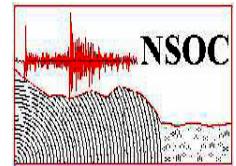


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YEMEN COUNTRY REPORT



MONEER ABDULLAH MOHAMMED AL-MASNI

**GEOLOGICAL SURVEY & MINERAL RESOURCES BOARD
(SEISMOLOGICAL AND VOLCANOLOGICAL OBSERVATORY CENTER)**

1. General information

1.1 Physiography

Yemen is a Middle Eastern country located on the Arabian Peninsula in southwest Asia between latitudes 12° and 19° N and longitudes 42° and 55° E. The country is bordered by Saudi Arabia to the north, the Red Sea to the west, the Arabian Sea and Gulf of Aden to the south and Oman to the east. The Bab-al-Mandab strait in the south-west of Yemen is divided by Mayoon Island into two parts that control the passage to the strait. Yemen's territory includes a number of Red Sea islands, including the Hanish Islands, Kamaran and Perim, as well as Socotra - the largest Yemini Island (3,650 sq. km) in the Arabian Sea, which is 510 km from the mainland coast

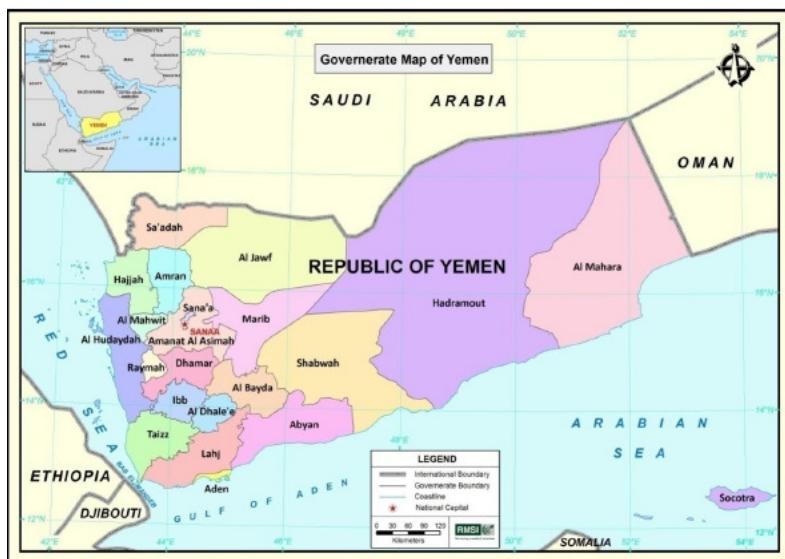


Figure 1-1: Governorates of Yemen

1.2 Topography

The country's topography consists of Coastal plains, Mountains highlands, Mountains Basins, plateau area and Deserts area. It is divided to several regions as shown in the map and explained as following below:

The Coastal Plains

The coastal plain is an extension of the southern coast of Yemen overlooking

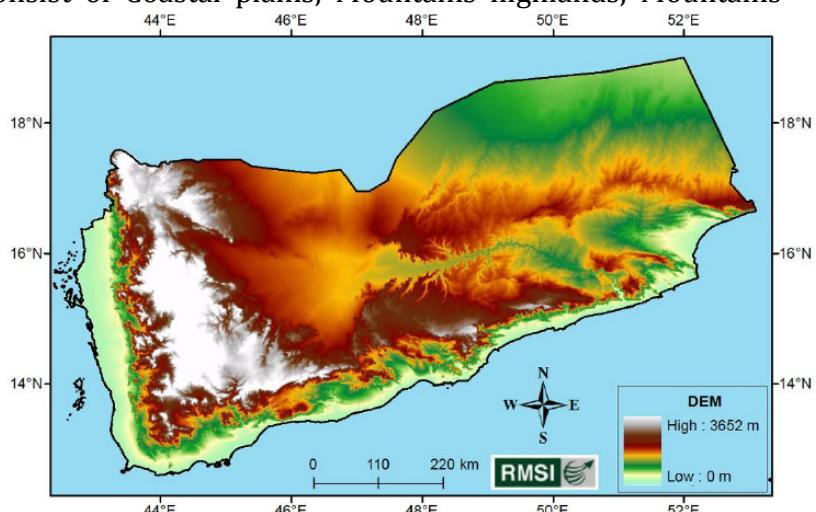


Figure 1-2 Topography map of Yemen

the Gulf of Aden and the Arabian Sea. The coastal plains comprise of the following: Tihamah Plain, Tuban-Abyan plain, Maifa'a Ahwar plain and the Eastern Coastal plain, which lies in Al Mahara governorate. The Tihamah, on the east coast of Yemen, also known as hot lands, forms a very arid and flat coastal plain. It is characterized by extensive crescent shaped sand dunes. The Tihamah ends abruptly at the escarpment of the western highlands. There are perennial streams in the highlands but these never reach the sea because of high evaporation in Tihamah. The elevation of the coastal plain gradually rises and it crosses the wide wadis that spring from the mountains and the runoff beds and flow into the sea.

In view of the abundant marine resources that characterize the coasts, the people of this area are predominantly engaged in fishing. Significant fishing centers include Al-Shihr, Al-Hami, Al-Mukalla, Eastern Al-Dais, Al-Raida, Qusai"ir, Al-Musaina"ah and the city of Aden. People also engage in trade, while Bedouin nomads rear livestock in the interior mountainous area and the depths of the eastern wadis.

The Mountain Highlands

This region stretches along the farthest borders of Yemen on the north to the farthest point in the south. This region underwent many formation movements that resulted in major and minor fractures some of which are parallel to the Red Sea while others are parallel to the Gulf of Aden. These in turn resulted in the formation of high plateaus within which some mountainous basins formed. The central highlands are an extensive high plateau over 2,000 m (6,562 ft) in elevation. The highest point in Yemen is Jabal Al-Nabi Shauib at 3,760 m. This area is drier than the western highlands because of rain-shadow influences, but still receives sufficient rain in wet years for extensive cropping. The mountain highlands include some major valleys like Mawr, Haradh, Zabeed, Seham and Raisan valleys whose waters flow into the Red Sea. The Wadi Tuban, Wadi Bana and Hadramout Wadi pour into the Gulf of Aden and the Arabian Sea.

The Mountainous Basins

This region has mountainous plains and basins located in the Mountain Highlands, mostly located in the eastern section of the water division line, which stretches from the farthest north to the farthest south. The main basins are Yareem, Dhamar, Abar, Sana'a, Amran, and Sa'ada.

The Plateau Areas

This region lies to the east and north of the Mountain Highlands and runs parallel to them. However, this topography is wider towards the Empty Quarter and begins a gradual decline. The surface slides toward the north and the east mildly. The majority of the surface of this region is formed from rocky desert surface, which is cut through by some valleys - especially the Hadramout and Hareeb valleys.

The Desert Areas

This is a sandy region almost devoid of flora except in the areas of rainfall courses where rain runs through after descending from mountainous areas adjacent to this region. The height of the region ranges between 500-1000 m above sea level and it slopes without terrainous discontinuity towards the north east to the center of the Empty Quarter. The Rub al Khali in the east is much lower, generally below 1,000 m (3,281 ft), and receives almost no rain. It is populated only by Bedouin herders of camels. The desert plain situated at the edge of the northern plateau of Wadi Hadramout extends westward to Ramlat Al-Sab'at. These plains form the territory of the desert districts of Thamud, Al'Ibr, Rima wa Al-Qif, Zamkh, and Manoukh. The northern part is famous for livestock grazing and rearing. The peripheries of the area converge with the border of Saudi Arabia and some overland international inlets, such as Al-'Ibr/, Al-Wadi"ah, and Al-Bude"i.

Apart from the above major divisions, many islands spread along the Yemen territorial waters with their distinctive terrain, climate and environment. Most of these islands lie in the Red Sea. The most significant ones are Kamaran which is the largest inhabited island in the Red Sea, the Hunnish Archipelago, and the Meon island, which has a strategic location in Bab Almandab strait - the southern gateway of the Red Sea. Some of the main islands on the Arabian Sea are the Socotra Archipelago. Socotra island is the largest island in this archipelago. The other islands in this archipelago are Samhah, Darsah and Abduljori

1.3 Climate

The climate of Yemen is hot and humid along west coast; temperate in western mountains affected by seasonal monsoon; and extraordinarily hot, dry and harsh in the desert to the east.

Rainfall is highly erratic and occurs in two periods - the first from March through May, and the second from July until September. The latter is the season with the heaviest rainfall. The main ecosystems in

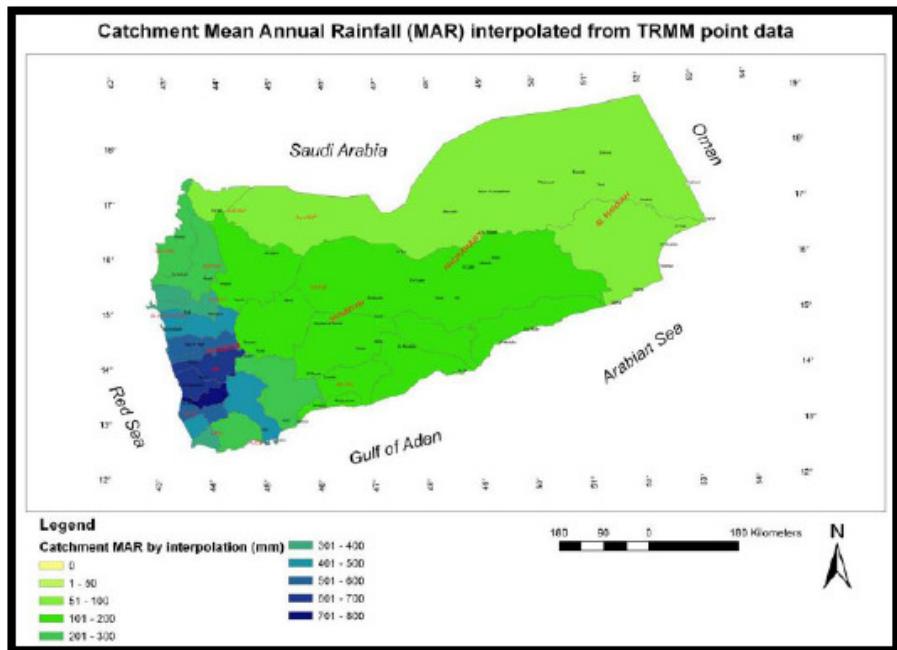


Figure 1-3 Estimated mean annual rainfall for 1989-1999 for major basins based on the TRMM satellite data (Wallingford 2010) Topography map of Yemen

Yemen are desert, dry Montana woodlands, grasslands and shrub lands.

Rainfall in Yemen, as in most arid zones, varies widely due to the local character of connective storms, typically of short duration, coupled with relatively high intensity and limited aerial extent. However, low intensity frontal-type rains are sometimes experienced, usually during the winter season. As a result, rainfall in Yemen is characterized by marked spatial variability. In the northern area, annual rainfall varies between 100 mm in the eastern desert and more than 800 mm in the central highlands. In the southern part, rainfall varies between 150 mm and 450 mm in agricultural areas. Areas that receive less than 500 mm per year are considered marginal for agriculture, with unreliable production.

1.4 Demography

Yemen, with a population of more than 20 million, is the world's 49th largest country with an area of 527,970 sq. km and is comparable in size to Thailand and somewhat larger than the state of California. Sana'a is the capital of Yemen located in the central

western part of the country ($15^{\circ}21' N$, $44^{\circ}12' E$).

In spite of being a large country, Yemen has an extremely low average population density of 42 persons /sq. km with an annual growth rate of 3.5 per cent. This extremely low average population density is due to extremely low population in eastern Yemen, which is largely

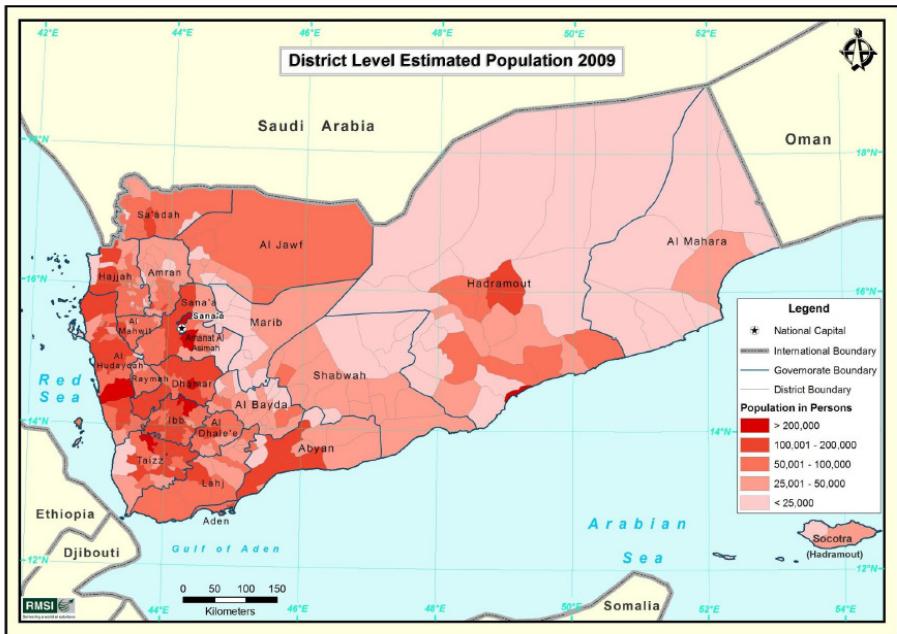


Figure 1-4 Distribution of population in Yemen (2009)

a desert area. The population density is higher in the western part of Yemen. For example, the Sana'a Basin has a population density of more than 1,000 persons/ sq. km, with an annual growth rate of about 7 per cent. Yemen is characterized by the diversity of aspects of the surface and the country can be geographically divided into five main regions: the coastal plains; the mountain highlands; the mountainous basins; the plateau areas; and the desert.

2. Natural Hazard in the country

2.1 DISASTER RISK PROFILE:

The country's topography of rugged mountains, highlands, deserts, and coastal plains, coupled with arid weather conditions, render Yemen highly susceptible to desertification, landslides, earthquakes and floods, and make it a disaster prone country that has experienced at least one disaster per year over the last three decades as shown in the following photos. These various disasters left significant economic damages that occur due to loss of lives, damage to livelihoods, property and infrastructure.

2.2 SPATIAL DISTRIBUTION OF DISASTERS IN YEMEN

Floods: The most recent major floods occurred in 1996, 2000, and 2008. The areas that are at risk from flooding are largely the densely populated areas of western Yemen, that include governorates of Sada'a, Sana'a, Dhamar, Ibb, Taiz, Lahz, Mareb, and Abyan.

In central and eastern Yemen, the Hadramout Valley and the southern coastline of Yemen are also at risk from flooding.

Floods in Yemen mostly result from high-intensity rainfall, and sometimes from coastal storm surges and tsunamis such as tsunami resulted form Sumatra earthquake in 2005.

Earthquakes: Yemen is located in the seismically active zone between the Arabian and African tectonic plates which are pulling apart. The western and southern portions of Yemen around the rifts of the Red Sea and Gulf of Aden represented by volcanic mountains over magma tic champers. These portions are the most active zones and at risk from earthquakes. Although the magnitudes of events are small but it is felling by peoples living in that areas..

The largest destructive earthquake was in 13,Dec.,1982 with magnitude Mw6.2 stroke the central part of Yemen at Dhamar region ..

Landslides: Unstable geological conditions, including the development of extensive cracks due to natural aging and extreme weather conditions, exist in several mountainous regions of Yemen such as Al-Dhafeer in 2006 Al Gayah and Al-Semah. In such regions, heavy rains, storms, earthquakes, or volcanic eruptions, as well as mining and inappropriately sited infrastructure, can combine to trigger landslides. Since the terrain of Yemen is mostly mountainous, the entire country is at risk of landslides.

Volcanic eruptions: As mentioned above the central and western plateau of Yemen located in the volcanic fields which consists of quaternary volcanic cones. These volcanic cones have similar age with that located along the axial of Red Sea and characterized by it's active and gases case. The last new eruptions was in 2007 at Al- Tair island at Red

Sea. Table 1 provides an overview of the natural disasters reported in Yemen over the last 30 years,



Photo show Earth Fissures at Gahran Basin caused by earthquake 1982 and water withdrawing .2007



Photo show Land slides at al-Dhafeer area,2006



Photo show heavy flooding in Hadramut area 2008



Photo show Volcanic Eruption at Gabal Al-Tair Island –Red sea.2007



Photo show Earthquake Building damage in Dhamar area,1982 .

Table 1: Top 12 natural disasters reported (1982-2010)

Disaster	Date	Affected	killed
Earthquakes	1982	2020000	2800
Drought	1988	--	--
Earthquake	1991	40093	70
Flood	1991	30000	65
Flood	1993	21500	50
Flood	1996	5000	33
Flood	1998	3000	32
Flood	1999	19750	36
landslides	2005		65
Flood	2006	2000	31
Volcanic eruption	2007		6
Flood	2007	2000	28
Flood	2008	700.000	73

3. Disaster Management System (DMS)

The Yemen Country Note is based on vigorous consultations undertaken with various governmental agencies, the UN agencies, and the World Bank country office staff to understand the current organizational structure for managing disasters in Yemen and identify possible areas of support for strengthening Disaster Risk Management (DRM). Major governmental agencies consulted include the ministries of Planning and International Cooperation, Oil and Minerals, Communications and Information Technology, Transport, Public Works and Highways, Civil Defense, Water and Environment, Agriculture and Irrigation, Health, and Local Administration. The findings of the consultations were presented to a cabinet level meeting, held on April 23rd 2009, chaired by the Deputy Prime Minister, Ministry of Planning and International Cooperation. During the meeting, the Government of Yemen provided guidance and identified priority areas of interventions for DRM.

3.1 Progress of implementation of Hyogo Framework for Action (HFA)

Yemen is a signatory to the Hyogo Framework for Action and in keeping with the five priority areas for action, Yemen has committed to:

- Ensuring that the reduction of risks from disasters is a national and a local priority with a strong institutional basis for implementation;
- Identification, assessment, and monitoring of risks from disasters, and enhancing its early warning system;
- Use of knowledge, innovation, and education to build a culture of safety and resilience at all levels.
- Reduction in the factors that make Yemen more vulnerable to disasters; and
- Strengthening disaster preparedness for effective responses at all levels.

The next section describes the state of progress that Yemen has made in the above mentioned five Hyogo Framework priority action areas, along with the gaps and possible next steps.

HFA Priority # 1 : Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation

Yemen has accorded high priority to disaster risk reduction, and has established two focal agencies to take the lead in this area. These are:

- (i) The National Disaster Management Unit (NDMU), housed within the Civil Defense General Directorate (CDGD) under the Ministry of Interior (MoI); and
- (ii) The Directorate of Environmental Emergencies and Disasters (DEE) under the Ministry of Water and Environment (MWE), established in 2004 through a ministerial decree.

The Unit in the Civil Defense Directorate has the mandate to focus on disaster management and response in Yemen, while the Department of Environmental Emergencies under the Ministry of Water is responsible for reporting on progress in Yemen on the five priority areas of action outlined in the Hyogo Framework for Action, to the UN International Strategy for Disaster Risk Reduction (UNIS DR) – UNIS DR being the agency that is responsible for monitoring progress on the Hyogo Framework. Although the DEE has represented Yemen at several international forums, it has limited resources.

The Unit in the Civil Defense Directorate, on the other hand, is better resourced as it has been responsible for providing emergency relief after disasters.

Yemen has established an institutional basis for implementation of actions related to disaster risk reduction. There is a legal foundation for the creation of an organizational structure for managing the risks from disasters, and Yemen has designated its Ministry of Interior to lead the structure. The 1997 Civil Defense Law defines the responsibilities of the Civil Defense General Directorate with respect to disaster management. Subsequently, the Executive Bylaw and the Republican Decree (N°386) became the basis for the Supreme Council of Civil Defense.

The Council is responsible for providing policy direction, approving plans for disaster preparedness and response, and defining the tasks and responsibilities of each ministry/agency, actors and stakeholders before and during any emergency. It is chaired by the Minister of Interior, and includes key ministries as members. However, when the floods occurred in 2008, the Supreme Council was chaired by the Prime Minister himself on two occasions.

There is progress on the identification, assessment, and monitoring of risks from disasters, and the establishment of an early warning system is in its infancy. The UN agencies and the Government of Norway have provided support to initiate disaster risk management related activities in Yemen. They supported the Disaster Preparedness, Management and Recovery project in 2003, which established under the Civil Defense General Directorate the National Disaster Management Unit. However, the Unit needs technical, and financial strengthening, in addition to an improved internal re-organization that enables it to develop the necessary vertical mechanisms for coordination with subnational entities and communities (which will also need strengthening). In order to develop an effective, comprehensive and integrated disaster risk management system, the Civil Defense General Directorate was accorded the status of an authority, with greater managerial and financial autonomy. However, it still functions as a ministerial department, and its budget is approved by the Ministry of Interior. The National Disaster Management Unit has a National Disaster Management Team that consists of focal staff from various ministries. It developed a National Disaster Management Plan in 2006. This Plan, in addition to proposed initiatives for capacity building, GIS mapping, and rescue operations, includes a checklist of activities to be undertaken in the event of a disaster, as well as a list of key contacts. This Plan is awaiting approval by Yemen's Cabinet.

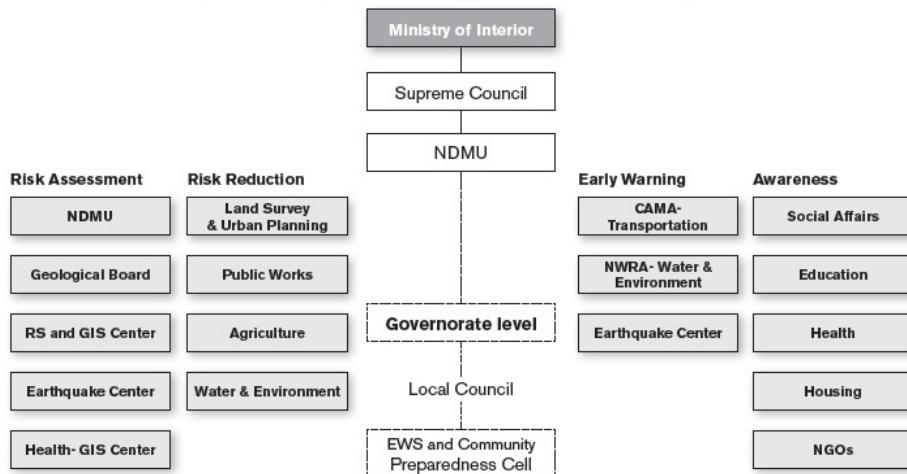
There is a need to further strengthen the organizational structure for managing the risks from disasters, streamline agencyfunctions, and improve functional coordination and information sharing for an early warning system. Other prominent agencies that play an important role in disaster risk management are the Public Works Program, the Geological Survey and Mineral Resources Board, the National Water Resources Agency, and the Vulnerability Assessment Mapping Unit under Ministry of Health. These agencies are active in risk assessment, early warning, and post disaster reconstruction & recovery according to their specific institutional mandate and implementation capabilities. Figure (3) provides an institutional map of agencies that are active within the different categories of activities that together constitute a comprehensive disaster risk management program, and their relationship with the National Disaster Management Unit.

Yemen has to make rapid progress towards making disaster risk management a priority at the local level. Sub national governments, their agencies, and local communities need to be integral to the planning and execution of disaster risk management activities, so that there is more ownership which can lead to more effective implementation.

There is already progress towards decentralization in Yemen, and Yemen's decentralization policy has mandated local governments with disaster risk management

and reduction. The legal foundation for developing and implementing disaster risk management programs at the local level already exists.

Figure(3) Organizational Map of Government agencies for disaster risk management in Yemen



HFA Priority # 2 : Identify, assess, and monitor disaster risks, and enhance early warning systems

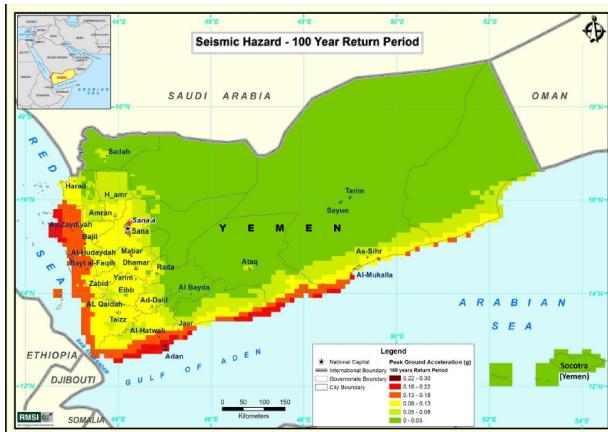
Implementation of initiatives that identify disaster risks is well underway, although a formal early warning system does not so far exist.

Several agencies are preparing digital risk maps of Yemen (Table 3). There is, however, no mechanism to either ensure compatibility between the data formats being developed by the agencies, or to avoid duplication of functions for optimizing the use of resources. There is also no institutionalized mechanism that links these agencies which are the critical suppliers of critical data, with the sub-national agencies and communities that are the users of this data. Unless such coordination and integrative mechanisms are in place, the design and implementation of disaster risk management activities will be ineffective and yield sub-optimal results.

Table 3: Agencies active in risk mapping

Agencies	Relation to Risk Assessment	Comments
Geological Survey Board Ministry of Oil and Minerals	Landslide and earthquake risk mapping	Good infrastructure, over 15 years experience. Need consistent budget and capacity building
Remote Sensing and GIS Center Min. Telecommunications	National depository of base maps for Yemen and satellite imagery	Good infrastructure, 4 years experience
GIS cell in NDMU Ministry of Interior	Preparing maps of hospitals and emergency shelters	Location within NDMU, just started working with UNDP staff
Health Sector Mapping, Ministry of Health	Health vulnerability assessment maps	Good infrastructure, developing health facility maps with WHO guidance and support

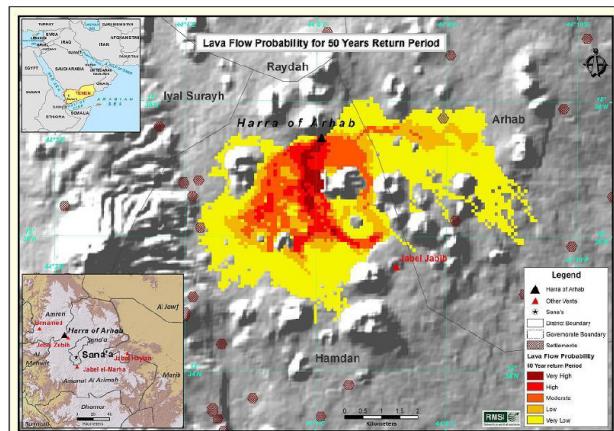
In 2010 National Probabilistic Risk Assessment of Yemen is issued as show in figures (4-A-D)below , as well as detailed risk assessment for the Governorate/s of Hadramout & Al-Mahara governorate, and Sana'a are underway. These studies will provide a risk atlas for various kinds of hazards , and be the basis for planning and execution of various initiatives for disaster risk management in the country. The atlas will enable informed political debate on difficult choices that Yemen may have to make for both planning and retrofitting sectoral infrastructure in various spatial locations, and help the country develop a strategy that can be supported by donors, including possibly through additional IDA operations.



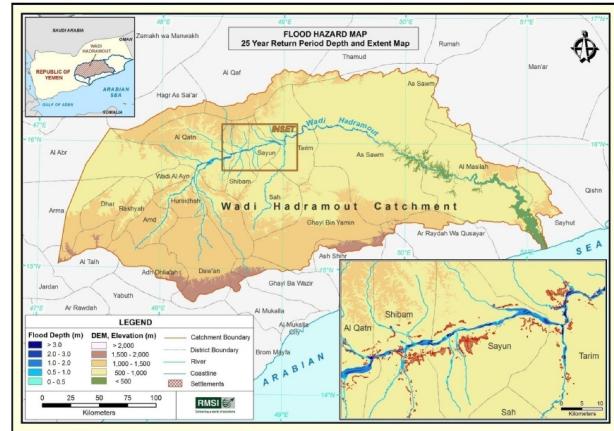
Figure(4.A) . show Earthquake PGA hazard of 100 year return period



Figure(4.B) . Land slid Susceptibility map



Figure(4.C) .Lava Flow probability for 50 years return period - North Sana'a



Figure(4.D) . Wadi- Hadramut 25 year return period flood hazard map

The Government of Yemen has allocated funds for the development of a formal early warning system.

Although there is no formal early warning system at the national or local level, the Government has allocated US \$7.5 million to the Civil Defense General Directorate for the development of emergency control rooms in fifteen governorates.

An emergency room, possibly for an early warning system and rescue operations, has become partially operational in Aden. A control room established in Sana'a is not yet operational due to financial and technical constraints. There are plans to establish emergency rooms in Mukalla, Taiz, and Hodeida.

An initiative to strengthen the capacity of the National Disaster Management Unit to enable it to deliver early warnings to coastal communities and enhance their preparedness is underway. This initiative, known as the Disaster Preparedness, Management, and Recovery Project is being supported by the UN DP. An initial assessment report from this project highlights a list of priority actions and priority intervention locations which are Al- Mahara, Hadramout, Aden, Shabwa, Abyan, Lahz, Taiz, Hodeidah, and Hajja. It also lists the key players that need to be involved in these areas. The project has supported community awareness programs in two pilot areas - Al Mahara and Socotra Island. The National Disaster Management Unit may partner with Oman to share early warnings about tsunamis with coastal communities.

HFA Priority # 3 : Use knowledge, innovation, and education to build a culture of safety and resilience at all

The Government of Yemen is extremely receptive to integrating knowledge and innovation into its disaster management program. The recently completed 2008 Damage and Loss Needs Assessment was well received by the Cabinet of Yemen and is being widely disseminated within the country. Similarly, the Government of Yemen is seeking to collaborate actively with Gulf Cooperation Countries in developing a regional mechanism in areas related to disaster mitigation like early warning systems and post-disaster response.

Initial educational efforts to start building a culture of resilience is underway in Yemen. A national strategy for awareness, targeting school children specifically and the public more generally, is being developed by the National Disaster Management Unit. The literature that is being developed for the awareness campaign includes advice on 'what to do during emergency'. Also included are interactive games for children.

Much progress remains to be made on building a culture of resilience at all levels. So far there exist no formal institutions or programs that can deliver training on adapting to climate change at a scale that is needed to build resilience at all levels. The National

Disaster Management Unit is trying to include the concept of disaster risk management as well as the importance of environmental protection in reducing risks from disasters, in the curriculum of schools. The Ministry of Water and Environment, the Ministry of Health, and the Ministry of Social Welfare are also developing communication material that can effectively reach out to the larger public and inform on the appropriate response needed during a disaster or an emergency. With multiple agencies developing communication strategies and tools, efforts are needed to ensure adequate coordination and avoid duplication so that there is optimum impact on building a culture of resilience at all levels.

HFA Priority # 4 : Reduce the underlying risk factors

Sectoral ministries are working towards reducing the risks posed by the three main factors that exacerbate Yemen's vulnerability to natural disasters: (i) climate change, (ii) depletion of water resources, and (iii) ineffective land use planning that are contributing to development in hazard prone areas. Table 4 maps the various national and sub-national entities that have a crucial role in limiting risks from the three underlying factors. There is a need to develop clear guidelines for mainstreaming disaster risk reduction into the sectoral planning and investment cycles of these ministries. Discussions amongst policy makers are underway to include in the institutional mandates of these agencies, an explicit focus on reducing the risks from disasters, so that appropriate initiatives can be mainstreamed and supported. These agencies have already embarked on some steps to reduce the risks from disasters, for example, the incorporation of flood plain protection in strategic land use planning, the development of appropriate building codes, and environmental impact assessment procedures.

Table 4. Agencies active in risk reduction

Agency	Relation to Risk Reduction	Comments
Governorates/Director of Districts	Implementation and Enforcement	With decentralization, the role of these agencies is crucial for the development of strategic land-use planning and their enforcement.
General Authority on Land Survey and Urban Planning	Master Plans in accordance with flood plain location	Has advisory role, need actual implementation at local level
Ministry of Public Works	Building codes, permits, design and construction	Needs greater implementation at local level
Ministry of Agriculture and Irrigation	Flood protection works, Dikes/ Dams	Ministry would like to focus in the areas of desertification and locust storms
Ministry of Water and Environment	Environmental Impact Assessment (EIA)	By law all infrastructure projects should follow EIA to ensure no alteration in hazard prone areas

risks. Effective disaster risk management strategies will be difficult to develop, and the implementation of policies and programs developed centrally will be difficult and inefficient.

HFA Priority # 5: Strengthen disaster preparedness for effective response at all levels

Disaster preparedness for effective response at all levels has not as yet received attention in Yemen, as the planning focus has been on disaster relief and recovery operations. Although there is no institutional mechanism to ensure adequate preparedness levels for natural disasters and an emergency response to them, as stated earlier, the National Disaster Management Unit in the Ministry of Interior has developed a National Disaster Management Plan. This plan spells out in detail, the role of key line ministries before, during, and in the post disaster emergency phase. It provides checklists for essential activities to be executed in the different phases of a disaster, as well as a list of essential contacts. This plan, however, is yet to be approved by Yemen's cabinet.

In the absence of attention to the pre-disaster planning, the only central government practice that exists is for an area to be declared a “Disaster Affected Area” before resources can be mobilized. In the event of a disaster, the President of Yemen declares the affected areas as “Disaster Affected Areas”. Only after this declaration can relief funds are allocated, with relief efforts coordinated through a high level inter-ministerial committee. Such a committee was organized under the Prime Minister’s Office after 2008 floods to coordinate national and international relief efforts. This committee coordinates the efforts of the army, international relief agencies, the branches of technical ministries, and utility agencies at governorate level, which are the main actors during the disaster relief phase of disaster operations. Immediate recovery and reconstruction activities, i.e. post emergency relief, are coordinated at the governorate level by branches of line ministries (chief being Ministry of Public Works) and local NGOs. Long-term recovery and reconstruction activities are mostly coordinated by specialized Recovery and Reconstruction Funds (e.g. recently established Fund for Recovery and Reconstruction in Hadramout and Al Mahara). There is a need to develop and adopt early warning protocols and preparedness plans at regional and local levels.