Natural Hazards in Saudi Arabia

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Abstract

As the name implies Natural Hazards are naturally occurring events that can endanger human lives and property. During the past few decades the losses to life and property from natural hazards have increased many folds mainly due to the increase in human population resulting in the inhabitation of areas prone to hazards.

Saudi Arabia is quite prone to different kinds of natural hazards. The North western region of the kingdom is prone to earthquakes and volcanic hazards whereas the central and western region of the kingdom is exposed to floods especially during events of heavy rainfall. Landslides are a common phenomenon in the inhabited mountainous regions of the south west. Dust storms are quite common in the central and the eastern regions of the Kingdom.

Pollution of natural resources specially groundwater has also been seen in the kingdom in the recent years especially around the wadis and agricultural farms where the extensive use of fertilizers for increasing agricultural yields have resulted in polluting the aquifers.

Different government agencies and various universities having been working on these issues, to mitigate these hazards and also educate the people. The SGS Chair on Natural Hazards established at the King Saud University is one such effort in addressing this subject.

Due to the 2009 Jeddah flood disaster more emphasis is being given to tackle the problems related to hydrological hazards. Similar events like this have the potential to affect other major cities of the Kingdom.

Key words

Natural hazards, Saudi Arabia, Flash floods, SGS Research Chair on Natural Hazards

Introduction

As the name implies Natural Hazards are naturally occurring events that can endanger human lives and property. During the past few decades the losses to life and property from natural hazards have increased many folds mainly due to the increase in human population resulting in the inhabitation of areas prone to hazards.

Most of the natural hazards can be predicted well in time because they occur repeatedly in the same geographical locations as they are related to weather patterns or physical and geological characteristics of the area. However, preventing the damages from natural hazard relies solely on the strength of the early warning systems available in the hazard prone area.

Natural hazards are threats to life and property only if they occur in populated or inhabited areas. Human intervention in the recent times has increased the frequency and severity of natural hazards. Increasing instances of flood disasters, casualties from landslides are examples were human intervention has increased the severity of these natural hazards.

The March 13^{th,} 2011, 8.9 magnitude earthquake followed by the tsunami in Japan, the 2004 Indian Ocean earthquake followed by tsunami in South-East Asia, the 2005 hurricane Karina in the US, the Kashmir Earthquake in 2005 and the 2008 Sichuan earthquake in China are just a few example of the notable natural disasters in the past 10 years. According to the ISDR, disaster statistics approximately 960,000 people were killed during the period 1991-2005 due to natural hazards and the number is ever increasing.

Earthquakes, tsunamis, floods and hurricanes are the most commonly occurring natural hazards which cause wide spread destruction of lives and property on a frequent basis. Human induced natural hazards such as desertification is becoming common in the presents times due to increasing population pressure on existing urban centers and coming up of new settlements there by disturbing the natural eco-system of the environment.

Hazards in arid regions

Though hazards like earthquakes, tsunami, floods and landslides can be common in any type of geographical settings; arid areas are prone to some other hazards as well which are not common in another type of climate. These hazards include desertification, erosion and sedimentation and salinization.

Desertification refers to the land degradation in arid and semi arid regions mainly due human influences and climatic variations. Over grazing, deforestation and poor agricultural practices are one of the most common causes of desertification. The coming up of urban centers in arid regions have added to the population pressure which is also a major reason behind desertification. About 70 percents of the world's dryland are degraded, (http://www.unccd.int/publicinfo/factsheets).

Though erosion and sedimentation can take place in all types of climatic environments but together with salinization they are the major cause of desertification in arid regions. Land uses such as over grazing, urban development, road and rail development and agriculture usage increases the risks of soil erosion. The major effects of erosion include the loss of important nutrients essential for plant growth, decrease in water storage capacities of the stream channels and reservoirs due to sedimentation and downstream damages to the natural eco-system due to sedimentation.

Salinization is another major issue in arid regions. Salinization occurs most commonly on irrigated lands due to poor irrigation practices. Accumulation of salts may take place due to the flooding of low lying areas, evaporation of water from depressions which have no outlets and rise in groundwater levels.

Dust storms or sand storms are other major natural hazards which are common in the arid and semi arid regions. They occur when strong wind blows the dust and sands from dry surfaces. The Sahara desert and the dryland around the Arabian Peninsula are the main source of airborne dust. Though drought and winds are the major cause of dust storms, they are also caused due to poor farming and grazing practices and construction projects.

Arid and semi arid regions are typically prone to flash floods in cases of occasional rainfall events mainly due to the lack of vegetation and poor infiltration capacity of the surface soils which results in the generation of enormous volumes of surface run off. Manmade structures such as dams are also responsible for causing flash floods in downstream areas when the dam gates are opened to maintain the reservoir threshold limit or in instances when there are dam failures.

In recent years flash floods have become an issue of concern in the major urban centers around the world. The reasons are mostly the increasing population pressure which requires more infrastructural development. This has often resulted in the construction of manmade structures in topographically low lying regions which in turn has obstructed the natural rainwater drainage. At the same time the increase in the constructed area has limited the natural land available for infiltration thus resulting in the generation of more surface runoff which at times exceeds the normal water bearing capacity of the urban sewer systems thereby causing floods.

Hazards in Saudi Arabia

Saudi Arabia is quite prone to different kind of natural hazards. The North western region of the kingdom is prone to earthquakes and volcanic hazards whereas the central and western region of the kingdom is exposed to floods especially during event of heavy rainfall. Landslides are a common phenomenon in the inhabited mountainous regions of the south west. Shifting sand dunes and dust storm is a serious natural hazard being faced by the cities mostly in Central and Easter Saudi Arabia. The phenomenon has become more common in the recent years due to the expansion of cities, road and infrastructure development.

Flood Hazards

A statistical analysis of natural hazards in Saudi Arabia between 1982 and 2005 showed that the most frequent hazard type was floods with an average return period of 7 times per years with the average economic losses amounting to about 19 million USD per year, (Al-Saud, 2010). Climate change has affected the global precipitation patterns with arid regions like Saudi Arabia receiving more rainfall than before, (IPCC Report, 2007).

This increase in the intensity of rainfall coupled with the improper urban planning where settlements are allowed to come up without taking into consideration, the natural risks that might occur, (Al-Saud, 2010) increases the severity of these hazrds.

The Jeddah floods which occurred as a result of more than 90 mm of rainfall falling within a span of 4 hours on the 25th of November, 2009 was described as the worst in the past 27 years by the civil defense. More than 100 people were reported dead and about 350 people went missing. The business damages alone were reported to the tune of 1 Billion Saudi Riyal.

A similar heavy rainfall event of more than 110 mm within a short span flooded the city of Jeddah again on the 26th of January 2011. Though there were only a few cases of death, but the loss to property was enormous as most of the cyies low lying areas were inundated.

Earthquake and Volcanic Hazards

North western Saudi Arabia experienced about more than 30000 earthquakes during April-June 2009. These earthquakes took place beneath Harrat Lunayyir (Palister et al, 2010). Peak activity was recorded by the SGS telemetered network of broadband seismometers on 19th May, 2009 where 19 earthquakes of magnitude 4 or greater occurred. The maximum recorded magnitude was 5.4 which caused minor structural damages in the town of Al-Eis about 40 km from the city of Madinah, (Pallister et al, 2010). A northwest trending 8 km long

surface rupture propagated across the northern part of volcanic field as a result of this earthquake.

This earthquake activity becomes more significant by the fact that the origin of the earthquake was in a volcanic field and the key question arising from the situation was as to whether the earthquake was of tectonic origin or was it triggered by the movement of magma below this volcanic field. Historically the area has witnessed volcanic eruption and the last recorded eruption took place about 1400 years ago, (The Geologic Evolution of Saudi Arabia, 2007). However further investigations by scientists favored a magmatic source. This event proves that the region still has some active magmatic activity and should be an alarm bell mainly due to its proximity to the city of Madinah.

Dust Storms

Dust storms are other potential and common natural hazards in Saudi Arabia and affect the daily life for short time intervals, (Maghrabi et al, 2009). The most important issue with dust storms is the reduction of visibility that increases the incidence of traffic accidents and may increase the occurrence of vertigo in aircraft pilots, (Davan et al., 1991; Kutiel and Furman, 2003). Other environmental impacts may include the adverse impacts on human health especially with patients suffering from lung disease, damage to telecommunication and mechanical systems, reduction in soil fertility and damage to crops.

The frequency of sandstorms increases during the months of March, April and May. The dust originates mainly from the arid areas across the Arabian Peninsula and transported by the southwesterly winds towards the east, (Ackerman and Cox, 1989). A dense wall of dust barreled across the Arabian Peninsula on March 26-27, 2011. The massive storm stretched for more than 500 kilometers across the Arabian Peninsula, (http://earthobservatory.nasa.gov).

Chemical Pollution

Chemical pollution has also become a potential hazard in the kingdom. Though the origin of this hazard is anthropogenic, nevertheless it has the potential of affecting a large number of people. The main sources of chemical pollution in the kingdom includes the extensive use of chemical fertilizers and pesticides in the agricultural tracts, leakages from gas stations and pollution associated with the mining activities.

Role of the Saudi Geological Survey Research Chair on Natural Hazards

The main goals of the chair are summarized in the following points:

- To strengthen and carry out innovative research in the field of natural hazards and related domains and active participation in national and international research activities.

- To address the major issues and problems related to prediction of natural hazards, early warning systems, hazard risk assessment and their mitigation.

- To support the training as well as the undergraduate/post-graduate programs in the Faculty of Science and Engineering at King Saud University and to encourage researchers to participate in the developmental, innovative and creative research activities related to natural hazards.

To achieve the above mentioned objectives the Chair would study in details the impacts of these hazards in the Kingdom and devise new and innovative ways of minimizing the impacts of these hazards on humans and their belongings by focusing on the following 3 themes.

- Earthquakes and Volcanoes

- Floods and hazards related to weakening of the earth's crust

- Hazards related to Chemical Pollution

Since its establishment in March 2010, the chair has organized a number of workshops, seminars, guest lectures and open discussions apart from its efforts to carry out applied research in Riyadh area.

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