Chapter 15 : DISASTER MANAGEMENT

15.1 Introduction
Managing disasters is a national concern. The legislation provides a hierarchic order of functions and responsibilities at different levels of administration starting, national level to the Panchayat level. Every district is required to have a Disaster Management Plan. The district plan shall be prepared by the District Authority, in consultation with the local authorities and with regard to the National Plan and the State Plan.

15.2 Types of Disasters
The National Disaster Management Act, 2005 defines disaster as “a catastrophe, mishap, calamity or grave occurrence affecting any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as beyond the coping capacity of the community of the affected area”.

The United Nations (UNDRO 1987, cited in Hanisch 1996, p.22) define disasters in the following way:
“A disaster is an event that is concentrated in space and time and that subject a society to severe danger and such serious losses of human life or such major material damage that the local social structure breaks down and the society is unable to perform any or some of its key functions.”

The high powered committee of the Government of India, in its October 2001 report defines disaster as “an occurrence of a severity and magnitude that normally results in deaths, injuries and property damage and that cannot be managed through the routine procedures and resources of government. It usually develops suddenly and unexpectedly and requires immediate, coordinated and effective response by multiple government and private sector organizations to meet human needs and speedy recovery”

WHO defines disaster as “any occurrence that causes damage, economic destruction, loss of human life and deterioration in health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area.” A disaster is the product of a hazard such as earthquake, flood or windstorm coinciding with a vulnerable situation, which might include communities, cities or villages. There are two kinds of disasters:

- **Natural disaster** - disasters with meteorological, geological or even biological origin such as earthquake, floods, high winds, fire hazard, etc.
- **Unnatural or man-made disaster** - disasters caused by humans or technological origin such as nuclear, chemical, etc.

15.2.1 Hazards
Hazards are defined as “phenomena that pose threat to people, structures or economic assets and which may cause a disaster”. They could be either man made or naturally occurring in our environment (UNDRO). A natural hazard pertains to a natural phenomenon that occurs in proximity and poses a threat to people; structures and economic assets caused by biological, geological, seismic, hydrological or meteorological conditions or processes in the natural environment.
A disaster is the product of a hazard such as earthquake, flood or windstorm coinciding with a vulnerable situation that might include communities, cities or villages. There are two main components in this definition: hazard and vulnerability, without the two, it cannot be classified as a disaster.

15.2.1.i Classification of Hazards
There are four basic types of hazardous events that put societies at risk. Those are:

II. **Violence driven**: War, armed conflict, physical assault, etc.
III. **Deterioration led**: Declining health, education and other social services, environmental degradation, etc.
IV. **Industrialization failure led**: Technological failures, oil spillage, factory explosions, fires, gas leakage, transport collisions.

15.2.2 Vulnerability
Vulnerability is defined as “The extent to which a community, structure, service, or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster prone area.”

15.2.2.i Vulnerability and Risk Assessment of the region due to natural Hazards
The vulnerability assessment as per Atlas of India indicates that the National Capital Region falls within:

1. High damage risk zone (MSK VIII) with regard to earthquake
2. Very high damage risk zone B (Vb = 50 m/s) with regard to wind and cyclone hazard and
3. Area liable to floods

The occurrence of earthquakes in and around sub-region is attributed to the following prominent tectonic features:

- Sohna fault
- Aravali fault
- The hidden Moradabad fault
- Sonipat-Delhi-Sohna fault
- Junction of Aravali and Sohna fault
- Delhi Haridwar ridge

Earthquakes of intensity lower than four on the Richter scale have originated at about 10 epicenters that lie in the Sub-region as also shown in Map 15-1. The Mahendragarh-Dehradun Fault line passes through Jhajjar and Rohtak districts.

15.2.3 Risk
Risk is a measure of the expected losses (deaths, injuries, property, economic activity etc) due to a hazard of a particular magnitude occurring in a given area over a specific time period. Figure 15-1 illustrates four factors- hazards, location, exposure, and vulnerability which contribute to risk. They are:

- Hazards (physical effects generated in the naturally occurring event),
- Location of the hazards relative to the community at risk,
- Exposure (the value and importance of the various types of structures and lifeline systems such as water supply, communication network, transportation network etc)
- Vulnerability of the exposed structures, to the hazards expected to affect them
Map 15-1: Seismic Tectonic Features in Haryana Sub-Region

Source: NCR-RP-2021
15.3 Disaster Management

According to the Indian National Disaster Management Act, 2005, disaster management means a continuous and integrated process of planning, organizing, coordinating, and implementing measures that are necessary or expedient for:

1. Prevention of danger or threat of any disaster
2. Mitigation or reduction of risk of any disaster or its severity or consequences
3. Capacity building
4. Preparedness to deal with any disaster
5. Prompt response to any threatening disaster situation or disaster
6. Assessing severity or magnitude of effects of any disaster
7. Evacuation, rescue, and relief
8. Rehabilitation and reconstruction.

The High Powered Committee defined Disaster Management as “a collective term encompassing all aspects of planning for and responding to disasters, including both pre and post disaster activities. It may refer to the management of both the risks and consequences of disasters”. Preparedness of disaster management could be divided into two phases:

A- Pre disaster phase
B- Post disaster phase

- Pre disaster phase
  o Risk identification
    • Hazard Assessment
    • Vulnerability Assessment
  
  o Mitigation
    • Physical/structural mitigation works
    • Land-use planning and building codes
    • Education, training and awareness about risks and prevention
  
  o Risk transfer
    • Insurance (Individual, Family, Community)
    • Insurance of public infrastructure and private assets
    • Privatization of public services with safety regulation (energy, water and transportation)
    • Calamity Funds
  
  o Preparedness
    • Development of Disaster Management Plan
    • Setting of Control Room
    • Setting of Wireless Station
• Constitution of Flood Zones
• Deployment of Country Boats
• Storage and Stock Piling of Emergency Relief
• Identification of Weak and Vulnerable Points
• Awareness Generation
• Mock Drill
• Selection of Flood / Cyclone Shelters/ Mounds
• Alternative Communication and Road Net Works
• Arrangement of vehicle for relief and rescue operation

• Post disaster phase
  ○ Emergency response
    • Humanitarian assistance
    • Sanitation, temporary repairs, and restoration of services
    • Damage assessment
    • Mobilization of resources
  ○ Rehabilitation & Reconstruction
    • Rehabilitation and reconstruction of damaged critical infrastructure
    • Revitalization of affected sectors
    • Macro- economic and budget management (stabilization and protection of social expenditures)
    • Incorporation of disaster mitigation components in reconstruction activities

15.4 Sub-Region and Hazards
The geological and geomorphologic setup of Haryana makes it prone to a number of natural hazards i.e. floods, water logging, soil salinity, soil erosion, landslides, drought etc. Natural hazards affect the infrastructure and cause loss of natural resources as well as human lives. Earthquakes, floods, cyclones and landslides rank among the most feared disasters in India, and the fear is naturally heightened in the districts of Faridabad & Gurgaon.

15.5 Types of hazards in Sub-Region

15.5.1 Earthquake Hazard & Disaster
An Earthquake is a series of underground shock waves and movements on the earth’s surface caused by natural processes of writhing of the earth’s crust.
Map 15-2: Earthquake hazard map of Haryana
Earthquake History

Eastern parts of Haryana along with Delhi lie in the Gangetic Plain. It is a down warp of the Himalayan foreland, of variable depth, converted into flat plains by long-vigorous sedimentation. This is known as a geosynclines and the Gangetic Plain is the Indo-Gangetic Geosynclines. It has shown considerable amounts of flexure and dislocation at the northern end and is bound on the north by the Himalayan Frontal Thrust. The floor of the Gangetic trough (if seen without all the sediments) is not an even plain, instead shows corrugated inequalities and buried ridges (shelf faults). The region sits atop the Delhi-Haridwar ridge, which is a sub-surface ridge, trending NE-SW. There are numerous faults in this region, like the Moradabad, Panipat and Sohna faults. Delhi, Chandigarh and many parts of Haryana lie in Zone IV and thus they are extremely vulnerable to earthquakes. Most earthquakes in this region are shallow, though a few earthquake of intermediate depth have been recorded in Haryana. The alluvial cover of the Indo-Gangetic plain makes even distant earthquake felt here quite strongly. This region often feels deep-seated earthquakes that are centered on the Pakistan-Afghanistan Border and in the Hindukush mountains in Afghanistan. However, it must be stated that proximity to faults does not necessarily translate into a higher hazard as compared to areas located further away, as damage from earthquakes depend on numerous factors such as subsurface geology and adherence to the building codes.

a) Seismic Hazard

All districts of Haryana sub-region lie in Zone IV and High damage risk zone (MSK VIII) in respect to earthquakes. Since, the earthquake database is available only for the earthquakes that taken place after the historical period i.e. 1800 A.D., hence, these zones offer a tentative insight of the earthquake hazard and need to be updated regularly.

Table 15-1: Earthquakes felt in the Haryana Sub-Region and surroundings

<table>
<thead>
<tr>
<th>Date</th>
<th>Place</th>
<th>Intensity</th>
<th>Northing</th>
<th>Easting</th>
<th>Depth</th>
<th>Origin Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>27 Aug 1960</td>
<td>Gurgaon-Faridabad</td>
<td>6.0</td>
<td>28.20</td>
<td>77.40</td>
<td></td>
<td>15:58:59.20</td>
</tr>
<tr>
<td>20 June 1966</td>
<td>Delhi-Gurgaon Border</td>
<td>Mb 4.7</td>
<td>28.50</td>
<td>76.98</td>
<td>053.0 kms</td>
<td>13:42:57</td>
</tr>
<tr>
<td>29 July 1980</td>
<td>Western Nepal</td>
<td>Mw 6.8</td>
<td>29.60</td>
<td>81.09</td>
<td></td>
<td>14:58:40</td>
</tr>
<tr>
<td>21 Oct 1991</td>
<td>Near Pilang (Uttarkashi), Uttaranchal</td>
<td>Mw 6.8</td>
<td>30.78</td>
<td>78.77</td>
<td></td>
<td>21:23:14</td>
</tr>
<tr>
<td>12 Nov 1996</td>
<td>Near Kurukshetra (Haryana-U.P. bdr. region)</td>
<td>Mb 4.5</td>
<td>29.928</td>
<td>77.207</td>
<td>055.0 kms</td>
<td>04:20:58</td>
</tr>
<tr>
<td>4 May 1997</td>
<td>Rothak-Sonipat Districts (Haryana)</td>
<td>ML 4.1</td>
<td>28.984</td>
<td>76.588</td>
<td>28.8 kms</td>
<td>07:19:22</td>
</tr>
<tr>
<td>30 Mar 1998</td>
<td>Mahendragarh-Bhiwani Districts (Haryana-Rajasthan Border.)</td>
<td>Mb 5.0</td>
<td>28.211</td>
<td>76.240</td>
<td>010.0 kms</td>
<td>23:55:45</td>
</tr>
<tr>
<td>22 Mar 1999</td>
<td>North of New Delhi, (Haryana-Uttar Pradesh Border region),</td>
<td>Mb 4.1</td>
<td>29.257</td>
<td>76.940</td>
<td>207.6 kms</td>
<td>09:56:16</td>
</tr>
<tr>
<td>29 Mar 1999</td>
<td>Near Gopeshwar (Chamoli), Uttaranchal</td>
<td>Mw 6.5</td>
<td>30.492</td>
<td>79.288</td>
<td></td>
<td>19:05:11</td>
</tr>
<tr>
<td>28 April 2001</td>
<td>Sonipat-Delhi region</td>
<td>Mb 4.3</td>
<td>28.591</td>
<td>77.044</td>
<td>15.4 kms</td>
<td>03:06:27</td>
</tr>
<tr>
<td>22 Dec 2003</td>
<td>Jind region, Haryana</td>
<td>ML 3.5</td>
<td>29.235</td>
<td>76.401</td>
<td>15.4 kms</td>
<td>20:19:08</td>
</tr>
<tr>
<td>27 Nov 2004</td>
<td>Chandigarh-north Haryana region</td>
<td>ML 3.9</td>
<td>30.352</td>
<td>77.129</td>
<td>19 kms</td>
<td>23:53:54</td>
</tr>
<tr>
<td>8 Oct 2005</td>
<td>Kashmir-Kohistan, Pakistan-India border</td>
<td>Mw 7.6</td>
<td>34.432</td>
<td>73.537</td>
<td>020.0 kms</td>
<td>03:50:40</td>
</tr>
<tr>
<td>25 Nov 2007</td>
<td>Delhi metropolitan area</td>
<td>Mb 4.6</td>
<td>28.677</td>
<td>77.204</td>
<td>10 kms</td>
<td>23:12:17</td>
</tr>
</tbody>
</table>

Source: NDMA & RDMD, Haryana
b) **Status of sub-region**: The sub-region lies in Zone IV and Shaking Intensity VIII.

i) **Nature** - Small landslips in hollows and on banked roads; cracks in the ground up to several centimeters. Water in lakes become turbid. New reservoirs come into existence. Dry wells refill.

c) **Analysis from Existing situation**
The entire region of Gurgaon falls in the high risk seismic zone IV and corresponds to MSK intensity VIII making it highly vulnerable to Earthquakes. The major tectonic features affecting Gurgaon are as follows:

- The Sohna Fault
- Junction of Aravali and Alluvia near Delhi
- Moradabad Fault
- Delhi Moradabad Fault
- Delhi-Haridwar Fault

### Destruction of buildings

i) **Persons and surroundings** – It causes fright and panic; people driving are disturbed, trees collapse, furniture gets displaced. All of this can cause monetary as well as damage to person.

ii) **Structures of all kinds** - Most buildings of Type C suffer damage of Grade 2, and few of Grade 3, most buildings of Type B suffers damage of Grade 3. Most buildings of Type A suffer damage of Grade 4. Occasionally pipe seams break, at times memorials and monuments are adversely affected or even collapse.

**Note**: **Type of Structures (Buildings)**

Type A - Building in field-stone, rural structures, unburnt-brick houses, clay houses.
Type B - Ordinary brick buildings, buildings of large block and prefabricated type, half timbered structures, buildings in natural hewn stone.
Type C - Reinforced buildings, well built wooden structures.

**Definition of Quantity**

| Single | Few - About 5 percent |
| Many | about 50 percent |
| **Most** | About 75 percent |

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**Table 15-2: Classification of Damage to buildings**

<table>
<thead>
<tr>
<th>Classification of Damage to buildings</th>
<th>Grade 1</th>
<th>Slight damage</th>
<th>Fine cracks in plaster; fall of small pieces of plaster</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 2</td>
<td>Moderate damage</td>
<td>Small cracks in walls; fall of fairly larger pieces of plaster; plantiles slip off; cracks in chimneys parts of chimney fall down.</td>
<td></td>
</tr>
<tr>
<td>Grade 3</td>
<td>Heavy damage</td>
<td>Large and deep cracks in walls; fall of chimneys.</td>
<td></td>
</tr>
<tr>
<td>Grade 4</td>
<td>Destruction</td>
<td>Gaps in walls; parts of buildings may collapse; separate parts of the buildings lose their cohesion; and inner walls collapse.</td>
<td></td>
</tr>
<tr>
<td>Grade 5</td>
<td>Total damage</td>
<td>Total collapse of the buildings</td>
<td></td>
</tr>
</tbody>
</table>

**Note**: Buildings built on soft soils are more likely to get damaged even if the earthquake is not particularly strong in magnitude. Similar problem persists in the alluvial plains and conditions across the river banks.

**Table 15-3: Focus areas analysis**

<table>
<thead>
<tr>
<th>15.6</th>
<th>Major Focus Areas</th>
<th>Minor Focus Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Region</td>
<td>Faridabad and Gurgaon</td>
<td>Sonipat</td>
</tr>
<tr>
<td>Surrounding</td>
<td>Delhi</td>
<td></td>
</tr>
</tbody>
</table>
Mitigation strategies that are to be incorporated while preparation of Disaster management Plans are:

1. **Main Mitigation Strategies**

   - **Engineered structures**, Architectural and engineering inputs together improve building design and construction practice. Soil type analysis before construction can help to accommodate on weak soils by adopting requisite safety measures in design.
   - Adherence to **Indian Standard Codes** for construction of buildings. Enforcement of the Byelaws including Land use control and restriction on the density and height of buildings.
   - **Strengthening** of important lifeline buildings that need to be functional post a disaster. Upgrade level of safety for hospitals, fire service buildings etc.
   - **Public awareness**, sensitization and training programmes for Architects, Builders, Contractors, Designers, Engineers, Financiers, Government functionaries, House owners, Masons etc.
   - **Reduce possible damages** from secondary effects such as like fire, floods, landslides etc. e.g. Identify potential landslide sites and restrict construction in those areas.

2. **Community Based Mitigation**

Community preparedness along with public education is vital for mitigating the earthquake impact. Earthquake drills and Public awareness programme are essential. Community based Earthquake Risk Management Project should be developed and sustainable programmes launched. Retrofitting of schools and important buildings, purchase of emergency response equipment and facilities, establishing proper insurance can be the programmes under Earthquake Risk Management Project. A large number of local masons and engineers needs to be trained in disaster resistant construction techniques.

### i. History of flood

#### Table 15-4: Major known flood disasters which have taken place in the Sub-Region

<table>
<thead>
<tr>
<th>Duration/Year</th>
<th>District Affected with in Sub-Region</th>
<th>Primary cause/Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>Sonipat, Faridabad and adjoining areas of Delhi</td>
<td>Heavy rainfall and discharge in Yamuna</td>
</tr>
<tr>
<td>1983</td>
<td>Rohtak, Sonipat, Gurgaon, Faridabad</td>
<td>Intensive rainfall</td>
</tr>
<tr>
<td>22-26th September, 1988</td>
<td>Faridabad, Sonipat</td>
<td>Heavy rainfall and discharge in Yamuna</td>
</tr>
<tr>
<td>5-15 September, 1995</td>
<td>Haryana</td>
<td>Heavy rainfall and discharge in Yamuna</td>
</tr>
<tr>
<td>June, 1996</td>
<td>Gurgaon, Mewat, Rewari, Faridabad</td>
<td>Intensive rainfall</td>
</tr>
<tr>
<td>16-20th October, 1998</td>
<td>Sonipat, Rohtak, Jhajjar</td>
<td>Intensive rainfall</td>
</tr>
<tr>
<td>5-8th August, 2008</td>
<td>Rohtak, Jhajjar, Sonipat</td>
<td>Intensive rainfall</td>
</tr>
</tbody>
</table>

*Source: Irrigation Department, Haryana*

Flood history of Haryana sub-region from 1978-2010, reveals that whenever heavy rainfall has taken place, it has resulted in flooding of district of Rohtak, Sonipat, Gurgaon & Faridabad. Sonipat & Faridabad are located on the river Yamuna & the flow of Yamuna depends on the rainfall in its catchment, including...
Himalayas, while the districts of Rohtak & Gurgaon are primarily flooded due to poor surface drainage facilities, which need to be re-sectioned to carry the floodwater. Strengthening of flood embankments along the river Yamuna may help, but has to be commensurate with the hydrology of the area, so that rainfall does not get trapped in the district.

Map 15-3: Flood Prone areas in the sub-region

Source: BMTPC, State natural Resources data Management System Centre & CWC (Central Water Commission)
ii. Flood status
Among the major disasters that occur in the sub-region, floods due to river are the most hazardous as they cause heavy damage to agricultural crops. The cause of flood is attributed to peculiarities of the rainfall in the state. The geomorphic setting of the state comprising of Himalayan topographic high in the north and Aravali mountain in the south resulted in the development of a saucer type of topographic depression in the central part of the state. The floods occur mainly due to heavy runoff in the mountainous terrain and over flow in river Yamuna in the plains during monsoon season. The active and old flood plain areas in Sub-Region are located in parts of Panipat, Sonipat and Faridabad.

iii. Analysis from existing situation
Major flood areas where disaster in the past was experienced were in Faridabad, Palwal and Panipat district. The gauge level of the Yamuna had risen up to 205-207 mm. The floods in the district of Faridabad, Palwal and Panipat are mainly due to heavy rains and over flow of River Yamuna. The districts of Faridabad, Palwal consist of hillocks, valleys and undulated terrain. Over flowing of some local streams due to rain also increases the quantum of floods. The floods in Yamuna River are caused due to excessive discharge of water from Tajewala head.

The main cause of floods in other districts like Gurgaon, Mewat, and Rohtak can be attributed to the heterogeneous topography. There is no perennial river; however a number of Barsati Nallahs/Hills Torrent can be found which crisscross the entire region and become the cause of floods during rainy season. The existence of low-lying areas in districts like Rohtak, Hajasj and Rewari could be blamed for water logging during heavy rain. Hence there is a strategy required at local level in preparedness & planning of response.

Considering that Climate change may bring about changes in the rainfall pattern further, past experience may not be adequate to plan for flood protection. On the other hand the drainage of Rohtak and Gurgaon depend on the drainage capacity through Delhi-which would require inter-state collaboration. Considering the above factors a flood management strategy is to be made involving Himachal Pradesh, Punjab, Haryana, and Delhi.

iv. Conclusions
The following tables show the categories of the districts of the sub-region into two focus areas; major and minor.

Table 15-5: Focus areas analysis:

<table>
<thead>
<tr>
<th>Minor Focus Areas</th>
<th>Major Focus Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gurgaon, Mewat &amp; Rohtak</td>
<td>Panipat, Sonipat, Faridabad &amp; Palwal</td>
</tr>
<tr>
<td>Mahendragarh</td>
<td>Delhi, Karnal</td>
</tr>
</tbody>
</table>

Table 15-6: Villages vulnerable to flooding

<table>
<thead>
<tr>
<th>District</th>
<th>Tehsil</th>
<th>Dangerously Exposed</th>
<th>Moderately Exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faridabad</td>
<td>Badshahpur, Majimabad, Dahkola, Mahawatpur, Bhupani, Mahmabadab, Faridanad Colonies-Gopi Colony, Raja Garden, Shastrti Colony, Barohi Talab, Baha Nagar, Shiv Colony</td>
<td>Sehatpur, Rajpur Kalan, Kabul pur Khadar, Chaka Majai, Kilori Khaddar, Pattimehtab, Ami Pur</td>
<td></td>
</tr>
<tr>
<td>Faridabad</td>
<td>Chhainsa, Bhanakpur, Machgar, Nawade Tigaon, Sunper, Behbalpur, Deeg, Dayalpur, Manjhawli, Akbarpur, Sotai, Chirs, Latifpur</td>
<td>Shikargarh, Garhi Begampur, Patti Parwarish, Gurason, Nangla Majra, Sikri, Ladi, Ladihyapur, Ferrozpur Kalan, Bhanankpur, Sehupura, Mohola, Sagarpur, Nangla Jogin, Sahajanpur, Chandpur, Imamudinpur, Shahupur Khadar, Zafarpur Majra Chhainsa, Walipur, Mohiyapur, Chhainsa, Neemka, Majeri</td>
<td></td>
</tr>
<tr>
<td>Ballabgarh</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>District</th>
<th>Tehsil</th>
<th>Dangerously Exposed Vulnerability</th>
<th>Moderately Exposed Vulnerability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panipat</td>
<td>Rana Majra, Pathargarh, Garhi Basic, nawada-par, Jalalpur- II, Nangla Par, Bahrmrup, Tamsabat, nawada Kurar, sanoli kalan &amp; Khurd, jhamba, ramra, Rasla Pur, pur</td>
<td>Babai, ngla, R. Chhaihpur kalan, Chhaihpur Khurd, Dhanasoli</td>
<td></td>
</tr>
<tr>
<td>Samalkha</td>
<td>Karauli, Rakshera, Budhanpur, Dehra, Raimal, Matnauli, Atta, Bilaspur, Begampur, Taharpur, Simblegarh</td>
<td>Hathwala, bastra, khkhipur, Atta, Dikadial</td>
<td></td>
</tr>
<tr>
<td>Sonipat</td>
<td>Begta, Chandoli, Pabnera, Gyaspur, Mirampur, Tikola, Jainpur, Asadpur</td>
<td>Ghasoli, Umedgarh, Rasulpur, Nisafgarh, Bakhtarwpur</td>
<td></td>
</tr>
</tbody>
</table>

Source: District Flood Control Orders

Table 15-7: Major areas and points vulnerable to floods

<table>
<thead>
<tr>
<th>District</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panipat</td>
<td>Tamsbad complex, Pathargarh complex, Sanoli bridge, Rakshera complex, Untla drain</td>
</tr>
<tr>
<td>Sonipat</td>
<td>Bega complex, Garhi Asadpur, Tikola complex, Dahesra bund, Rabra Puthi, Moi Huda, Drain No. 8 at crossing Rohtak Disty, Drain No. 8 at crossing Delhi branch</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>Raniyala minor near village Kot &amp; Kosar, Singar minor village Bakra.</td>
</tr>
<tr>
<td>Rohtak</td>
<td>Rohtak Town area, Drain No. 8 RD 186 to 213, Kunjia Fatehpur, Subana Kasni bund, Outfall drain No.8, Gundamh drain</td>
</tr>
<tr>
<td>Faridabad</td>
<td>Ali Link Drain, Embankment from Basantpur to Mohabatpur, Khidwali complex, Lalpur complex, Gurlwari complex, Sultanpur complex, Chhainsa, Thantri, Salika, Phatnagar complex, Village between Zehar nallah and old Yamuna, Alikia village</td>
</tr>
<tr>
<td>Jhajjar</td>
<td>Jatwara, Ahri, Kulana, Patauda, Luhari, Amadalpur, Chandpur, Dadanpur, Surehti, Hasanpur, Raiya, Silana, Baba, Raipur, Sabli, Zahidpur, Patasni, Jahangirpur, Surah, Kili, Munimpur, Yukubpur, Kutani, Azadgarh, Bahalgarh, Surajgarh, Koelpur, Shanjananpu, Dubaldhan, Chimni, Beri, Sheria, Gochhi</td>
</tr>
<tr>
<td>Rewari</td>
<td>Palhawas, Guraora, Neolla, Ushmapur, Rauhrai</td>
</tr>
<tr>
<td>Palwal</td>
<td>Hathin, Atoha, deeghot, Bela, Aurangabad, Teekri Gujar, Manpur, Khaambi, Bamnikhera, Badoli, Chhajju Nagar, Baghpur, Jatauli, Hodal</td>
</tr>
<tr>
<td>Mewat</td>
<td>Pinangwan, Bhadas</td>
</tr>
</tbody>
</table>

Source: Irrigation Department, Haryana
v. Mitigation strategies

There are two different ways to mitigate floods, Structural and Non-structural. Structural measures are physical measures and these help in “modifying the floods”, while non-structural measures are the planning measures that help in “modifying the losses due to floods”. In the structural measures water is kept away from people and in the non-structural measures one tries to keep the people away from water. All of these works can be individually divided into long term and short-term measures.

<table>
<thead>
<tr>
<th>Vulnerable area</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the points of view of intensity of floods the affected area/villages are classified into the following categories;</td>
</tr>
<tr>
<td><strong>Dangerously exposed area</strong>: Areas in close proximity to Yamuna River termed as dangerously exposed area</td>
</tr>
<tr>
<td><strong>Moderately exposed area</strong>: Areas far from river Yamuna or situated after dangerously exposed areas referred as moderately exposed area</td>
</tr>
</tbody>
</table>

**Structural Measures:**
- a) Water Shed Management: Timely cleaning, de-silting and deepening of natural water reservoir and drainage channels (both urban and rural).
- b) Reservoirs: The entire natural water storage place should be cleaned regularly. Encroachments on tanks and ponds or natural drainage channel should be removed monsoon.
- c) Natural water retention basins: Construction and maintenance of all the flood protection embankments, ring bunds and other bunds. Dams and levees can be constructed and used as temporarily storing space with reduced the chances of lower plains getting flooded.
- d) Buildings on elevated area: The buildings in flood prone areas should be constructed on an elevated area and if necessary on stilts and platform.

**Non-structural Measures:**
- a) Flood plain zoning: Flood plain zoning, which places restrictions on the use of land on flood plains, can reduce the cost of flood damage. Local governments may pass laws that prevent uncontrolled building or development on flood plains to limit flood risks and to protect nearby property. Landowners in areas that adopt local ordinances or laws to limit development on flood plains can purchase flood insurance to help cover the cost of damage from floods.
- b) Flood forecasting and warning: These are issued for different areas mostly by the central water Commission/ Meteorological department and by the State Irrigation/ Flood Department.

The information pertaining to flood control preparedness for the sub-region is as under:

- Identification of flood areas, which are likely to cut off people from essential commodities, making appropriate arrangements to ensure supply of food grains and other necessities until the floods recede.
- Preparation of contour maps: The contour maps of the districts should be prepared before the onset of monsoon. The danger levels should be marked on the contour plans and the areas likely to be submerged.
- Inspect & strengthen where necessary, flood protection embankment ring bunds and other bunds.
- Inspect all drains, link drains through responsible officer and remove congestion.
- Construction of new drains: based on the past experience, new drains should be constructed in the flood prone areas.
- Test pump houses
- Stock sufficient quantities of sand bags, bamboo poles & other material.
- The staff should be properly trained to fight the fury of the floods.

15.5.3 Drought Hazard & Disaster

Imprudent irrigation through canals leads to introduction of salts and alkali in the soil.

a) History: On an average, severe drought occurs once in every five years in the country, often on successive years, causing severe losses to agriculture and allied sectors. Haryana is predominantly an agrarian economy so the drought condition depends on various ground and surface water sources and rainfall. The water needs of the agricultural sector are very high, as several thousand tons of water is required to produce each metric ton of food grains. There is a need for effective monitoring of agricultural drought, its onset, progression and impact on crops to minimize the damages.
**b) Drought Hazard**

Drought (conditions of receiving less than 75% of the normal rainfall) causes an acute scarcity of moisture in the soil. The deficiency of moisture leads to loss of soil productivity, deprivation of the vegetation and initiation of desertification. Drought is a perpetual attribute in some parts of sub-region. Satellite images exhibit the district of Rewari in the Sub-Region and Mahendragarh, Bhiwani and Hissar surrounding the Sub-Region are affected by sand spread. Formation of sand dunes and sand spread causes acute moisture stress on agri lands, producing drought like situation every year.

**c) Drought status in Sub-Region**

In Haryana the status of drought is once in every 3 years and the districts frequently affected by drought in the Sub-Region are Gurgaon and Rohtak.

<table>
<thead>
<tr>
<th>Types of Drought</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Meteorological drought</strong></td>
<td>Meteorological drought is simple absence/deficit of rainfall from the normal. It is the least severe form of drought and is often identified by sunny days and hot weather.</td>
</tr>
<tr>
<td><strong>Hydrological drought</strong></td>
<td>Meteorological drought often leads to reduction of natural stream flows or groundwater levels, plus stored water supplies. Main impact is on water resource systems.</td>
</tr>
<tr>
<td><strong>Agricultural drought</strong></td>
<td>This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields. It results in the reduced seasonal output of crops &amp; other related production. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation.</td>
</tr>
<tr>
<td><strong>Socioeconomic drought</strong></td>
<td>Socioeconomic drought correlates the supply and demand of goods and services with the three above-mentioned types of drought. Drought may cause shortages in supply of economic goods.</td>
</tr>
</tbody>
</table>

**Major mitigation strategies:**

- **Drought monitoring** is continuous observation of rainfall situation, water availability in reservoirs, lakes, rivers and comparing with the existing water needs of various sectors of the society.

- **Water supply augmentation and conservation** through rainwater harvesting in houses and farmers’ fields increases the content of water available. Water harvesting by either allowing the runoff water from all the fields to a common point (e.g. Farm ponds, see the picture) or allowing it to infiltrate into the soil where it has fallen (in situ) (e.g. contour bunds, contour cultivation, raised bed planting etc) helps increase water availability for sustained agricultural production.

- Expansion of irrigation facilities reduces the drought vulnerability. Land use based on its capability helps in optimum use of land and water and can avoid the undue demand created due to their misuse.

- **Livelihood planning** identifies those livelihoods which are least affected by the drought. These include increased off-farm employment opportunities, collection of non-timber forest produce from the community forests, raising goats, and carpentry etc.

- **Drought planning**

Components of drought plan include establishing a drought taskforce; a team of specialists who advise the government to deal with drought situation, establishing coordination mechanism among various agencies which deal with the droughts, providing crop insurance schemes to the farmers to cope with the drought related crop losses, and public awareness generation.

**Public awareness and education**

Public should be educated about effective drought mitigation. This includes organizing drought information meetings for the public and media, implementing water conservation awareness programs in the mass media like television, publishing and distributing pamphlets on water conservation techniques and agricultural drought management strategies like crop contingency plans and rainwater harvesting and establishing drought information centers for easy access to the farmers.

**d) Conclusions**

**Table 15-8: Major and minor focus areas**

<table>
<thead>
<tr>
<th>Major Focus Areas</th>
<th>Minor Focus Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-Region</td>
<td>Gurgaon, Rewari and Rohtak</td>
</tr>
<tr>
<td>Surrounding</td>
<td>Bhiwani and Mahendragarh</td>
</tr>
<tr>
<td></td>
<td>Jhajjar</td>
</tr>
<tr>
<td></td>
<td>Hissar (counter magnet area),</td>
</tr>
</tbody>
</table>
15.5.4 Fire Hazard & Disaster

Fire disasters can occur above the ground (in tall buildings and on planes), on the ground, and below the ground (in mines). Sometimes they occur in circumstances that are unexpected or unpredictable.

a) Fire status in sub-region

Some of the major fire disasters that occurred in the region:

- Explosion at a firecracker factory in Rohtak, on 24/5/95 which resulted in a death toll of 23 people, which included 13 women, 6 children and 4 men.
- At least 45 people were killed (16 women and eight children) and 16 seriously injured on 7/11/1999 in Sonipat, Haryana, when a fire began due to sparks from some high-tension wires which fell over a firecracker shop and an adjoining cloth store. Some 25 stores, some of them selling plastic wares, were completely gutted.

b) Causes

- There is a low probability of natural fire hazard in the region but vulnerability of urban/ manmade fire disasters is very high in the Sub-Region.
- Major fire incidents are related to industries, power, buildings and public gathering.
- Rural areas lack fire-fighting facilities.

c) Conclusions

- Rural areas to be provided fire services in the sub-region
- Training of fire services for search and rescue operations in the aftermath of disasters and provision for adequate number of trained manpower.
- Meeting the deficiencies as per minimum requirements in the availability of fire stations and fire units at Sub-Region and district level. This would help to reduce the response time of 3-5 minutes in urban area and 7-10 minutes in rural areas.
- Establishing Fire Training Institute in the sub-region.
- Public awareness campaign, protective clothing to operational staff, better command & control system.

15.5.5 Chemical and industrial Accidents

Industrial disaster can be either rapid (minutes or hours) or sudden (no warning) depending on the nature of occurrence. Since a series of processes and reactions are involved, the onset may vary accordingly. Release of chemicals may be because of human errors, technological failure or natural activities including geological activities like earthquakes, natural fires, floods etc. The industrial facility should have monitoring and warning systems for detection of fire and building up of dangerous conditions. Explosion in some of the cases can happen. Greatest mishap in the history was Bhopal chemical gas leak.
a) Chemical and industrial Accidents Hazards
Haryana has number of industries and further growth in their numbers is expected to take advantage of proximity to Delhi. This rapid growth may lead to chemical leaks or explosions in the industrial facilities and expose people to various dangers like:

- fire spread in the industry and residential areas nearby
- Heat conditions
- Chemical gas leak (poisonous)
- Combustion of various products and heat waves
- Low oxygen levels
- Falling of structural elements and machinery
- Contamination of the nearby environment (land, water and air)

Mitigation strategies
- Hazard Mapping – inventories and maps of storage locations of toxins or hazardous substances along with the possible characteristics should be displayed and known to all. The community in the immediate vicinity should be aware of this hazard and possible effects in case of an accident should be known. The map should determine the area that may get affected in case an accident occurs. Hazard map should determine possible zone getting affected and safe route for evacuation should be marked.

- Land use planning – densely populated residential areas should be separated far away from industrial areas. A buffer zone (green belt) should separate the industrial and the residential zone.

- Community preparedness – The community should be aware of the hazardous installations and know how to combat them. The local community has to be informed about the response steps to be taken in case of an accident. Community members should monitor the pollution levels of the industry and participate in mock drills.

Other possible risk reduction measures:
- Maintain the wind flow diagram of the region, improve fire resistance and warning systems, improve fire fighting and pollution dispersion capabilities, develop emergency relief and evacuation planning for employees and nearby settlements, limit storage capacity of the toxic substances, insurance for industries and safety legislation.

b) Chemical and industrial accident status in Sub-Region
Explosion at a firecracker factory in Rohtak, Haryana on 24/5/95 resulted in a death of 23 people, which included 13 women, 6 children and 4 men. Industrial accidents at present account for 12.24% of total.

c) Analysis from existing situation
Almost all districts have major and minor industries set up in the sub-region. Major industrial centers are located in Gurgaon, Faridabad, Sonipat, Rewari and Panipat.

d) Conclusions
Hazardous industries should be identified and located on the map. Districts or areas with number of hazardous industries should prepare disaster plan within the view of extent of vulnerability for those industries. Prime hazardous industries should be located away from the residential areas. Two major hazardous industries should not be located in vicinity so that at time of mishap, one cannot lead to other.

15.5.6 Other type of Hazards
a) Water logging
In areas where there is inadequate drainage such as in topographic depressions, the rise of water table is more conspicuous during wetter periods. Excessive irrigation and seepage from canals has aggravated the problem of water logging in the Sub-Region. Satellite images reveal that large tracts of Panipat, and Rohtak were severely water-logged in addition to parts of Gurgaon, Rewari, Jhajjar and Sonipat where water logging exists in scattered locations. About 5.95 % area of the state is totally waterlogged (0-1.5m) whereas potential waterlogged (1.5-3m) areas constitute about 15.02%.

b) Soil salinity- alkalinity
The imprudent irrigation through canals leads to introduction of salts and alkali in the soil due to over irrigation, the water table rises along with their soluble salts. In the Sub-Region, alkaline soils occur in Panipat district, while saline soils are encountered towards ‘the end of the surface and sub surface flow directions’ particularly in areas of topographic depression (insufficient drainage) in the districts of Sonipat, Rohtak and Gurgaon. About 5.78% of the state area is affected by problem of soil salinity and alkalinity.
c) Epidemic
It is defined as the occurrence of an illness or other health related event that is clearly in excess of unexpected occurrence. The onset of an epidemic can be either rapid or sudden and this depends on several factors. An epidemic can be anticipated by the rise in number of people suffering from a particular disease. In some cases an epidemic can be anticipated or predicted by an increase in the vector breeding sites or in the death of the disease carriers (say plague is carried by flea on rodents).

Table 15-9: Some of the Major Epidemics observed in India:

<table>
<thead>
<tr>
<th>Year</th>
<th>Epidemic</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Cholera</td>
</tr>
<tr>
<td>2002</td>
<td>Plague</td>
</tr>
<tr>
<td>2003</td>
<td>Severe Acute Respiratory Syndrome (SARS)</td>
</tr>
<tr>
<td></td>
<td>Dengue</td>
</tr>
<tr>
<td>2005</td>
<td>Meningococcal disease</td>
</tr>
<tr>
<td></td>
<td>Japanese Encephalitis (JE)</td>
</tr>
<tr>
<td>2006</td>
<td>Avian influenza</td>
</tr>
<tr>
<td></td>
<td>Chikungunya</td>
</tr>
<tr>
<td></td>
<td>Dengue</td>
</tr>
<tr>
<td>2009</td>
<td>H1N1/ Swine flu</td>
</tr>
</tbody>
</table>

Measures to reduce risk due to Epidemics

- **Structuring of health services** is important to have clear understanding of roles and responsibilities of the public health system. Organizational preparedness and the coordination mechanism is required right from the State and District to the sub center level which is manned by the Village Health Nurses or the Health Workers.

- **Contingency Plan** for response should be prepared after identifying the epidemics that are likely to occur in the region. Early warning system through a surveillance system is the primary requirement so as to have an effective response and prevent any outbreaks. Therefore, surveillance needs to be carried out at a regular basis through the routine surveillance system by involving the health tier system. Maps of all the health facilities in the region with an inventory of drugs and vaccines, laboratory set-ups, list of number of doctors and supporting staff etc. needs to be kept ready and updated at regular intervals.

- **Training** is required to build the capacity at all levels. It will help to cope better during the emergency response period for epidemics.

- **Personnel protection** through vaccination is an effective mitigation strategy. Common sources of infection carriers can be tackled by improving the sanitary conditions, drive to check and fumigate breeding places of any vector (source of infection), improving disposal methods of waste, disinfecting the water source etc.

d) Heat waves
It is complex phenomenon resulting from a certain combination of the temperature, humidity air movement and duration. Simply stated, a heat wave is an extended period of very high summer temperatures with the potential to adversely affected communities. Heat waves are generally observed in month of April, May and June.
Chapter 15
Disaster Management

An analysis of Disaster management preparedness in the sub-region has been worked out for the above mentioned hazards. The following tables summarises the districts which are prone to hazards.

### 15.6 Analysis of Disaster Management preparedness in the sub-region

#### Table 15-10: Analysis of existing situation

<table>
<thead>
<tr>
<th>Districts of Sub-Region</th>
<th>Earth quack hazard</th>
<th>Flood Hazard</th>
<th>Drought hazard</th>
<th>Fire hazard</th>
<th>Chemical and Industrial</th>
<th>Other types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faridabad</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Palwal</td>
<td>×</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td>Panipat</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mewat</td>
<td>×</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rohtak</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sonipat</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Rewari</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Jhajjar</td>
<td>×</td>
<td>×</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

#### Table 15-11: Institutional Arrangements for different types of hazards

<table>
<thead>
<tr>
<th>Disaster</th>
<th>Nodal Ministry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Accidents</td>
<td>Ministry of Civil Aviation</td>
</tr>
<tr>
<td>Civil Strife</td>
<td>Ministry of Home Affairs</td>
</tr>
<tr>
<td>Railway Accidents</td>
<td>Ministry of Railways</td>
</tr>
<tr>
<td>Chemical Disasters</td>
<td>Ministry of Environment &amp; Forest</td>
</tr>
<tr>
<td>Biological Disasters</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>Nuclear Accident inside or outside the country</td>
<td>Dept of Atomic Energy</td>
</tr>
<tr>
<td>Natural Disasters</td>
<td>Ministry of Agriculture</td>
</tr>
</tbody>
</table>
Hierarchical implementation and responsibility

1. **STATE LEVEL:** The state has to set up a Disaster Management Authority. At the state level, the work of post-calamity relief was being handled by the Departments of Relief & Rehabilitation. The Government of India is working with the state governments to restructure the departments of Relief & Rehabilitation into departments of Disaster Management with an enhanced area of responsibility to include mitigation and preparedness apart from their present responsibilities of relief and rehabilitation.

The State has to restructure/re-group the officers/staff within the Department of Disaster Management with definite functions to pursue the holistic approach to disaster management. The four functional groups to be assigned with specific tasks within the departments as:-

- Functional Group 1: Hazard Mitigation
- Functional Group 2: Preparedness and Capacity Building
- Functional Group 3: Relief and Response
- Functional Group 4: Administration and Finance

2. **DISTRICT LEVEL:** At the district level, the District Magistrate will be the focal point for coordinating all activities relating to prevention, mitigation and preparedness apart from his existing responsibilities pertaining to response and relief. The District Coordination and Relief Committee is being reconstituted/re-designated into Disaster Management Committees with officers from relevant departments being added as members. Because of its enhanced mandate of mitigation and prevention, the district heads of the departments engaged in development are now being included in the Committee so that mitigation and prevention is mainstreamed into the district plan. The existing system of drawing up preparedness and response plans will continue. There will, however, also be a long-term mitigation plan.

3. **BLOCK/TALUKA LEVEL:** Similarly, sub-divisional and Block/Taluka level Disaster Management Committees are also being constituted. At the village level Disaster Management Committees and Disaster Management Teams are being constituted. Each village in multi-hazard prone district will have a Disaster Management Plan. The Disaster Management Committee draws up the plans consist of elected representatives at the village level, local authorities; Government functionaries including doctors/paramedics of primary health centers located in the village, primary school teachers etc. The plan encompasses prevention, mitigation and preparedness measures.

4. **VILLAGE LEVEL:** The Disaster Management Teams at the village level will consist of members of youth organizations like Nehru Yuvak Kendra Sanghathan (NYKS) and National Service Scheme (NSS) and other nongovernmental organizations as well as able-bodied volunteers from the village. The teams are provided basic training in evacuation, search and rescue, first aid trauma counseling etc. The Disaster Management Committee will review the disaster management plan at least once in a year. It would also generate awareness among the people in the village about dos’ and don’ts for specific hazards depending on the vulnerability of the village.

In the State, Disaster Management Authority stands constituted with following duties/functions:

(a) Lay down the State Disaster Management Policy;

(b) Approve the State Plan in accordance with the guidelines laid down by the National Disaster Management Authority;

(c) Approve the Disaster Management Plans prepared by the Departments of the Government of Haryana;

(d) Lay down guidelines to be followed by the Departments of the Government of Haryana for the purposes of integration of measures for prevention and mitigation of disasters in their developmental plans and projects and provide necessary technical assistance therefor;

(e) Coordinate the implementation of the State Disaster Management Plan

(f) Recommend provision of funds for preparedness and mitigation measures for Disaster Management

(g) Review the development plans prepared by the Departments of the Government at the district level, statutory authorities or local authorities with a view to make necessary provisions therein for prevention of disaster or mitigation;

(h) Review the measures being taken for mitigation, capacity building and preparedness by the departments of the Government of Haryana and issue such guidelines as may be necessary.
Table 15-12: Institutional responsibility and arrangements for specific disasters

<table>
<thead>
<tr>
<th>District</th>
<th>Name of Plan / document</th>
<th>Prepared by</th>
<th>Dated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palwal</td>
<td>Disaster Management Plan for District Palwal-2009</td>
<td>District Administration</td>
<td>2009</td>
</tr>
<tr>
<td>Gurgaon</td>
<td>District Disaster Management Plan</td>
<td>District Disaster Management Authority, Gurgaon District, Haryana</td>
<td>26th January, 2011</td>
</tr>
<tr>
<td>Jhajjar</td>
<td>District Disaster Management Plan</td>
<td>District Administration (Deputy Commissioner, District Jhajjar)</td>
<td>2011</td>
</tr>
<tr>
<td>Rewari</td>
<td>District Disaster Management Plan - Rewari</td>
<td>District Administration, Rewari</td>
<td>2012</td>
</tr>
<tr>
<td>Panipat</td>
<td>District disaster management plan-2012, Panipat</td>
<td>District Administration, Panipat</td>
<td>2012</td>
</tr>
<tr>
<td>Rohtak</td>
<td>Disaster management plan of district Rohtak</td>
<td>District Administration, Rohtak</td>
<td></td>
</tr>
<tr>
<td>Mewat</td>
<td>District disaster management plan, Mewat-Nuh</td>
<td>District Administration (Dep. Commissioner, Mewat-Nuh)</td>
<td>2010-2011</td>
</tr>
</tbody>
</table>
| Faridabad| 1. Household emergency plan  
2. Flood Management plan 97 _ Faridabad-2012  
3. Agriculture Contingency Plan | Various | 2011  
2012  
2008 |

Source: Various Govt. Websites

It is apparent from above that Disaster Management Plans have been prepared for each of the nine districts of the sub-region. District Disaster Management Committees have also been formed in each of these Districts. Disaster Management Plans (DDMP) defines role and responsibilities of the different Government departments, NGO’s and general public for pre and post disaster management.

15.7 Safety Measures against hazards

15.7.1 Risk reduction can take place in two ways:

1. Preparedness

This protective process embraces measures that enable governments, communities and individuals to respond rapidly to disaster situations. Preparedness includes the formulation of viable emergency plans, the development of warning systems, the maintenance of inventories and the training of personnel. It includes search and rescue measures as well as evacuation plans for areas that may be at risk from a recurring disaster.

Preparedness therefore, encompasses those measures taken before a disaster event that are aimed at minimizing loss of life, disruption of critical services, and damage when the disaster occurs. It is supported by appropriate legislation with clear allocation of responsibilities and budgetary provisions.

2. Mitigation

Mitigation embraces all measures taken to reduce the effect of the hazard itself and the vulnerable conditions in order to reduce the scale of a future disaster. Therefore, mitigation activities can be focused on the hazard itself or the elements exposed to the threat. Examples of mitigation measures are hazard specific include modifying the occurrence of the hazard, e.g. water management in drought prone areas, avoiding the hazard by sitting people away from the hazard and by strengthening structures to reduce damage when a hazard occurs. In addition to these physical measures, mitigation should be aimed at reducing the physical, economic and social vulnerability to threats and the underlying causes for this vulnerability.

15.7.2 Safety against Earthquake Hazards

As far as earthquakes are concerned the BIS codes are:

2. IS 4326:1993 Earthquake Resistant Design and Construction of Buildings
3. IS 13827:1993 Improving Earthquake Resistance of Earthen Buildings
15.7.3 Safety against Underground Blasts

Underground blasts are covered by:

1. IS 6922:1973 Criteria for Safety and Design of Structures subject to Underground Blasts and

15.7.4 Safety against Floods

IS-13739:1993 Guidelines for estimation of flood damages, scientific procedure for collection of flood damages is given along with methods to quantify losses.

Mitigation measures are as follows:

- Flood control order every year by DC office
- Drains should be maintained and monitored
- No. of drains should be increased
- Gullies, manholes and storm water carriers must be cleared from silt before the rainy season
- Flood warning system must be present
- Drinking water supply should be improved (specially in flood affected areas)

15.7.5 Safety against Landslides

Bureau of Indian Standards has published:

1. IS 14496 (Part2):1998 Guidelines for preparation of landslide hazard zonation maps in mountainous terrain,
2. IS 14458 Guidelines for Retaining Walls for Hilly areas (3 Parts),
3. IS 14680:1999 Guidelines for Landslide Control, and

15.7.6 Safety against Fire Hazards

National Building Code, Part 4 provides comprehensive recommendations for minimum standards of fire protection. It specifies the demarcation of fire zones, restrictions on construction of buildings in each fire zone, classification of buildings based on occupancy, types of building construction according to fire resistance of the structural and non-structural components and other restrictions and requirements necessary to minimize danger to life from fire, smoke, fumes or panic before the building can be evacuated. It is essential to introduce accountability at all levels regarding safety of buildings and infrastructure.

15.8 Policies and Proposals

For disaster management, the following policies and strategies are proposed:

i) Disaster management is a multi-sectoral, multi-disciplinary subject, which involves many groups. Therefore, all the groups (Government/NGOs/Community) are required to work together. There is a need to have proper planning at various levels for disaster preparedness, mitigation and response. Disaster Management Committee (DMC) be constituted at Sub-Regional Level and District Disaster Management Committee (DDMC) at district level. The Committee should meet at least twice a year.

ii) Human resource development is an important aspect of capacity building where several players are involved. For this, training programmes are essential for people from various organizations. Organizing workshops, seminars, research activities etc. should be undertaken periodically. For
centralized and standardized capacity development of the community and the first responders, one or both the Administrative Training Institutes, which are located within the NCR region, may be identified. Additional faculty may have to be provided to take on the additional training load. Disaster Management Centres may be established at strategic locations in the Sub-Region for sensitizing people, training of personnel and mitigation measures. Community awareness and capacity building within the community and government should be undertaken at all the three levels: National, State and Districts including villages. These would need to cover education and research, public sensitisation and awareness and institutional strengthening and development.

iii) The Emergency Response Centers (ERC) shall be setup, both in terms of manpower and resource. Number of Centers can be assessed by a team of professionals. These Centers will have the resources (man-power, equipment and material) and resilient communication system and will function on the concept of incident Response System. These ERCs shall function under the EOC, NCR.

iv) Efforts shall be made on using state of art technologies viz. GIS, GPS, remote sensing, computer modeling and expert systems, electronic information and management systems etc. for collection, storage, retrieval and dissemination of information. The control rooms shall be modernized and made more effective and community friendly in the participating States.

v) Detailed database shall be compiled on the occurrence of hazards, damage caused to buildings and infrastructure and the economic losses suffered by various government departments, public and private enterprises, agriculture and horticulture and the related infrastructure in the area. This information shall be widely publicized to create awareness among public. District administration shall be prepared for all eventualities in future.

vi) Telecommunications in terms of disaster warning systems should be set up at all the levels to ensure timely and accurate dissemination of warnings to the vulnerable community even at remote places in vernacular languages. Disaster warning sets may be located in the State and district level headquarters.

vii) A complete techno-legal regime has to be proposed for amending the present building bye-laws to include safety aspects from natural hazard’s point of view. The relevant Town and Country Planning Acts, Development and Municipal Acts of the participating States should be carefully examined and amendments, if any, shall be carried out to incorporate necessary provisions on safety aspects relating to natural hazards. All multi-storied and high-risk buildings [as defined by the Earthquake manuals and National Building Code (NBC)] should be established keeping in view their ability to withstand earthquake of the defined intensity.

viii) The States need to take up review of relief manuals and scarcity preparedness guidelines to suit local needs and geo-climatic conditions. Appropriate guidelines have to be developed to cover the aspects of land use zoning, hazard resistant building construction. Transfer of better technologies can be effected through building centers.

ix) The vulnerability and risk assessment due to natural hazards shall be carried out and Prevention cum Preparedness Plan shall be prepared. Priority be given to public buildings (such as hospitals, educational institutional, power stations, infrastructures, heritage monuments, life-line structures and those which are likely to attract large congregation) keeping in view their ability to withstand earthquake of the defined intensity. Suitable action shall be taken for retrofitting and strengthening of structures identified as vulnerable as per earthquake manuals and National Building Code (NBC). Innovative construction technologies should be studied and implemented.
x) Keeping in view the geotectonic features of the Sub-Region, it is observed that rocky ridges, although form a small part (as indicated in Map 15.1), yet act as water divides for recharging the aquifer of the surrounding areas and therefore, should be kept preserved.

xi) Seismic micro-zonation on a scale of 1: 50,000 to 1:10,000 shall be done for towns and cities. Seismic microzonation is conducted for physical environment of towns and cities for proper physical planning. Seismic micro-zonation for selected areas/towns, having high growth rates be taken up on priority.

xii) Better spatial/physical town planning that anticipates disaster preparedness and need for evacuation and emergency services.

xiii) Flood: Different areas in the Sub-Region, which are liable to flooding in rivers of return period of 5, 10, 25, 50 and 100 years, shall be identified on map for land use zoning at regional and Sub-regional levels. Detailed Contour Maps on a scale of 1:1,5000 at a contour interval of 0.3 to 0.5 metre shall be prepared to identify the flood prone areas.

xiv) High Winds: Since, desert is extending eastward in the southern part of NCR, suitable measures should be adopted to arrest the tendency of desert extension in the Sub-Region.

xv) Fire: Comprehensive risk evaluation of growing towns shall be undertaken on priority in order to identify areas in each town vulnerable to fires and database in terms of available equipments and personnel shall be compiled and periodically updated. Areas in cities and towns in the Sub-Region may be classified as High Vulnerability, Moderate Vulnerability, and Low Vulnerability from fire hazard’s point of view. Fire safety measures for different areas shall be worked out as per the basic character of cities/towns. Part IV of National Building Code and other related Indian Standards provide safety regulations, which should be followed as guide for formulating Development Control Rules/bye-laws for mitigation of the fire hazard. Further, Fire departments/authorities should be involved in planning for Sub-Region from the initial stage so that there is a coordinated effort among different participating States also.

xvi) CBRN Preparedness need to be ensured by formulating and enforcement of mitigation measures, creating trained Specialist Response teams including Medical First Responders, equipping them with all protection, detection, decontamination and medical logistics with evacuation assets, communication and networking systems with appropriate intra-hospital and inter-linkages with Police, Fire & Emergency services, telemedicine/tele-health services. The Preparedness plans should be covered under District Disaster Management Plan.

xvii) Psycho-social Support and Mental Health Services should be an integral part of the District Disaster Management Plan.

15.8.1 Strategies for Disaster Management

(i) Prepare Disaster Management plans; revising town planning bye-laws and adopting model bye-laws; disseminating earthquake-resistant building codes, the National Building Code 2005 and other safety codes.

(ii) Preparation of Seismic Zonation Map is a urgent need to safe guard or to take preventive action against disaster. A study shall be initiated for preparation of Seismic Hazard Microzonation (SHM) Map for the sub-region.

(iii) Training trainers in professional and technical institutions; training professionals like engineers, architects, and masons in earthquake-resistant construction.

(iv) Launching demonstration projects and public awareness campaigns to disseminate earthquake-resistant techniques, seismic safety and seismic risk reduction.
(v) Enforcing and monitoring compliance of earthquake-resistant building codes, town planning byelaws and other safety regulations; establishing an appropriate mechanism for compliance review of all construction designs submitted to ULBs; undertaking mandatory technical audit of structural designs of major projects by the respective competent authorities.

(vi) Develop an inventory of the existing built environment; assessing its seismic risk and vulnerability by carrying out a structural safety audit of all critical lifeline structures.

(vii) Develop and undertake seismic strengthening and retrofitting standards for existing critical lifeline structures, initially as pilot projects and for other critical lifeline structures in a phased manner.

(viii) Increase awareness of earthquake risk and vulnerability and seismic risk reduction measures to various stakeholders through sensitization workshops, seminars and public awareness campaigns.

(ix) Prepare state and district DM plans, with specific reference to the management of earthquakes.

(x) Prepare community and village level DM plans, with specific reference to management of earthquakes.

(xi) Carry out the vulnerability mapping of earthquake-prone areas and creating inventory of resources for effective response.

15.9 Factors considered in seismic safety as per Building Code IS: 4326-1993
The most important factors considered in the Code for ensuring seismic safety of various category buildings are the following:

I) For safety of walls
   (i) Mortar used in foundations and walls
   (ii) Size and placing of door, window openings in walls
   (iii) Length of wall between cross walls
   (iv) Height of wall above floor to ceiling
   (v) Unconnected perpendicular walls.
   (vi) Provision of horizontal seismic bands at
        (a) plinth level
        (b) door and window lintel level
        (c) ceiling of flat floor/roof, or eave level of sloping roofs
        (d) gable ends and top of ridge wall
        (e) window sill level
   (vii) Provision of vertical steel bar
        (a) at each corner/junction of walls
        (b) at door & window jambs

II) For safety of roofs or floors
    (i) Roofs/floors with prefabricated or precast elements
    (ii) Cantilever balconies
    (iii) Roofs/floors with wooden joists with various covering elements
    (iv) Jack arch roof or floors
    (v) Sloping roofs with sheets or tile covering
    (vi) Sloping raftered roofs

15.10 General guidance about seismic safety of masonry buildings
(a) A single storeyed building using one brick thick walls will be relatively safer than three storeyed one. The fourth storey, if added, will be unsafe, and will make the lower storeys more vulnerable.
(b) Use of half – brick thick load bearing walls will make the storey very unsafe during seismic Intensity VIII on MSK Intensity scale and, if used in 3rd or 4th storey, it may have a catastrophic failure.
(c) Too many window openings make a wall weaker, and use of smaller size piers less than 18 inches (45 cm) in width between them will increase the damageability even higher.
(d) Richer cement-sand mortar of 1:4 mixture (1 part cement by 4 parts of sand) makes the masonry stronger against earthquake shaking as compared with 1:6 mortar by a factor of 2.5 to 3.0. Also 1:6 mortar is stronger than limecinder or lime-surkhi mortar.

(e) Use of clay mud mortar produces the weakest masonry. Its strength in dry condition reduces to less than 50 percent when the walls get wet during rains. Hence, use of good plastering is essential to protect such masonry during rainy months.

(f) Longer walls between consecutive cross walls are found weaker than shorter walls. The length is controlled for safety by limiting its length to thickness ratio.

(g) Taller walls between any two floors are found to be weaker than shorter walls. The storey height is controlled by limiting its height to thickness ratio.

(h) All four walls enclosing a room should be properly connected at each corner. Walls not so connected will easily separate at corners and overturn under the earthquake motion.

(i) The most important seismic safety requirement is provision of seismic bands in all storeys in all external as well as internal walls. These bands maintain the integrity of the whole building as one unit under earthquake shaking. Besides the earthquake safety, they also increase the stability of the walls under the vertical loads.

(j) The roof structure of the sloping roofs needs its integrity through bracing and proper connectivity with the walls. Such integrity is automatically provided by reinforced concrete slabs wherever used for floors and the roof.

15.11 Disaster Management Proposal/strategies: Broad guidelines for management of a disaster are as under:

- Drought management
  - Average frequency of occurrence of drought is 3 yrs
  - Agricultural activities majorly affected by drought
  - Areas affected most by drought are Gurgaon, Rewari and Rohtak. Practices in Irrigation need to be improved using drip irrigation and conservative systems for watering of the crops

- Proposed measures for safety against Fire hazard in the sub-region (mitigation strategies against fire hazards have been given in Annexure 15.1):
  - Fire safety services to be provided in the rural and urban areas of the sub-region
  - Training of fire services for search and rescue operations in the aftermath of disasters and provision for adequate number of trained manpower.

- Meeting the deficiencies as per minimum requirements in the availability of fire stations and fire units at Sub-Region and district level should be an immediate priority. This would aim to reduce response time to 3-5 minutes in urban area and 7-10 minutes in rural areas.

- Establishing one Fire Training Institute in the sub-region.

- Public awareness campaign and protective clothing to be provided to operational staff, better command & control system.

- Major industrial centres located in Gurgaon, Faridabad, Sonipat, Rewari and Panipat need to be protected against hazards due to chemical leaks and accidents.
  - Hazardous industries should be identified and located on the map
  - Districts or areas with number of hazardous industries should prepare disaster plan within the view of extent of vulnerability for those industries.
  - Hazardous industries should be located away from the existing and proposed residential area.
  - Two types of major hazardous industries should not be located in vicinity so that at time of mishap, one does not pass on the mishap to the other.
Sub-Regional Plan for Haryana Sub-Region of NCR-2021

Chapter 15

Disaster Management

Town and Country Planning Department, Haryana

### Annexure 15-1: Mitigation strategies against Fire hazards

- **Flammable Chemical Proper Handling and Storage procedures:**
  Chemicals use and storage at the university are either covered under the specific Chemical Hygiene Plan in each or laboratory or under the Hazard Communications Policy. These plans and policy define safe storage and handling of chemicals. Basically, either follows the manufactures recommendation or industry standards and guidelines.

- **Potential ignition sources and their control procedures:**
  Open flames, electrical equipment, heat producing devices, and use and disposal of chemicals. The control procedures for these sources are detailed in the Chemical Hygiene Plan, and the following guidelines 5.1 Office Safety, 7.1 General Shop and Work Site Safety, 7.10 Welding and Cutting, and 11.6 Hazardous Waste Satellite Accumulations Areas. Smoking is not permitted in the interior of any University vehicle or building, with the exception of residence halls.

- **Types of Fire Protection Equipment and systems to control fires:**
  Many systems are in place including the following; Fire suppression equipment (sprinklers and fire extinguishers); Proper storage areas (flammable storage rooms and cabinets); Fire alarms and detectors; Building systems such as doors, walls, ceilings, and floors.

- **Job Titles responsible for maintenance of systems installed to prevent or control ignitions or fires:**
  Various groups at Facilities Management (FM) including: Electrical Shop, Plumbing Shop, and Carpenter Shop. See Director of Facilities Management for details.

- **Job Titles responsible for control of fuel source hazards:**
  All employees who use or store fuel sources are also responsible for there control. Major sources such as heating plants and gasoline storage are the responsibility of Facilities Management (FM) shops such as the Steam Plant, HVAC shop, and the Garage.

- **Housekeeping:**
  Housekeeping is the responsibility of the individual employee and facilities management. In general, the individual is responsible for their workspace and the facilities management is responsible for waste receptacles and the common spaces on campus. Hazardous waste is removed upon request of the waste generators by the department of Environmental Health and Safety.

- **Training:**
  All employees are required to receive Basic Safety and Area Specific training upon beginning at the University and annually thereafter, included in this training are fire prevention and emergency action plan training.

- **Maintenance:**
  The maintenance of heat producing equipment is the responsibility of the department and employees using the equipment. In the case of area specific equipment such as coffee pots, microwave ovens, and hot plate it is the responsibility of the department using the workspace. In the building systems it would be the responsibility of Facilities Management. In all cases employees would follow the manufacturer's instructions and practices or industry standards as appropriate.

- **Specific Guidelines:**
  Decorations for any mass gathering event should observe the following safety precautions:
  - All trees and wreaths are to be artificial and flame-resistant. Unless specifically inspected and approved by the Fire Department. Documentation should be available to prove their flame resistance.
  - Only use decorations that are noncombustible or have a label that states that they are “flameproof,” “flame-resistant,” or “flame-retardant.” Keep the label to document acceptability.
  - Electric lights or lit decorations are acceptable only if they are labeled with Underwriters Laboratory or Factory Mutual approval. Inspect light strings for frayed or bare wires, cracked sockets, loose connections and damaged insulation. Replace the entire string of lights if any of these safety deficiencies are present. Always follow the manufacturer’s recommendations.
  - No lit candles, open flames, or spark-producing devices are permitted.
  - Do not obstruct corridors, stairways, exits or doors from closing. Decorations are not to be hung so as to obstruct exit lights, sprinkler pipes or heads, smoke detectors, fire alarm pull stations, portable fire extinguishers or cabinets, or other safety apparatus.
  - Do not place decorations near electrical equipment or other heat sources.
  - Do not hang Decorations from sprinkler heads.
  - Do not route electrical cords across aisles or corridors (tripping hazard) or under doors.
  - Keep extension cords to a minimum. Extension cords must have 3-prong grounded outlets.

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