

Flood as a Disaster in the Middle East Region

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Abstract: This paper deals with flood as a disaster in the Middle East Region. General flood and Cloudburst have their own source of origin. Here specific areas of origin and estimated loss have been identified and ranked amongst the region. Rivers flowing in the region is also being identified. Flood and cloudburst as a disaster has been well explained, distinguished and supported by examples to understand the severity to the society. Mitigation measures and prominent disaster monitoring bodies in the Middle East region is being identified.

Keywords: Flood disaster, Integrated Flood Management, Hazard, Cloudburst, Wadi

1. Introduction

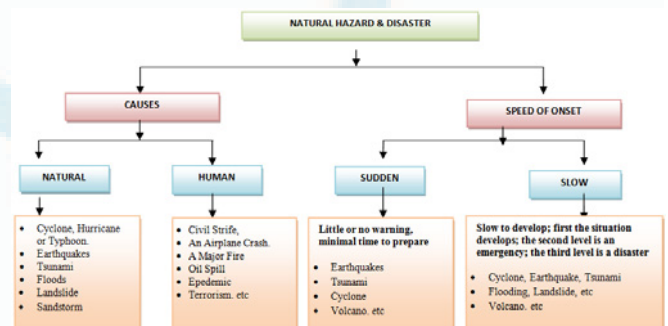
Natural Hazard and Disaster take place when severe and extreme weather and climate events occur naturally in all parts of the world, although some regions are more vulnerable to certain hazards than others. It is imperative to understand the difference between natural hazards and natural disasters. The former become natural disasters when people's lives and livelihoods are destroyed. These cause severe human and material losses eventually which become a major obstacle to sustainable development. Accurate forecasts and warning in a form that is readily understood by common masses is required so that they are prepared against such hazard before they become disasters. By doing so lives and property can be protected.

Each hazard is in some way unique from the other. They occur at different time at different places. Their scale of occurrence also varies from place to place. They can be short lived like Tornadoes and Cloud Burst. These are violent events, affecting a relatively small area. They can be gradual also like droughts which develop slowly, but can affect most of a continent and entire populations for months or even years. Sometimes multiple hazards are involved in extreme weather events for example high winds accompanied by heavy rain in a tropical storm can result in flooding and mudslides. Severe summer weather (thunder and lightning storms or tornadoes) can be accompanied by heavy hail and flash floods in temperate latitudes. Winter's storms with high winds and heavy snow or freezing rain can also contribute to avalanches on some mountains slopes and to high runoff or flooding later on in the melt season. Across the world a lot of National and International Meteorological and Hydrological Services and specialized centers have responsibility for investigating geophysical hazards.

2. Structure

Generally, disasters are of two types – Natural and Manmade. Based on the devastation, these are further classified into major/minor disasters.

- Natural: (Major: Floods, Cyclone, Drought, Earthquake, Landslides and Avalanches. Minor: Cold wave, Thunderstorms, Heat waves, Mud slides etc).
- Manmade: (Major: Nuclear, Chemical, Biological, Epidemic, Deforestation, Wars. Minor: Building collapse, Water contamination or anticipated food shortages., Road / train accidents, riots, Food poisoning, Industrial disaster/ crisis, Environmental pollution etc).



3. Implications of Disasters

Infrastructure damage, Telecommunication loss, Flooding, Landslides, Power disruption, Water problems, Agricultural damage, Loss/damage to housing, Damage to inland and coastal environments, Disruption of standard of living, lifestyle, etc are few prominent implications usually happened by disaster within a region.

3.1 Floods

A flood is a situation when there is an overflow of an expanse of water that submerges land. Floods can occur anywhere after heavy rain events. All floodplains are vulnerable and causative event like rains, ice jam, dam breaks heavy storms can cause flooding in any part of the world.

Flash floods can also occur after a period of drought when heavy rain falls onto very dry, hard ground that the water cannot penetrate. Floods come in all sorts of forms, from small flash floods to sheets of water covering huge areas

of land. They can be triggered by severe thunderstorms, tornadoes, tropical and extra-tropical cyclones (many of which can be exacerbated by the El Niño phenomenon), monsoons, ice jams or melting snow.

In coastal areas, storm surge caused by tropical cyclones, tsunamis, or rivers swollen by exceptionally high tides can cause flooding. Dikes can flood when the rivers feeding them carry large amounts of snowmelt. Dam breaks or sudden regulatory operations can also cause catastrophic flooding. Floods threaten human life and property worldwide.

Flash Floods (Cloud Burst)

A Flash Flood is an event that occurs within 6 hours following the end of the causative event (such as rains, ice jams, or dam breaks) which result in fatalities, injuries, and/or significant damage to property.

Examples of Flash Floods include damage to buildings, roads, gravel shoulders, bridges, railways or other landscape features including soil erosion.

Generally, flash flooding events develop rapidly and can occur anywhere water collects, especially areas of steep terrain, and water runoffs. Flash Floods rarely last more than 12 hours. The sudden nature of the flood makes it extremely dangerous

Floods

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Generally, flooding events usually take longer to develop and they usually occur along or near larger rivers. The duration of flooding events may extend longer than 24 hours, perhaps several days.

While the size of a lake or other body of water will vary with seasonal changes in precipitation and snow melt, it is not a significant flood unless such escapes of water endanger land areas used by man like a village, city or other inhabited area. Floods can also occur in rivers, when flow exceeds the capacity of the river channel, particularly at bends or meanders. Floods often cause damage to homes and businesses if they are placed in natural flood plains of rivers.

3.2 Flood as Disaster in the Middle East Region

Middle East refers to a region around the Persian and the Arabian gulfs. The region forms a single roughly quadrilateral land mass of about 3,542(km) from west to

east and 3,200 (km) from north to south. The region falls almost entirely between 25 degree east to 60 degree east longitude and 13 degree north to 42 degree north latitude .The countries which form the part of Middle East are- Morocco , Algeria, Libya, Egypt, Lebanon, Jordan, Turkey, Syria, Saudi Arabia, Israel, Palestine, Yemen, Iran, Iraq, Kuwait, Cyprus, Tunisia, U.A.E, Oman ,Bahrain and Qatar. Many situations like the movement of people and livestock to other host areas with limited resources, the development of unsafe informal settlements in urban centres, limited availability and access to transport, health, education and other basic public services in hazard prone areas. Become reasons of hazard turning in to a disaster. On-going environmental degradation, rapid unplanned urbanization, acute water scarcity, a changing demography and migration trends on achieving sustainable development goals for the region these are some of the problems faced by the Arab nations and the ultimate impact of these is that the region has become a much vulnerable region. Although this region has very few large rivers system but the unpredictable rainfall and in absence of excess water controlling measures in the rivers has resulted it into a disaster causing loss to life and property in the region. In most of the countries there are few regions which are prone to regular floods; an attempt has been done to analyze the major flood prone region in the Middle Eastern countries. Turkey, Algeria, Iraq, Tunisia, Saudi Arabia, Lebanon, Morocco, Yemen, Egypt and Syria are countries in the Middle East region where we can find severe loss of life and property by Flood as a disaster (Table 1 &2).

Table 1: Region in the Middle East majorly effected by Flood as a Disaster

Countries	Important Areas
Turkey	Erzurum, Batman, Bitlis, Cinar, Bismil (Sanliurfa Province), Rize, Icel, Konya, Tokat provinces, Antalya, Thracian and Aegean Region, Filyos basin, Bartın basin etc
Iraq	Erbil, Salaheddine, Kirku, Choman, Pashdar district etc
Lebanon	Akkar, Bekaa region
Saudi Arabia	Macque, Jizane, Jeddah region etc
Syria	Hassake Governorate
Yemen	Ramya, Dhamar, Hodeida, Manakhah, Hijja, Taaz, Ibb Provinces, Sanaa, raima, Salafiyah regions etc.
Algeria	Tindouf region, Adrar, Laghouat, Oran, Djanet, Bologhine, Ghardaia, Tsabit, Biskara, El-bayadh, Tebessa, Tizi, Alisi, Adrar etc
Morocco	Ksiba, Taza, Quarzazate, Settat, Essaouira, Marrakesh, kalaat, Tetouan, Er-Rachidia and Safi Provinces, Northern and Central regions etc
Tunisia	Jendouba, Beja, Manouba, Hfor El Tine, Tunis, Bizerte, etc
Egypt	Sinai, Haute, Ain, Ayatt and Hourgada region etc

Table 2: Rank wise Severity by Flood in the Middle East Region (2000-2010)

Country	Total Killed	Tot. Affected	Rank (on basis of Total effected)
Turkey	159	122832	1
Algeria	197	96386	2
Iraq	4	42490	3
Tunisia	12	28500	4
Saudi	197	23480	5
Lebanon		17000	6
Morocco	81	7056	7
Yemen	182	4737	8
Egypt	45	4370	9
Syria	6	NA	10

Source: Em-dat database

Nile is the longest river in the region with a length of 6650 km. It flows to many countries of Africa Ethiopia, Eritrea, Sudan, Uganda, Tanzania, Kenya, Rwanda, Burundi, Egypt, Democratic Republic of the Congo, South Sudan. It has many tributaries in Africa, a source of prosperity and livelihood in the region. It has such significance in Egypt as people commonly accept that “Egypt is the gift of river Nile”. It outflows in the Mediterranean Sea. Euphrates is another important river with a length of 3596 km and outflows in the Persian Gulf. It flow majorly in Iraq (60.5%), followed by Turkey (24.8%) and Syria (14.7%). Tigris is a river which flow in Turkey, Iraq and Syria. It has a length of 1950 km and outflows in Shatt al – Arab. Kizil is very important river of Turkey with a length of 1182 km and outflows in Black Sea. Helmand is an important river flow in Iran and Afghanistan with a length of 1130 km and outflows in Hamun-i-Helmand region. However, table 3 clearly highlights the major rivers and Wadis (Mainly dry water course through which water flows after heavy rainfall) flowing in the Middle Eastern countries.

Table 3: Major Rivers and Wadis of Middle East

Algeria	Chelif, Djedi , Draa, Medjerda, Ouedguir, Oued Saoura, Oued Zouzfana, Seybouse river
Cyprus	Chrysochou, Pedieos, Stavrostis
Egypt	Nile and its tributaries
Iran	Abhar River, Alamut River, Alwand River, , Aras River, Atrek River, Bahu Kalat River, Bakhtiari River, Gadar River, Chalus River, Dez River, Diyala River, Do Hezar River, Halil River, Haraz River, Helmand River, Jajrood River, Jarahi River, Karaj River, Karkheh River, Kech River, Kojoor River, Lar River, Marun River, Mehran River, Noor River, Sardab River, Se Hazar River, Sefid-Rūd, Seimare River, Shahrood (River), Shatt al-Arab, Sumbar River, Zangmar River
Iraq	Iwand River, Diyala River, Euphrates, Khabur (Tigris), Great Zab, Khasa River, Khawr Abd Allah
Israel	Ayalon River, Belus River, Dan River, Ga'aton River, Hasbani River, Jordan River, Kishon River, Lakhish River
Jordan	Jordan River, Yarmouk River, Zarqa River

Kuwait	No River (Kuwait does not have any permanent rivers, but does have many wadis, the most notable of which is Wadi al Batin which forms the border between Kuwait and Iraq. Also listed are the river-like marine channels around Bubiyan Island)
Lebanon	Abraham River, Awali (river), Beirut River, Hasbani River
Libya	No Major river but many wadis like • Cinyps, Libya, Wadi Kham etc
Morocco	Baht River, Dadès River, Draa River, Imini River, Inaouen River, Loukkos River, Massa River, Moulouya River,Noun River, Ouergha River, Oum Er-Rbia River
Oman	No Major river but many wadis like Wadi Al Hijar, Wadi Bani Khalid, Wadi Dhaiqah etc
Saudi Arabia	Saudi Arabia does not have any permanent rivers, but does have numerous wadis, which is an either permanently or intermittently dry riverbed like Wadi as Surr, Wadi al-Hamd, Wadi al-Jizl, Wadi al-Aqiq, Wadi Rabigh, Wadi Fāṭimah, Wadi Saba, Wadi Fajr, Wadi Al-Rummah, Wadi Hanifa, Wadi Bishah, Wadi Tathlith etc
Syria	Afrin River, Balikh River, Banias River, Dhahab River, Euphrates, Jaghjahg River, Queiq River, Orontes River, Sajur River, Khabur River, Jordan River, Tigris etc
Tunisia	Medjerda River
Turkey	Çoruh River , Euphrates , Tigris River and their important tributaries, Afrin River, Akhurian River, Aksu River,Ankara Rive, Astarpa Rive, Bartın River, Botan River, Cadmus (river), Çekerek River, Ceyhan River, Çoruh River, Deli Çay River, Delice River, Dim River, Filyos River, Gediz River, Gök River, Harşit River, Jaghjahg River, Kelkit River, Khabur River, Kura River, Lycus, Manavgat River
Oman	Oman does not have any permanent rivers, but does have wadis
UAE	The United Arab Emirates does not have any permanent rivers, but does have wadis like, Dubai Creek, Wadi al Batha, Wadi Shi in Sharjah, Wadi Wurayah in Fujairah, Wadi Siji in Fujairah and Ras al-Khaimah, Wadi Ham in Fujairah, Wadi Hatta in Dubai, Wadi al Ain in Abu Dhabi
Yemen	There is absent of Major river in Yemen but have many wadis like , Aaragah, Wadi Ahwar, Wadi Ar Ruqub, Wadi Bana

Few examples of Major Floods occurred in the Middle Easter regions are as follows:

3.3 Flood in Turkey: May 2004

Affected Area: Clayton County and in the Maquoketa River Basin in Delaware

Severe flooding occurred on May 23, 2004, in the Turkey River Basin in Clayton County and in the Maquoketa River Basin in Delaware County following intense thunderstorms over northeast Iowa. Rain gages at Postville and Waucoma, Iowa, recorded 72-hour rainfall of 6.32 and 6.55 inches, respectively, on May 23. The peak discharge on May 23 at the Turkey River at Garber stream flow-

gaging station was 66,700 cubic feet per second and is the largest flood on record in the Turkey River Basin.

Three large floods have occurred at the Turkey River at Garber gaging station in a 13-year period. Peak discharges of the floods of June 1991 and May 1999 were 49,900 cubic feet per second and 53,900 cubic feet per second respectively. The peak discharge on May 23 at the Maquoketa River at Manchester gaging station was 26,000 cubic feet per second and is the largest known flood in the upper part of the Maquoketa River Basin.

Thunderstorms caused severe flooding along the lower Turkey and upper Maquoketa Rivers in northeast Iowa in May 2004. New maximum peak discharge records were set during May 22–23, 2004, at 10 U.S. Geological Survey (USGS) stream flow-gaging stations (gaging stations) that included the mainstems of the Turkey River in Clayton County, the Maquoketa River in Delaware County, and Bloody Run Creek in Clayton.

3.4 Flood in Iraq: February 2006

Loss: 3,300 families have been forced to leave their homes
Effected Area: Erbil, Sallahaddin, Kirkuk, Dyiala and Missan

Heavy rains in northern Iraq in early February 2006 caused rivers to overflow; leading to extensive flooding. The flooding was compounded by the natural melting of the ice in the mountainous north of the country. The most affected governorates include Erbil, Sallahaddin, Kirkuk, Dyiala and Missan. More than 7,000 families were forced to leave their houses. The Iraqi Ministry of Environment has attributed much of the flooding to excessive rains in mountainous areas, which has led to rising water levels in the Tigris River.

The worst affected regions are in the northern governorate of Erbil, where nearly 3,300 families have been forced to leave their homes and seek shelter. In Salahuddine (north of Baghdad), an estimated 2,900 families have been displaced, with further displacements in Kirkuk, DIALA and Missan in southern Iraq. In the southern governorate of Missan, continuous rainfall has resulted in overflows of sewage onto streets, leading to cases of diarrhoea and vomiting among children in these areas, according to a volunteer doctor in Salahddine governorate. The table below reflects the number of severely affected families and their location:

3.5 Flood in Nile

The river Nile flooded every year between June and September, in a season the Egyptian called Akhet – the inundation. The three stages of the Egyptian flood cycle were Akhet, the time of the Nile flood, Peret, the sowing time, and Shemu, the time of harvest. Without this cycle people would die from starvation. The flood cycle was so predictable that the Egyptians even based their ancient

calendar on it. Akhet was the first season of the year, between the months of June and September. Peret or the Egyptian Autumn season marked the time when their crops grew in the fields and were harvested, running from October to mid-February. Shemu was the third and last season of the Egyptian year which ran from mid-February until the end of May; it essentially signaled the spring season of the Egyptian calendar.

Once a year, between July and October, the rains came and overflow the river banks causing the yearly flood of the Nile. Most ancient settlement was located on high ground and most farming occurred down by the Nile. In this way the floods would help them grow crops while not flooding their homes.

3.6 Tajrish Flood (1987)

- July 26th 1987
- About 400 Human Losses
- More than 75 million US \$ Damage
- Effective factor : River channel encroachment

3.7 Masouleh Flood (1998)

- July 30th, 1998
- More than 50 Human losses.
- More than 1 million US \$ Damage
- Effective factor : River channel encroachment

3.8 Qum Flood (2009)

- March 31th 2009
- About 4 Human Losses
- More than 30 million US \$ Damage
- Effective factor : River channel encroachment using river bed

3.9 Golestan Flood-2001

- Aug 10th 2001
- About 200 Human Losses
- More than 60 million US \$ Damage

4. Cloud Burst

A cloudburst is an extreme amount of precipitation, sometimes with hail and thunder, which normally lasts no longer than a few minutes but is capable of creating flood conditions. Usually the rain fall rate here is equal to or greater than 100 mm (3.94 inches) per hour. During a cloudburst, more than 2 cm of rain may fall in a few minutes. Cumulonimbus clouds, where rapid precipitation is possible in which large droplets can grow rapidly by coagulating with smaller droplets which fall down on the surface slowly due to so called Langmuir precipitation process. This is one of the major sources of flood in the Middle Eastern region and at many places it is referred as Flash Flood because it happened in a very short span of

time with a major catastrophe in the region. Table 4 clearly highlights the major areas of occurrence of this flash flood as a disaster in the Middle Eastern countries.

Table 4: Region in the Middle East majorly effected by Flash Flood (Cloudburst) as a Disaster

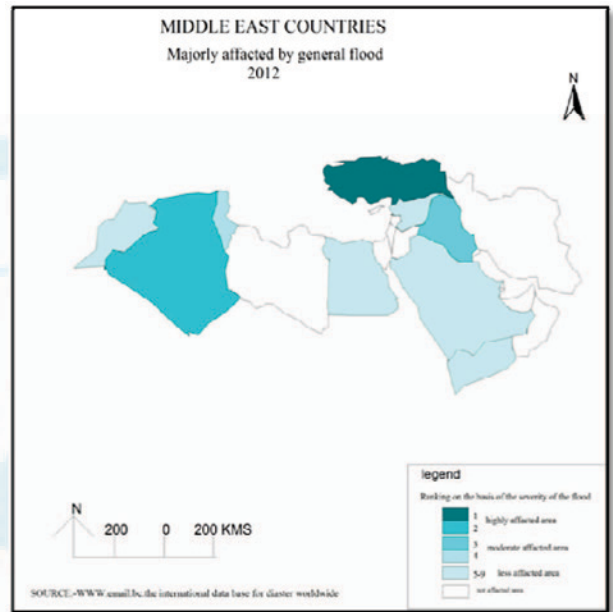
Countries	Important Areas
Morocco	Bouznika, sale, Quazzane, Driouch, Rabat, Agadir, Boufrah Province, Settat, Fez and Eastern Taza regions
Algeria	Ghardaia region, Algiers, Tipaza, Tizi-ouz, M'sila region, Regions of Naama and Tlem etc
Turkey	Silivri, Catalca district, Caykara area, Istanbul, Duzce, sakarya, Alibeykoy and Esenser district
Iraq	Khalifan district, Glikand, Setaqan, Taryawa, Mergassur, Choman, Sumeil, Nasiriyah etc
Yemen	Tarim, Sah, Shibam, Qatun, Hadhramout, Ibb, Omrane, Saada and Dhamar Provinces, etc
Tunisia	Tunis, Ariana, Manouba, Gabes, Gafsa, Monastir, etc
Saudi Arabia	Medina, Assir, Djeddah regions
West Bank (palestine)	Gaza trip

Table 5: Ranking on basis of Severity by Cloudburst (2000-2010)

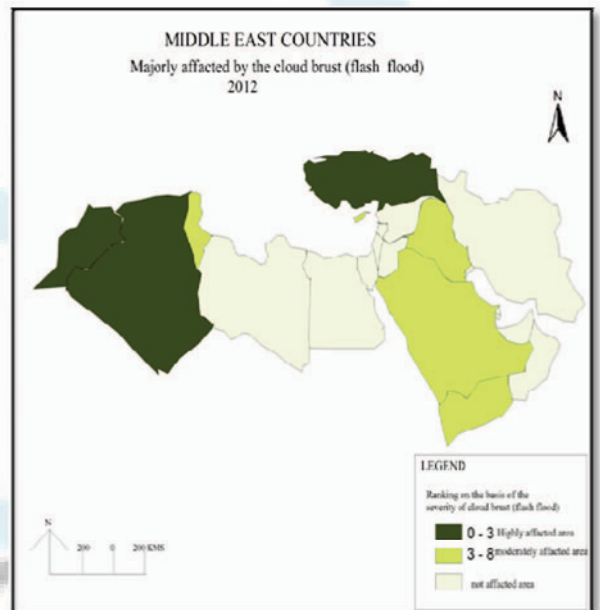
Country/Region	Killed	Total Affected	Rank on basis of total effected
Morocco	182	127840	1
Algeria	1125	104678	2
Turkey	49	38120	
Iraq	28	31021	4
Yemen	176	27688	5
Tunisia	33	5008	6
Saudi Arabia	63	67	7

Source: Em-dat database ([www. http://www.emdat.be/database](http://www.emdat.be/database))

Here we see that Morocco, Algeria, Turkey, Iraq, Yemen and Tunisia are the major countries which are vulnerable to this disaster. There is a major loss of life and on the basis of total affected, Morocco is the worst affected by this Flash flood in the Middle eastern countries followed by Algeria, Turkey, Iraq, Yemen, Tunisia, Saudi Arabia and others . (Table 5)



Map 1: Countries affected by General Flood in Middle East



Map 2: Countries affected by Cloud burst in Middle East

Examples of Major Cloudburst occurred in the Middle East regions are as follows:

4.1 Cloud Burst in Algeria: 9 -10 November 2001

Magnitude: More than 100 mm rainfall and strong winds of up to 200 km/hr

Death: 921

Effected Area: Bab el Oued, Bouzarea, Frais Vallon Beau Fraisier, Hammamet (Severely Effected) Chlef, Tipasa, Relizane, Tiaret, Tlemcen, Mascara, Ain-Temouchent, Oran, Mostaganem, Tizi-Ouzou (Moderately affected areas) in western Algiers, capital of the country

On 10 November 2001 severe rains hit the northern part of Algeria and caused floods and mudslides in ten wilayas: Bab el Oued, Bouzarea, Fraï Vallon Beau Fraïsier, Hammamet were severely effected where more than 680 death, have been recorded, others area like Chlef, Tipasa, Relizane, Tiaret, Tlemcen, Mascara, Ain-Temouchent, Oran, Mostaganem, Tizi-Ouzou in Algeria was also effected where the death toll was less than 50 in western Algiers, capital of the country,

The heavy rains led to massive flooding killing 921 people in Algeria and leaving 23,000 homeless. This amounted to the worst flooding and second worst natural disaster to hit Algeria since independence in 1962. The unusual weather continued for nearly 48 hours and was associated with strong winds along the Mediterranean coast Damage resulted from the heavy rains and the intensity of the wind but also from flashfloods and mudslides. The situation was further aggravated because of the hilly contour of the affected areas. This was the Algeria worst recorded flash flood. The flashflood did most damage in Algeria densely populated working class district of Bab el Oued.

4.2 Cloudburst in Yemen: 24th October 2008

Magnitude: 91 mm rainfall over 30 hour period

Death: 90

Affected Area: Hadhramaut, Lahij, Al Mahrah and Ta'izz (Eastern Governorates of Yemen)

On October 24, 2008, The tropical storm led to severe rain and flooding over the eastern Governorates of Yemen, Hadramout and Al-Mahara for about 30 hours, resulting in total rainfall of almost 91 mm (versus 5-6 mm in normal periods).

Given the topography of the affected area (mountainous terrain, flat valleys and riverbeds), this large quantity of water in the catchment area led to severe flash floods in the valleys, with water surges exceeding 10 meters in some areas. This area had experienced major floods in 1989 and 1996 but this flood is considered the most devastating and led to one of the worst natural disasters to hit Yemen in more than a decade.

Wadi Hadramout was the worst hit region, sustaining 67.5% of the total damage and loss, with 16 of its 19 districts reporting damages. Hadramout's coastal areas (Sahel) sustained 28.6% of the total damage and loss, while Al-Mahara sustained 3.9% of the total. Infrastructure was particularly badly hit, with major roads, communications, power, and water supply networks all sustaining major destruction and damage. Around 93 persons were reported to have lost their lives as a result of the floods, Some 25,000 people were displaced. Overall, about 700,000 persons—over 50% of the total population in the affected areas—have had their livelihoods destroyed or significantly affected, of which two-thirds live in Wadi Hadramout.

4.3 Cloudburst in Saudi Arabia: 25th November 2009

Magnitude: More than 90 mm rainfall

Death: 161

Affected Area: In the port city of Jeddah, Rabigh and Mecca

On 25th November, 2009 Saudi Arabian was affected by major flash affecting Jeddah, on the Red Sea (western) coast of Saudi Arabia, and other areas of Makkah Province. Some 161 people are reported to have been killed, and more than 350 were missing. More than 90 millimetres (3½ inches) of rain fell in Jeddah in just four hours on Wednesday 25 November This is nearly twice the average for an entire year and the heaviest rainfall in Saudi Arabia in a decade. The flooding came just two days before the expected date of the Eid al-Adha festival and during the annual Hajj pilgrimage to nearby Mecca. Business losses were estimated at a billion riyals (US\$270 million).

The average amount of rain during the winter month (November to January) is about 51 mm, However on 25th November 2009 more than 90 mm of rain within a just four hour had worsen the situation in Saudi Arabia where the climate is mostly arid and as it rains so rarely in Saudi Arabia, Saudi cities lack infrastructure to deal with heavy rain (Mainly rain sewers and drainage canal to deal with a torrent and road and structure which are not built to deal with the occasional flood)

The 2010 Environment Outlook Report for the Arab Region points out that most of disaster losses in the Arab region were caused by drought, earthquakes, floods and storms. The report also states that more than 37 million Arab people were affected and more than 20 billion dollars were lost between 1980 and 2008 due to natural disasters. Rapid urbanization, environmental degradation, water scarcity, changing demography and migration trends are further amplifying levels of vulnerability among the Arab population. Secondary risks associated with population displacement, disease outbreak, pandemic influenza, conflict and civil unrest pose multi-fold challenges to the region, on a larger scale than ever before.

Flood control measures:

- **Structural measures:** include reservoirs, embankments, channel improvements etc.
- **Non-structural measures include:** flood plain zoning, watershed management, flood forecasting and flood warning

In many cases, floods caused deaths, suffering and extensive damages to both public and private properties. Unplanned urbanization on both banks of rivers and upper reaches of the basins has a major role in the rising cost of floods, besides the meteorological and hydrological magnitudes of the occurrences. New approach to tackle with the reduction and control the susceptibility to the flood damages, namely the "Integrated Flood

Management" concept. It is nowadays well known that, owing to the complex nature of the Hazard Mitigation, specific measures for the flood hazards cannot be implemented or evaluated independently

However for Prevention of flood risks a thorough risk analysis provides the base for an integrated approach to flood risk management, including pre-flood prevention, risk mitigation and flood preparedness. Prevention of flood risks focuses on the design of flood management schemes taking into account economic development and climate change. These measures include application of safety standards, raising and reinforcing of embankments, coastal protection works, and storm surge barriers as well as making room for rivers. Mitigation of risks requires another type of measure, taking into account spatial planning: development of new urban areas, flood proofing and compartmentalization and dedicated protection of vital infrastructure.

5. Monitoring Bodies for Disaster in the Middle East Region

There are various bodies in each of the Middle Eastern countries to Monitor Disaster and have their own specific mitigation programme in the region. However few prominent amongst them are as follows:

- Arab Academy for Science, Technology and Maritime Transport (AASTMT)
- The Arab Centre for the Study of Arid Zones and Dry Lands (ACSAD)
- The Arab Organization for Agricultural Development (AOAD)
- The Arab Labor Organization (ALO)
- The Arab League's Educational, Cultural and Scientific Organization (ALECSO) etc.

These have consistently incorporated disaster risk reduction measures into their projects and technical assistance programmes covering various Arab countries. In addition, a Regional Centre for Disaster Risk Reduction Training and Research (RCDRR) was established in Cairo to strengthen capacities of Arab countries in reducing disaster risk in the region.

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