". This suggests that disaster would occur but evaluating the level of disaster preparedness is crucial towards successful management of disaster risks.

A number of theorists have revealed that despite improvements in methods of dealing with disasters, disasters and petrochemical hazards still pose a serious threat and more attention should be given to preparing for disasters (Lagadec, 1997; Turner, 1994; Borodzicz and Van Haperen, 2002) cited by Borodzicz (2005, p. 155). Building upon this, the participants rated the level of preparedness for disaster risks quite well below average and collective findings suggest that preparation for disaster must pre-dated disaster recovery and rescue activities during disaster. This is because government policies were still seen as reactive in nature, disaster risk education and communication were lacking and stakeholders within the country were yet to imagine the worst case scenario. The starting point for disaster preparedness and promotion of disaster resilience culture lies in the

knowledge of the hazards and environmental vulnerability to disasters (Hari & Yuko, 2007). On the other hand, the level of adaptation should disaster happens was considered low. The chances of changing occupation, the literacy level, poverty and discourse in government policy hampered adaptation. Evidence from the interviews showed that the capacity to cope and adapt to disaster pragmatically depend on the vulnerability of the affected people. For example, participants believed that poor people and uneducated people are more vulnerable to disaster risks. The government and the organisations operating within the environment can help by redirecting policy on disaster risks education and communication, disaster risks reduction programme and focus on eliminating activities that directly impact on the environment.

5. Conclusions and Recommendations

This research presents heuristic guidance through which disaster risks can be effectively managed. The study explored the complex relationship of disaster risks on the environment and local vulnerable people. The findings showed that understanding how petrochemical hazards might lead to emergencies, crises and disasters situation within the study area and the level of preparedness for managing such events are crucial to effective emergency and disaster management. This result confirmed existing findings and arguments that more attentions need to be given to understanding and managing situations of emergency and disaster (Borodzicz, 2005). The Civil Defence Corps (CDC) who is responsible for handling emergencies and disasters as conferred on it by the Royal Decree 1986 of Saudi Arabia would require constant training and simulation exercise on disaster management. This perhaps would enable personnel to be better prepared for disasters in the country. In fact, Schramm & Hansen (1991) argued that lack of training of workers and administration regulators to identify and correct hazards in big factories (such as petrochemical factories) contribute to increase cases of emergencies, crises and disasters. In this instance, a commitment to planning today will help support employees, customers, community and the country (Boin, 2008, p. 2). Therefore, disaster planning and training for the management of disasters and related problems demand crucial attention and consideration.

The impacts from disaster risks are extremely devastating and significantly affect people, environment and business organisations. Findings revealed that while the impacts of disasters vary considerably across different affected stakeholders, the environment remains the principal benefactor of such disastrous effects. It may be recommended that the government of Saudi Arabia adopt the United Nations International Strategy for Disaster Reduction (UNISDR) methods for dealing with disasters. The effects of disaster depend majorly on the level of exposures and vulnerability of the human subjects to the source of the disaster. As a disaster preparedness measure, a range of policy and strategy tools can be used to reduce disaster risks and vulnerability of local people (Hari & Yuko, 2008). There is need for the adoption of environmental risk assessment and environmental management systems based on the International Standards Organisation (ISO) 14001 standard. This would help policymakers to identify and properly assess significant areas that are more vulnerable to disaster risks. In another context, environmental codes and standards and their proper enforcement and monitoring will go a long way when they are used for disaster preparedness and response purpose (Hari & Yuko, 2008, p. 12). At the organisational level, there is need for a well-maintained inventory of petrochemical hazards and hazardous substances used by oil and gas companies, and their proper labelling will ensure that during a disaster event, the risks that such petrochemical hazards pose to local people living nearby can be mitigated by proper isolation, handling, and segregation (Hari & Yuko, 2008). In conclusion, this research anchored on the concept that disaster preparedness is crucial for effective management of disaster risks such as petrochemical hazards. Findings from the study through literature review and semi-structured interview revealed that proximity of human subjects, exposure to petrochemical hazards, disaster risk education and extent of disaster preparedness play pivotal role in successful management of impending disasters.

Acknowledgement

I would to specially thank my PhD supervisor – Professor Edward P. Borodzicz for his guidance and supervision which has help shape my research interest. This work emerged from an ongoing PhD research at the University of Portsmouth, United Kingdom and thanks to colleagues who have help peer-review the work prior to submission.

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