

Cyclone Chapala Disaster Risk Reduction Situation Report

DRR sitrep 2015-004 – 04 Nov 2015, 03:00 UTC

Summary report

Ongoing Cyclone situation

Cyclone Chapala made an extremely rare landfall along the Gulf of Aden coast of Yemen on 3 November 2015, triggering massive rainfall flooding in a desert location unaccustomed to tropical cyclone landfalls¹. The India Meteorological Department (IMD)² promptly downgraded Chapala to a tropical storm in the hours immediately after landfall. According to IMD, the centre of Chapala made landfall about 71 kilometers southwest of Al Mukalla, Yemen, as of 7 a.m. 3 November Yemen time. At that time, the cyclone's maximum sustained winds were of 120-130 kph. Earlier, on 30 October, Chapala had rapidly intensified to a high-end Category 4 and remained in that category throughout most of Saturday. This made Chapala the strongest tropical system on record so far south in the North Indian Ocean³. Chapala had the potential to dump at least 3 to 4 times the average yearly rain⁴ in just a day or two over parts of central and eastern Yemen. Average rainfall along the southern Yemeni coast is 50 millimeters or less. In Chapala's path on the Yemeni island of Socotra, it killed at least three people while another 100 injured as a result of the floods and strong winds. Based on current projections the estimated 1.1 million people may be affected by Cyclone Chapala, mainly in the two governorates of Shabwah and Hadramaut. Initial reports from OCHA⁵ suggest more than 40,000 people are displaced or temporarily evacuated from coastal areas and at least 450 homes damaged or destroyed.

Disaster management in Yemen is complicated by the armed conflict which has spread rapidly across much of Yemen since mid-March 2015, with devastating consequences for civilians. UNOCHA's partners now estimate that 21.1 million people – 80 per cent of the population – require some form of humanitarian or protection assistance. This represents a 33 per cent increase in needs since the conflict escalated in March 2015.

What are the most devastating cyclones to hit Yemen in recent memory?

Tropical cyclones form in this part of the Indian Ocean, on average once or twice per year. However, only a few have hit the Arabian Peninsula since reliable records started in 1979, according to NASA Earth Observatory⁶. The last cyclonic storm to strike the coastlines of Oman and Yemen was Keila in 2011, which resulted in widespread floods and 14 fatalities. Previously, in 2008 a rare tropical cyclone brought devastating flooding to Yemen and killed at least 100 people. 20,000 others were displaced in the south of the country and over 50% of the total population in the affected areas had their livelihoods destroyed or significantly affected, mainly in Wadi Hadramout. In 2007, cyclone Gonu inflicted more than 50 deaths in Oman.

What are the underlying drivers of disaster risk in Yemen?

Yemen is a disaster prone country that faces a number of natural hazards every year, the most important being flash floods, earthquake, and land or rockslides. Over the last two decades, Yemen has become increasingly vulnerable to natural hazard related disasters due to high population growth, poorly controlled

¹ <http://www.weather.com/storms/hurricane/news/cyclone-chapala-yemen-oman-arabian-peninsula>

² <http://www.rsmcnewdelhi.imd.gov.in/index.php?lang=en>

³ <http://www.weather.com/storms/hurricane/news/cyclone-chapala-yemen-oman-arabian-peninsula>

⁴ http://www.lib.utexas.edu/maps/middle_east_and_asia/yemen_rainfall_2002.jpg

⁵ <http://reliefweb.int/report/yemen/yemen-cyclone-chapala-flash-update-1-3-november-2015>

⁶ <http://visibleearth.nasa.gov/view.php?id=86915>

urbanization, unplanned and unregulated urban development, and lack of environmental controls. Increased concentration of physical assets and vulnerable population in high-risk areas are leading to increased exposure to adverse natural events.⁷

Yemen has been affected by violent conflict in recent years and a major part of the region affected by Cyclone Chapala is already in the midst of a humanitarian crisis. The governorate of Hadramaut was already at "crisis" level, with 106,900 displaced people. Most of the areas to the west of Hadramaut are classified as in "emergency" status, with widespread food shortages and more than two million people displaced from their homes.

1. Cyclone Chapala

Ongoing situation

According to the Regional Specialized Meteorological Centre (RSMC) for Tropical Cyclones over North Indian Ocean⁸, Cyclone Chapala, currently a depression over Yemen further weakened into a well-marked low pressure area and lay over the same region at 0300 UTC on 4 November.

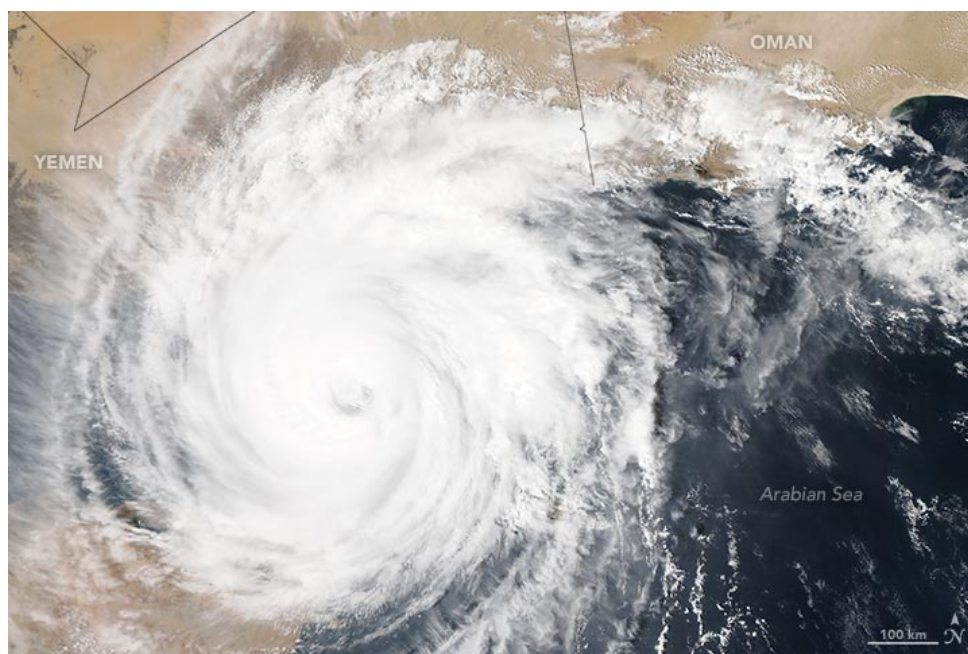


Figure 1: Cyclone Chapala over the Gulf of Aden on 3 November 2015 when storm's maximum sustained winds were 195 kilometers per hour—the equivalent of a category 3 hurricane. **Source:** NASA Earth Observatory⁹

Cyclone Track

According to the RSMC¹⁰, the extremely severe cyclonic storm, 'Chapala' over the west-central Indian Ocean moved westwards and weakened into a very severe cyclonic storm over Gulf of Aden and the adjoining west-central Indian Ocean on the evening of the 2 November 2015. It then moved west-north-westwards and crossed Yemen coast to the southwest of Riyan on 3 November as a very severe cyclonic storm with a maximum sustained wind speed of 120-130 kph. It then continued to move west-north-westwards, weakened into a Severe Cyclonic Storm and lay centred at 0830 IST (03:00 UTC) of the 3

⁷ https://www.qfdr.org/sites/default/files/GFDRR_Yemen_DLNA_2009_EN.pdf

⁸ <http://www.rsmcnewdelhi.imd.gov.in/index.php?lang=en>

⁹ <http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=86915&src=nha>

¹⁰ <http://www.rsmcnewdelhi.imd.gov.in/images/Press-Release.pdf>

November 2015 over Yemen about 100 km southwest of Riyan (Yemen). It then moved west-north-westwards and weakened further rapidly into a Cyclonic Storm and subsequently into a Depression.

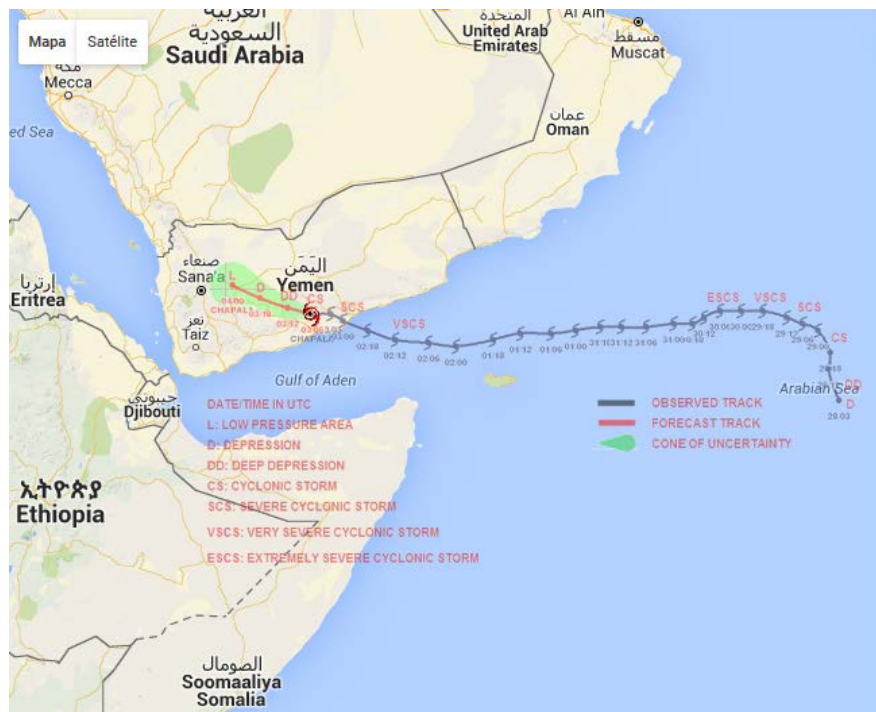


Figure 2: Cyclone Chapala's path. *Source:* RSMC/WMO

Cyclone Chapala was able to maintain its intensity on Sunday, 1 November due to record-warm sea-surface temperatures and light wind shear. There was also a large, solid central core of showers and thunderstorms (convection), which created a barrier around Chapala so it was not influenced by extremely dry air from the Arabian Peninsula¹¹.

The cyclone decreased in intensity as it hit land due to the consuming of dry arid air (these are not optimal conditions for cyclones), however Chapala still reached landfall as a Category 1 cyclone which is extremely rare for Yemen³.

What are the potential damages of Cyclone Chapala?

On the 1 November 2015, the eye of Chapala passed north of the Yemeni island of Socotra. Here there were reports of heavy rain, floods and wind damage. It is possible that the island has not experienced a cyclone of hurricane-equivalent intensity since 1922¹². At least three people were reported killed and 100 injured¹³.

By 4 November, the most serious impacts were associated with the heavy rainfall. The region is climatically very arid and according to WMO¹⁴, there is a fear that the storm will trigger significant flooding and related severe impacts such as mudslides, and infrastructural damages. This rainfall has represented an extremely unusual event for the area and it is highly unlikely that the natural water courses and drainage systems are able to cope with this amount of rain.

¹¹ <http://www.wunderground.com/blog/JeffMasters/chapala-closing-in-on-yemen-record-november-warmth-in-florida-europe>

¹² <http://www.weather.com/storms/hurricane/news/cyclone-chapala-yemen-oman-arabian-peninsula>

¹³ <http://www.aljazeera.com/news/2015/11/deadly-cyclone-chapala-wreaking-havoc-yemeni-waters-151101195831014.html>

¹⁴ <https://www.wmo.int/media/content/cyclone-chapala-intensifies-arabian-sea>

Despite Chapala's weakening prior to landfall, torrential rain triggered major flooding in parts of Yemen late Monday into Tuesday. Chapala had the potential to dump at least 3 to 4 times the average yearly rain in just a day or two over parts of central and eastern Yemen¹⁵. Floods and tidal surges inflicted heavy damage on Al Mukalla, (pop. 300,000) the main sea port and the capital city of the Hadhramaut coastal region in Yemen in the southern part of Arabia on the Gulf of Aden close to the Arabian Sea. Images from the city and surrounding Hadramout province showed streets and vehicles submerged by torrents of muddy brown flood water. "The damage is enormous and we fear human losses," Minister of Fisheries, Fahd Kafain, told Agence France-Presse. UNOCHA is also reporting floods in At

Past cyclones have severely affected Hadramout province such as the 2008 cyclone which had a huge impact on the productive sector, especially agriculture counting almost 70% of the total losses in the 2008 cyclone.¹⁶

2. Historical Disasters

Located at the southwestern edge of the Arabian Peninsula and bordered by the Arabian Sea and the Gulf of Aden to the south, and Red Sea to the west, the Republic of Yemen has large areas of flat coastal plains and dry highlands. Its unique topography and largely arid weather makes Yemen highly susceptible to desertification and floods.

2.1 Cyclones in Yemen

Tropical cyclones form in this part of the Indian Ocean on average once or twice per year. However, only two have hit the Peninsula since reliable records started in 1979¹⁷. The most important, was the 2008 event which severely affected Hadramout region, one of the most-at-risk provinces again in the 2015 Cyclone Chapala.

According to the Damage, losses and needs assessment¹⁸ of the October 2008 tropical storm and floods, severe rains and flooding affected 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). The total catchment area of about 2 million hectare collected some 2 billion cubic meter of water. 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. The total value of the disaster effects caused by the October 2008 storm and floods in Yemen is estimated at US\$1,638 million. This is equivalent to 6% of Yemen's Gross Domestic Product (GDP).

From this event, 73 persons were reported to have lost their lives as a result of the floods and 17 people were missing. The flooding and heavy rain also caused 2,826 houses and huts in both Governorates to be destroyed and 3,679 houses to be partially damaged. Some 25,000 people were displaced as a result, seeking temporary shelter in mosques and schools or with host families. The impact on agricultural land and people's livelihoods has been particularly devastating. A total of 22,902 Feddans (acres) of cultivated agricultural land and 51,455 Feddans of uncultivated land were damaged in both Governorates due to soil erosion. Public and private irrigation infrastructure also sustained significant damage. Some 58,500 livestock heads (sheep, goats, camels and cattle) died

¹⁵ <http://www.weather.com/storms/hurricane/news/cyclone-chapala-yemen-oman-arabian-peninsula>

¹⁶ https://www.gfdr.org/sites/default/files/GFDRR_Yemen_DLNA_2009_EN.pdf

¹⁷ <http://visibleearth.nasa.gov/view.php?id=86915>

¹⁸ https://www.gfdr.org/sites/default/files/GFDRR_Yemen_DLNA_2009_EN.pdf

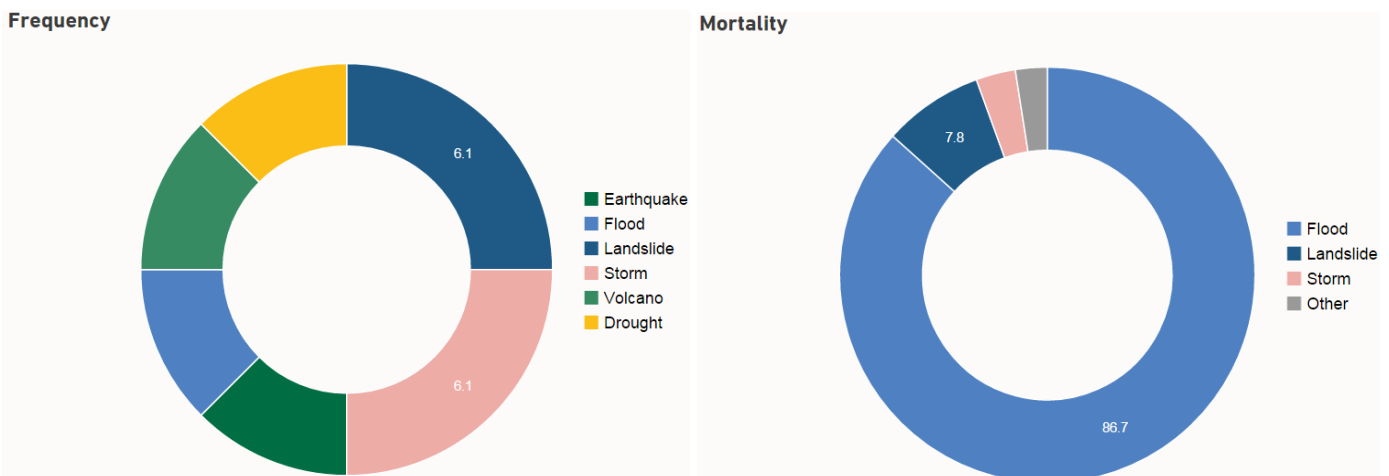
due to the water surge. Overall, about 700,000 persons—over 50% of the total population in the affected areas—had their livelihoods destroyed or significantly affected, of which two-thirds live in Wadi Hadramout.

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.

2.2 Other disasters in Yemen

2.2.1 Internationally Reported Losses 1990 – 2014

The data below is sourced from the Centre for Research on the Epidemiology of Disasters (CRED) database. It keeps data of disaster impacts from 1900 to the present, and gets its data from UN agencies, US Government agencies, official governmental sources, International Federation of Red Cross and Red Crescent Societies (IFRC), research centres, Lloyd’s, Reinsurance sources, the press, and private sources¹⁹. According to it, the more frequent reported disasters in Yemen are storms, landslides and earthquakes. However, floods have been the deadliest disasters in the country followed by landslides.



Source: EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be - Université catholique de Louvain - Brussels - Belgium

2.2.2 Disasters in Yemen from national datasets 1970-2013

The table shows that disasters with the highest mortality are flash floods and earthquakes with 1458 and 918 deaths respectively.²⁰ Climate change is also a factor in flood risk. Recent floods caused approximately US\$ 1.7 billion in total damages and losses, and estimated to have increased the poverty rate from 28 to 51%. Therefore, to enable the coastal cities to resist the risks of floods, residues were removed from the stream valley, channels drilled with walls of rock and concrete built along the side of the channel²¹.

¹⁹ <http://www.preventionweb.net/countries/yem/data/>

²⁰ GARUniverse <http://www.desinventar.net/DesInventar/profiletab.jsp>

²¹ http://www.preventionweb.net/files/42725_hfaexecsummary2015arabic.pdf

The below data is sourced from the national disaster loss database from the GARUniverse dataset²². The main sources of data are government reports and the level of observation is national, so it has a very good coverage in terms of source, space and time. The data is collected in a disaggregated manner at municipality level, which allows its use in sub-national analysis.

Event	DataCards	Deaths	Injured	Missing	Houses Destroyed	Houses Damaged	Victims	Affected	Relocated	Evacuated	Losses \$Local	Damages in crops Ha	Lost Cattle
ALLUVION	2	0	0	0	0	0	0	0	0	0	0	0	0
CYCLONE	3	3	3	0	64	0	0	0	0	0	0	0	0
DROUGHT	4	0	0	0	0	0	0	0	0	0	0	0	0
EARTHQUAKE	95	918	1482	0	1682	10678	0	0	0	0	0	0	0
FIRE	27	18	19846	0	127	29	11	6	5	12	5600000	0	0
FLOOD	164	849	727078	199	8577	10647	40	23549	0	8064	13362221121	6055.14	30
FROST	3	76	4	0	0	0	0	0	0	0	1000000000	0	0
HEAT WAVE	3	0	155	0	0	0	0	0	0	0	0	0	0
LANDSLIDE	211	257	36	0	164	248	289	242	342	17	795954602	3.5	0
FLASH FLOOD	857	1458	350197	162	11428	15621	2679	5028	6023	346	12223007102	14175	416
POLLUTION	3	0	0	0	0	0	0	0	0	0	0	0	0
RAINS	114	53	72	0	250	258	209	20	12	18	0	0	1435
SAND STORM	11	7	1	0	0	0	4	0	1	0	0	0	0
SEDIMENTATION	1	0	0	0	0	0	0	0	0	0	0	0	0
SNOWSTORM	2	0	13	0	0	0	0	0	0	0	0	0	0
STORM	8	1	5	0	25	0	0	0	0	6	0	0	0
STRONG WIND	15	1	0	0	0	56	0	0	0	0	0	0	0
SUBSIDENCE	4	4	0	0	0	0	0	0	0	0	0	0	0
SURGE	6	5	2	8	0	0	0	0	0	0	0	0	0
THUNDER STORM	158	473	198	0	75	6	26	8	7	9	0	0	0
TORNADO	1	0	0	0	0	0	0	0	0	0	0	0	0
TSUNAMI	5	2	5	0	0	0	0	9	0	3	0	0	0

Note: * Number of disaggregated records, per date per location, within the country. **Source:** GARUniverse dataset <http://www.desinventar.net/DesInventar/profiletab.jsp>

²² 65 datasets covering 82 countries and 3 states have been especially updated and customized for the GVR 2015. These datasets contain a standardized subset of the records of the original datasets as produced by each country. The GVR only uses records of disaster of geological or weather related origin. In addition, several tight criteria of quality has been imposed on these records in order to be analyzed. One of the highlights of GVR 2015 analysis is the economic valuation of direct damage (variables "Economic loss (conservative)" and "Economic loss (with Agriculture)").

3.2 Governance

In excerpts from the Regional Synthesis Report 2005-2015: Implementing the Hyogo Framework for Action in LAS Member states¹⁵ Yemen reported that there is no legislation related to financial issues for DRR at the local level; however, the governor of each province directs some of the budget allocated for public development to face emergency situations and recover from them. With the absence of a national fund, disasters are handled as they occur, through deduction from the central government budget.

There are further reports on incorporating DRM considerations in the general strategy for education development but not specifically in educational curricula due to the increased demand on including awareness raising material corresponding to various emerging issues.

Environmental protection legislation incorporating DRR has been passed, but with major challenges in implementation and enforcement due to the partly limited resources and capacities. In addition there is ongoing awareness raising campaigns related to disaster losses and environmental protection, especially in view of severe flooding

However Yemen also reports that it has no national, local or sectorial (i.e. schools and hospitals) preparedness efforts and contingency plans, although there are reports on carrying out quarterly drills for tsunami hazards in conjunction with the tsunami early warning centre for the Indian Ocean and on individual initiatives to assess damages by various stakeholder in different sectors, in the absence of any unified methodology.

3. Underlying risk drivers for Yemen

3.1. Disaster Risk Driver Indicators

Yemen: Basic Country Statistics and Indicators (2014)

Population	People	24,407,381
Urban	% Total population	33.450
Rural	% Total population	66.550
Urban population growth	% Annual	4.037
Population density	People / km ²	46.2
GDP (Gross Domestic Product)	Million US\$	35,954.502
GDP per capita	US\$	1,473.10
Capital stock	Million US\$	79,114
GFCF (Gross Fixed Capital Formation)	Million US\$	5,890.703
Social Expenditure	Million US\$	2,521
Gross Savings	Million US\$	3,330.937
Total reserves	Million US\$	5,284.072

Source: PreventionWeb Yemen country page: <http://www.preventionweb.net/countries/yem/data/>

Probabilistic²³ Economic Loss Risks based on the Global Assessment Report 2015

The UNISDR Global Assessment Report on Disaster Risk Reduction (GAR)²⁴ is a comprehensive review and analysis of disaster risk and risk management, and is published every two years. GAR15 was launched in March 2015 and focused on how to make development sustainable. Main findings of the report are based on analysis of the GAR risk model, which is a multi-hazard model developed in partnership with leading scientific and technical institutions in the world. The GAR global risk model allows the probabilistic estimation of risks for a number of these hazards, permitting a better understanding of the levels of disaster risk. Two elements that the GAR risk model can produce at the national level are the probable maximum loss and the average annual loss.

Average Annual Loss (AAL) by hazard in Yemen

Hazard	Absolute [Million US\$]	Capital stock [%]	GFCF [%]	Social expenditure [%]	Total Reserves [%]	Gross Savings [%]
Earthquake	45.87	0.058	0.779	1.820	0.868	1.377
Multi-Hazard	45.87	0.058	0.779	1.820	0.868	1.377

Source: UNISDR, Global Assessment Report 2015. <http://www.preventionweb.net/countries/yem/data/>

The annual average loss table for Yemen shows that it is earthquakes pose the greatest threat to Yemen in terms of hazard impacts. Earthquakes pose to cost Yemen about USD 45 million per year, which represent around 1,8 % of its social expenditure and around 0,8% of its total reserves.

INFORM 2015 Risk Index²⁵

The INFORM model adopts the three aspects of vulnerability reflected in the UNISDR definition. The aspects of physical exposure and physical vulnerability are integrated in the hazard & exposure dimension, the aspect of fragility of the socio-economic system becomes INFORM's vulnerability dimension while lack of resilience to cope and recover is treated under the lack of coping capacity dimension.

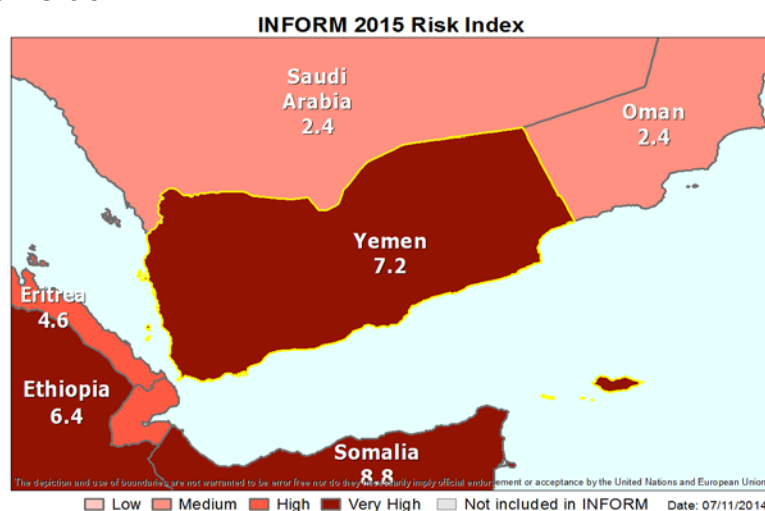


Figure 3: INFORM 2015 Risk Index for Yemen. Source: www.inform-index.org/

²³ A probabilistic approach to risk assessments estimates the likelihood of an event over a specified time. This method is different from a deterministic method where a possible source of earthquake is determined and the probable maximum earthquake and the impacts that this source can generate are then estimated.

²⁴ <http://www.preventionweb.net/english/hyogo/gar/2015/en/home/>

²⁵ INFORM is a collaboration of the Inter-Agency Standing Committee Task Team for Preparedness and Resilience and the European Commission: www.inform-index.org/

According to the INFORM 2015 Risk Index, Yemen has a risk index of 7,2. It means, Yemen has a very high risk, especially in terms of hazard and low coping capacity.

4. Useful DRR Resources

4.1. Joint Typhoon Warning Centre (JTWC)

- Tropical Cyclone Chapala warning and imagery
<http://www.usno.navy.mil/JTWC/>

4.2. Regional Specialized Meteorological Centre for Tropical Cyclones over North Indian Ocean

- Tropical Cyclone Chapala warnings and graphics
<http://www.rsmcnewdelhi.imd.gov.in/index.php?lang=en>

4.3. Directorate General of Meteorology of Oman

- Tropical Cyclone Chapala track. Information about the surface wind speed and maximum wave height in the neighboring governorate of Dohfar (Oman)
<http://met.gov.om/dms/download/WarningReport/warn2e.pdf>

4.3. Preventionweb.net

PreventionWeb.net is the participatory platform of the disaster risk reduction community, a knowledge service of the UN Office for Disaster Risk Reduction (UNISDR). It aims to help people understand risk and do risk reduction (DRR) more easily by providing a place to share knowledge and information, and connect. The platform hosts tools including regional, national and local DRR framework implementation progress reporting: <http://www.preventionweb.net/>

- PreventionWeb Yemen country page:
<http://www.preventionweb.net/countries/yem/data/>
- Collection of DRR related standards: <http://bit.ly/1KzhzNq>
- Yemen: Statement made at the Preparatory Committee of the Third UN World Conference on Disaster Risk Reduction (WCDRR) <http://preventionweb.net/go/40545> (external video link)
- Yemen: National progress report on the implementation of the Hyogo Framework for Action (2013-2015): <http://preventionweb.net/go/40141>