BLOCK 1 INCREASED UNDERSTANDING OF DISASTERS - I

Block Introduction

This is the first Block of the Course on Disaster Management: Methods and Techniques (CDM-02). It has four Units. The block provides a detailed understanding of the occurrence of the four major disasters i.e. earthquake, flood, cyclone, drought and famine, damage caused by them, the government policy pertaining to provision of relief and rehabilitation and other related aspects.

UNIT 1 Earthquake

Earthquake is one of the most dangerous and instantaneously destructive natural hazards. A large portion of India is vulnerable to earthquake activity of varying magnitude particularly in tlie Northern Himalayan region. This unit focuses on their impact on the life and property of tlie people, with particular reference to some recent earthquakes in the country. Various relief and rehabilitation measures are discussed. The unit also highlights the lessons learnt from tlie past experiences so as to ensure better handling of future earthquakes to minimize the resultant damage.

UNIT 2. *Flood* and Drainage

Flood and drainage congestion are the phenomena of nature that have caused great havoc of disaster dimensions in India. The unit identifies the major flood prone areas in India, the extent of the vulnerability and damage experienced in the past due to floods and drainage congestion. It highlights the main thrust of flood management efforts and tlie structural as also lion-structural measures to deal with floods. The unit also brings forth tlie lessons learnt from previous experiences in handling floods that would prove helpful in future.

UNIT 3 *Cyclone*

This unit examines, in brief, the three major cyclones that wreaked havoc in India in the recent years. This includes the infamous super cyclone of 1999 that struck Orissa. An analysis of the extent of damage caused by cyclones has been attempted. The role of different administrative agencies in providing the relief and rehabilitation has also been discussed.

UNIT 4 Drought and Famine

Drought and Famine have devastating long term effects on the economy leading to problems like social and economic destabilization, epidemics, malnutrition and migration. This unit analyses the damage caused by drought in India with particular reference to the two recent major droughts that have occurred in 1982 and 1987. It focuses on various components of relief and rehabilitation measures. The government policy towards drought management with its emphasis on integrated disaster preparedness is discussed. This unit attempts to develop a clear understanding of tlie lessons learnt from handling the earlier situations that would facilitate further improvements in drought management.

UNIT 1 EARTHQUAKE

Structure

1.0 OBJECTIVES

After studying this Unit, you should be able to:

- discuss some of tlie damaging earthquakes that have occurred in recent years in India;
- describe tlie important aspects of rescue and relief in the areas affected by earthquake;
- highlight the lessons learnt from these earthquakes and identify tlie seismic zones in-the country ; and
- understand the government action pertaining to relief and rehabilitation.

1.1 INTRODUCTION

Earthquakes are one of the most dangerous and instantaneously destructive natural hazards. The impact of the eartliquake phenomenon is sudden with hardly any warning. It is not possible to forecast earthquakes in terms of exact time of occurrence, place of occurrence and magnitude of tlie event. Thus, such a situation gives no time for making preparations at that stage to reduce tlie loss of lives and property. Tlie major damage in case of earthquake takes place in terms of collapse of buildings and damage to infrastructural facilities, disrupting the normal life., Electric short circuits and gas leaks can create big fires and broken water mains and damaged water tanks can lead to severe flooding compounding the misery of tlie affected community. A large portion of our country is vulnerable to earthquake activity of varying magnitudes. Most of tlie highly vulnerable areas are in the Himalayan and sub-Himalayan regions, Andaman and Nicobar Islands and Kutch area of Gujarat. These areas have faced at least six earthquakes of magnitude 8 + on tlie Richter scale in the period of recorded history of eartliquakes in tlie country.

The nature and impact of earthquake disaster is dependent upon a number of factors including its magnitude, geological and soil conditions, location of fault, construction of major structures and prevailing construction practices in tlie particular areas. Tlie occurrence of eartliquakes of significance is increasingly felt even in regions that were earlier considered less vulnerable to earthquakes. For example, tlie Latur earthquake of September 30, 1993, occurred in seismic zone one. As per the seismic zone map of the country, this area was considered to be less active seismically. On tlie other hand, tlie devastating earthquake at Bhuj (Gujarat) on January 26, 2001 occurred in a highly prone area. Thus, no place seems to be free from tlie fear of eartliquakes, big or small. Hence it is essential to have a good understanding of this phenomenon in the Indian context.

1.2 SOME DAMAGING EARTHQUAKES IN INDIA – AN OVERVIEW

Earthquakes are categorized according to their magnitude in five categories as follows:

Less than 3 in magnitude: Mild, micro or tremor;

3 to 4.9: slight;

5 to 6.9: moderate;

7 to 7.9: great; and

8 or more: very great

India has a very long history of earthquakes. The occurrence of earthquake is riot a new phenomenon for most of the northern parts of our country. In the past we have already faced some major earthquakes like Rann of Kutch (1 819) magnitude 8.0, Assam (1897) magnitude 8.7, Kangra (H.P.) (1905) magnitude 8.0, Bihar-Nepal border (1934) magnitude 8.4, Andaman Islands (1941) magnitude 8.0 and Assam (1950) magnitude 8.6. Besides these major earthquakes, a large number of other moderate and minor earthquakes have been experienced in different parts of the country. In the recent past, India experienced major earthquakes at Uttarkaslii (1991), Latur (1993) and Jabalpur (1997), Chamoli (1999) and Bhuj (2001). In this section we will discuss in detail a few of these recent earthquakes.

1.2.1 Uttarkashi Earthquake

Table 1: Fact Sheet of Uttarkashi Earthquake

Magnitude of the Earthquake	6.6 on Richter Scale
Date of occurrence	20 October, 1991
Focal depth	12 km
Epicenter	Village Agora (30.7^0 N, 78.68" E)
'rime of occurrence	02 h 53 m 16 s
People killed	770
People injured	5000
Cattle head lost	3100
Houses fully destroyed	20184
I-louses partially damaged	74714
Villages affected	2093
Affected property	425000

a) Seismic History of the Region

The earthquake affected area has a ltnown Iiistory of earthquake occurrence. In the last 100 years, this region had experienced about eleven earthquakes of magnitude ranging 6.0 and 6.6 on Richter scale. The return period for the earthquake of similar magnitude is about 8-9 years. The entire area is under seismic zones IV and V with a higher vulnerability for seismic losses.

Widespread damage took place due to this earthquake. The detailed break-up of the damage under various categories grouped by Districts is given in Table 2.

Table 2: Damage Due to Uttarkashi Earthquake 1991

District	Affected Villages (No.)	Affected Population (in lakh)	Damaged Houses		Human Lives lost	Injured Persons	Cattle loss
			Fully	Partly			
Uttarkashi	601	2.50	14857	19811	653	4710	562
Tehri Garhwal	605	1.00	4730	21954	63	43	71
Chamoli	699	0.72	573	1973	2	18	10
Dehradun	116	0.02	26	452			9
Pauri Garhwal	72	0.01	34	449	-	3	5
Nainital	-		2	4			
Total	2003	4.25	20222	44643	718	4774	657

Source: Deptt. Of Revenue and Relief, Govt. of U.P, April,1994

i) Damage to Buildings/Houses:

The buildings/houses in the earthquake affected area can be classified into' (a) engineered and (b) non-engineered structures. It has been observecl that tlie performance of these two types of buildings during the earthquake was different. Tlie non-engineered buildings found throughout tlie rural areas and tlie old stone buildings in the towns suffered severe damage. The engineered buildings were also there in the earthquake affected area such as the buildings in the irrigation project colony at Maneri and Indo -Tibetan Border Police Colony at Mahitanda. Buildings in both these colonies faced the earth quake in a very safe manner and suffered no damage, except for minor cracks in tlie buildings that were observed.

ii) Damage to Infrastructural Facilities

Large scale damage to infrastructural facilities took place in the earthquake affected area. The damage to roads was due to rockfall, land-slides and rock-slides along tlie road side slopes causing heavy damage to road network in the earthquake affected areas. The other services like communication network and power supply system were affected very badly due to the severe damage to telephone and electric poles. In case of social infrastructure, tlie buildings that house health and education facilities had suffered damage. Tlie surface water tanks at Uttarkashi and Maneri did not suffer any damage, however, the joints in the piped supply lines failed clue to ground shaking, resulting in disruption of the water supply in certain areas for quite some time.

iii) Damage to Bridges:

Due to difficult terrain a large number of bridges were located to cross the rivers and deep river valleys throughout the hilly area. Tlie performance of steel bridges was found satisfactory except the Gawana bridge on the road to Cangotri about six km. from Uttarkashi. The stone

masonry tower suspension foot bridge suffered slight to medium damages.

b) Rescue and Relief

It was quite a difficult tash for the administration to organise relief work just after the earthquake due to heavy damage to roads, communication network and bridges etc. The prime issue involved in the first stage of rescue and relief was to reach tlie affected village with necessary relief materials like food, warm clothes, medicines etc. For this purpose, the army and other para military forces like Border Security Force (BSF), Indo Tibetan Border Police (ITBP) alongwith the services of Directorate General for Border Roads (DGBR) were pressed into service. A large number of other social groups like NCC cadets, NSS volunteers, Task Force of Uttarkashi administration and several NGOs also came forward lo help the local administration in the rescue and relief operations. To reach the inaccessible villages, the services of five heavy and seven light army helicopters were utilised immediately after the earthquake. The DGBR took up the challenge of repairing the damaged roads on a war fooling. The government provided food items like flour, pulses, rice, oil. sugar, milk, sliced bread etc. As the winter season was approaching fast, it was not possible to reconstruct all damaged houses; hence community centres were immediately constructed lo provide sheller to the affected community. Besides the community centres, tin sheets, tarpoline and tents along with blankets were distributed free of cost to protect people from the cold. The district wise distribution of these items is given in the Table 3.

Table 3: Distribution of Relief Materials

Districts	Tin Sheets	Tarpoline/Tents	Blankets
Uttarkashi	338241	33123	102277
Tehri Garhwal	170280	8792	25093
Chamoli	11576	620	3654
Dehradun	776	-	-
Total	**520873**	**42535**	**131024**

Source: Department of Revenue and Relief, Govt of U.P. Lucknow

To provide relief to the people. who had lost every thing as a result of this earthquake, the government had issued orders lo pay each family Rs.750/- per month from November.1991 lo January, 1992. Later on, this amount was raised to Rs.3000/- per family. This amount included the cost of 20 kg. of food items, one blanket per person upto a maximum of 5 blankets per family and a cash subsidy of Rs. 200/- per unit per family.

a) Reconstruction of Earthquake Affected Area

In order to reconstruct the houses which had been damaged completely by the earthquake, a detailed district wise scheme was drawn up. The finances for this scheme were procured from HUDCO and under Indira Awas Yojna. The details of the reconstruction and the progress reported upto April 1994 is given in Table 4.

District	HUDCO		Indira Awas Yojna	
	Houses Constructed	Houses Under Construction	I-louses Constructed	Houses Under Construction
Uttarkashi	1798	160	2810	26
Tehri Garhwal	3479	-	954	-
Chamoli	243	-	93	-
Total	15520	160	3863	26

Source: Department of Revenue and Relief, Govt. of U.P. Lucknow

1.2.2 Latur Earthquake

An earthquake of moderate magnitude of 6.4 (on Richter scale) struck the Marathwada region of Maharashtra state on 30th September 1993. The impact of this earthquake was felt in the adjoining states of Andhra Pradesh and Karnataka also. In all, eight districts in Maharashtra and three districts in Karnataka have been affected. However, the severely affected areas were mainly the Latur and Osmanabad districts of Maharashtra. The total area affected due to this earthquake was about *52,000* sq. km. The fact sheet of the earthquake is given in Table 5.

a) Seismic History of tlie Region

The major portion of tlie earthquake affected area lies in zone one of the seismic zone map of India. Accordingly, prior to this earthquake this area was considered relatively safe from tlie earthquake point of view because geologically speaking, it was located in a stable continental region (SCR). The village Killari, where the impact of the earthquake was most severe, had earlier also, prior to this earthquake cxperienccd small tremors in 1962, 1967. 1983 and 1992. In 1992, about 125 termors were felt between August and October 18-19,1992.

Damage due to Latur Earthquake

Widespread damage toolc place due to this earthquake. About 25 villages around the epicenter of tlie earthquake were damaged very severely while another 58 villages suffered severe damages. The entire region had a traditional system of dwelling unit construction which involved heavy stone walls, and a massive roof over the wooden timber sub-structure. The wall has been constructed in such a manner that it could not resist tlie impact of any earthquake. During tlie earthquake most of the houses were destroyed causing death of people in large numbers as also a wide spread damage to installations and properties in the affected areas as indicated in Table 5.

Table 5: Fact Sheet of Latur Earthquake

Magnitude of the earthquake	5.4 on Richter Scale
Date of occurrence	Scp. 30.1993
Focal depth	15Km.
Epicenter	Village Killari (76.34° E, 18.03°N)
Time of occurrence	3h, 55m, 47.5 S
People killed	9484
Cattle head lost	14845
Houses fully damaged	34313
Houses partially damaged	16.5 lakh
Villages affected	95.8
Affected property	30000

Besides the housing, other infrastructural facilities also received severe damages. The infrastructural losses incurred in the two worst affected districts of Latur and Osmanabad are shown in Table 6.

Table 6: **Infrastructural** losses due to Latur **Earthquake**

Types of Infrastructure	Amount Lost (Rs. in Million)		
	Latur	**Osmanabad**	**Total**
Electric Installation		4.60	8.50
Water Supply System	7.20	9.70	16.90
School buildings	35.50	59.00	94.50
Samaj Mandirs	3.70	1.80	5.50
Health Department Buildings	14.44	20.80	35.24
PWD Buildings	12.80	19.50	32.30
Gram Panchayat Buildings	4.00	24.00	28.00
Total	**81.54**	**139.40**	**220.94**

Source: Government of Maharashtra Rehabilitation Proposals

b) Rescue **and** Relief:

In the aftermath of the earthquake an overwhelming response by administration, voluntary organisations and local community was noticed. Army services were pressed into action for the rescue operation. This involved clearance of rubble, rescuing the injured, removal and cremation of dead bodies. The army personnel had succeeded in rescuing about 9000 people. Along with the treatment of injured , medical teams were deputed to take up the preventive measures against the spread of any epidemic. Provisions were made for temporary relief shelters to the survivors of the earthquake. These shelters were made up of G.I. (galvanized iron) sheeted roofs over the bamboo or wooden frames. About 30,000 families were provided the temporary shelters in the two worst affected districts of Latur and Osmanabad.

c) Rehabilitation of Earthq **uake** Affected Area:

The Government of Maharashtra had started a very ambitious programme for the rehabilitation of the earthquake affected area. The Maharashtra Earthquake Reconstruction Project (1993) was one of the most comprehensive. reconstruction and mitigation projects ever taken up in India. It encompassed all aspects of complete rehabilitation. This programme had the following components.

i) Housing Construction and **Repair**

Under the rehabilitation programme, about 49 villages were rehabilitated on new sites with 23000 houses and all necessary infrastructure and amenities. About 29,600 houses were reconstructed while 1,80,000 houses were retrofitted, for better earthquake resistance.

ii) Infrastructure

This comprised repair, reconstruction and strengthening of public buildings and other infrastructure including schools, health centres, social service facilities, roads, bridges, etc. .

iii) Economic Rehabilitation

This included the replacement and reconstruction on a grant basis, of business losses/agricultural losses like minor equipment, bullocks, milch cattle. sheep, goats and repair and reconstruction of dry wells.

iv) Social Rehabilitation

Under this head provision was made for special facilities and activities to address tlie needs of women and children affected by tlie earthquake along with the improvement of various facilities in all the affected districts. The restoration of various social facilities have been taken up like old age homes, balika sadans, homes for handicapped, community centres for women etc.

v) Community Rehabilitation

Under this, provisions were made for tlie cost of works and materials to re-establish essential services within tlie affected community.

vi) Technical Assistance, Training and Equipment

Under this tlie provisions were for design, supervision and monitoring of project components. The component also included tlic development of a disaster management programme for tlie state of Maharashtra and a seismic monitoring and research programme for the Government of India.

1.2.3 Bhuj Earthquake

on January 26, 2001, when tlie nation had just started the Republic Day celebrations. a devastating earthquake struck near Bhuj in the Kachchh region of Gujarat around 0845 hours in the morning. The magnitude of this earthquake was 6.9 on the Richter scale and it was tlie borderline earthquake between tlie "nioderate" and "great" categories. Hitting a prosperous region of tlie country, its impacts were truly disastrous. The fact sheet is as in Table 7 below.

Table 7: Fact Sheet of Bhuj Earthquake

Magnitude of the earthquake	6.9 on Richter Scale
Date of occurrence	January 26.200 1
Focal depth	25Km.
Epicenter	23.40^0 N, 70.28^0 E (near Bhachao in Bhuj district
Time of occurrence	08h, 46m, 42.9 s (IST)
People killed	18250
Cattle head lost	More than 20,000
Houses destroyed	310657
Houses damaged	524929
Villages affected	3825

The destruction would have been much more but for the facts that Bhuj is a comparatively less populated area, the earthquake originated at a relatively deeper focus (25 km as compared to the focal depth of 12 km in Uttarkashi earthquake and 15 km in the Latur earthquake), and it occurred at a time when everybody was

awake and most were in the open. Nevertheless, this quake is the worst in the country in recent decades in terms of the persons killed and injured. Gujarat being the second most industrialized state in the country took a heavy beating in terms of adverse socio-economic impacts but it also had the resilience and the will to meet the emergency. The famous Gujarati philanthropy and an abundance of goodwill from across the country channelled relief supplies and services to augment the efforts of the central and state governments. The international aid from governmental and non-governmental sources also came in abundance.

The devastation was considerable in Ahmedabad the biggest city and the commercial and educational capital of the state although it was located km from the epicenter. It was apparent that many multi-storied buildings were constructed in defiance of the engineering norms and land-use regulations. The initial estimates put the total property loss in Gujarat due to this earthquake at around Rs. 15,0001-crore.

Check Your Progress 1

Note: i) Use the space given below for your answers
ii) Check your answers with those given at the end of the Unit.

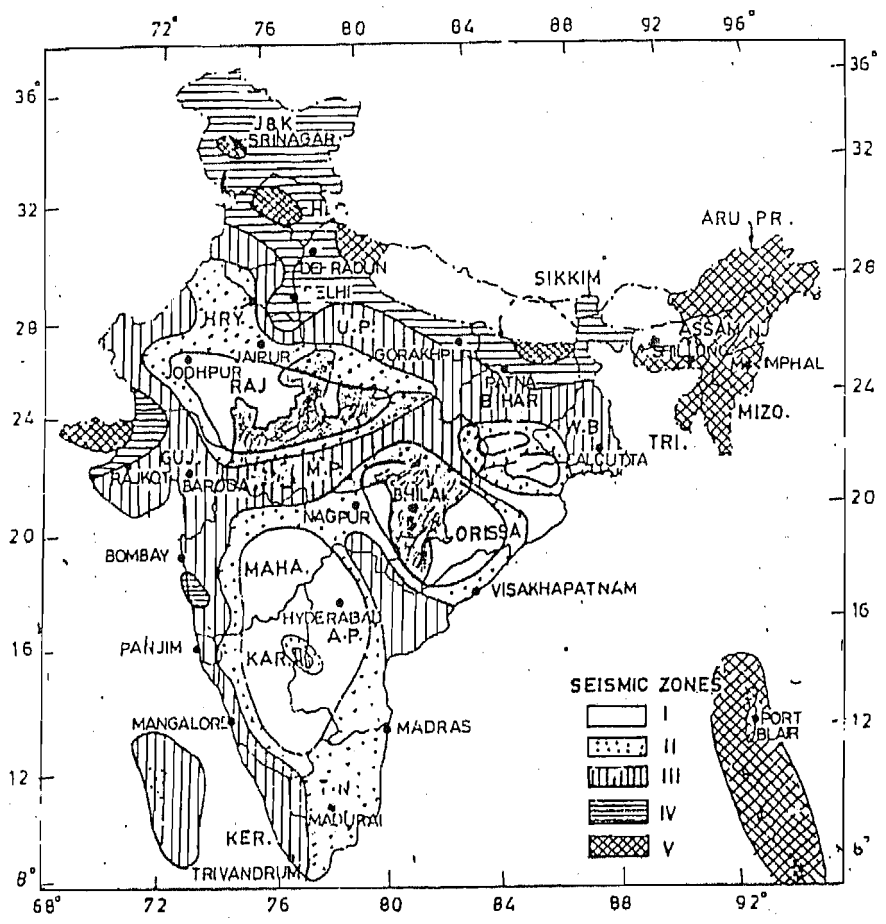
I) Highlight the damage occurred due to the Uttarkashi Earthquake to buildings, infrastructural facilities and bridges. .

2) How was the rescue and relief organised in the areas affected by the earthquake?

3) List the main components of the Maharashtra Earthquake Reconstruction Project launched in 1993.

1.3 LESSONS LEARNT FROM THE PAST EXPERIENCES

The most important lesson learnt by studying the past occurrences of earthquakes is that it has become possible to delineable seismic zones in the country as shown in Fig. 1.



SEISMIC ZONING MAP ALONG WITH STATE BOUNDARIES (SOURCE) BUREAU OF INDIAN STANDARDS IS : 1893 : 1984

Fig. 1, Seismic Zones

It will be seen that the country is divided into five seismic zones with zone 5 being the most vulnerable.

The other important lesson from recent studies is that these appears to be an increase in the occurrence of earthquakes in recent years although there is no apparent scientific reason for this. If we take into account the earthquakes of magnitudes 6.0 and more i.e. those earthquakes that caused damage to life and property, India has experienced one such earthquake once in two years during the last 14 years. On the other hand during the 25 years (1950-75), there was one such earthquake in 6 years. In the period before that, such earthquakes occurred roughly once in 13 years during the 130 years period (1820-1950).

On the disaster management side also, if we take care of the various lessons learnt from the past earthquakes, we can minimise considerably tlie damage resulting from future earthquakes. The following are a few points which emerged as a result of a study of past earthquakes.

a) **Disaster** Management

i) After every earthquake, it becomes evident that tlie preparation to face the calamity is almost negligible. This fact lias been faced again and again. In order to avoid such situations after tlie occurrence of earthquakes, we must start the requisite preparations for facing the event. We can achieve this through "action plans" prepared for different regions of the country. These plans must be tested for their effective functioning and must be evaluated and updated regularly according to the changing requirements.

ii) After every earthquake, a lot of relief material is sent by various voluntary groups, administration etc. Lack of coordination in the collection and proper distribution of such relief materials is very commonly felt after every earthquake. Mechanism lias to be developed to ensure proper distribution of relief material.

iii) Tlie narrow streets of tlie affected areas get blocked by the debris, preventing the escape routes for tlie affected community on one hand arid on the other, hampering the rescue and relief operations during the emergency period. Similarly, the approach roads get blocked due to landslide and bridge failure in the aftermath of the earthquake in hilly regions. Alternative methods/techniques must be identified for pi-oviding the necessary relief materials like food, clothes. medicine, evacuation of injured, etc.

iv) People do not know adequately about the earthquake resistant features in house construction as well as the necessary precautions to be taken during the different stages of earthquake management. For achieving this, awareness campaigns have to be started on a very large scale.

v) Awareness and sensitization process should start from schools and through Panchayats and NGOs.

b) **House** Construction

i) Buildings with light weight building materials like timber, bamboo etc., performed better than tlie heavy material buildings like stone, brick etc. Hence, to improve tlie performance of buildings, light weight building materials should be adopted.

ii) Tlie performance of buildings with irregular layouts is not satisfactory during tlie earthquakes, so buildings with simple, regular layouts must be constructed.

iii) The performance of lion-engineered buildings was not found satisfactory during tlie earthquakes. So, the buildings should be designed by qualified engineers and tlie construction of these buildings should be done as per tlie provisions in the code. It lias been estimated that constructing an earthquake resistant building adds only about 10% to tlie construction cost of a building.

iv) Tlie collapse of heavy roofs is one of tlie major causes for heavy loss of lives during the earthquakes. So, tlie light material roofs with proper connections to the wall systems must be adopted. Tlie performance of properly laid RCC slabbed roofs was found quite satisfactory. If possible, RCC slabs must be provided for roofs.

1.4 GOVERNMENT ACTION PERTAINING TO RELIEF AND REHABILITATION

Disaster management is the responsibility of the state governments in India. Every state has framed regulations to provide relief and rehabilitation to the affected community during and after the disaster situations.

The basic purpose of relief measures taken up by the state government is to provide immediate relief to the affected community not compensating fully for the losses incurred due to natural calamity. In case of earthquakes, the relief measures in terms of economic help can be taken up under the following heads:

i) damaged crops

ii) cattle loss

iii) clothes and utensils

iv) ex-gratia payment to tlie next of kin of the deseased persons and also to the injured

v) injured persons

vi) provision for free food in the temporary relief camps

vii) damaged agricultural implements

viii) damaged houses

The amount of relief provided by various states during tlie time of calamity differs from state to state. For example in the case of tlie Jabalpur earthquake on May 22, 1997, the state government had taken up the following relief measures for the affected community.

i) It started 23 relief camps (12 in rural and 11 in urban areas) for 35256 affected people. Food was distributed free of cost in all these camps.

ii) The forest department of Madhya Pradesh provided bamboos and wooden logs free of cost to the victims of the earthquake, for temporary shellers in the affected villages.

iii) A sum of Rs.1,00,000/- was provided to relatives of the dead persons due to this earthquake,

iv) A sum of Rs.2,000/- to Rs.10,000/- was provided to the injured persons, depending upon the severity of injury.

v) A sum of Rs.3,000/- has been given to the house owners and tenants of the partially damaged houses.

vi) For the persons whose houses had been damaged fully, a grant of Rs.18,000/- and other necessary materials like bamboo and wooden logs etc. for reconstruction of liouses were provided.

Check Your Progress *2*

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) -Discuss in brief, the measures that can be taken to minimise damage caused by earthquakes in future.

2) What necessary steps can be adopted towards construction of earthquake resistant houses?

3) What is the basic purpose of relief measures taken up by the slate government in providing relief to people in case of earthquake? List-the various heads of giving economic relief.

1.5 LET US SUM UP

India has a long history of major earthquakes particularly in the Himalayan Region. Earthquakes, as we have learnt in this Unit, cause extensive damage to buildings, infrastructural facilities, bridges etc. and result. in loss of life and limb. Fire and flooding can follow an earthquake. In any such calamity, the prime issue is organising rescue and relief ta the affected. The Maharashtra Earthquake Reconstruction Project embarked by tlie government in 1993, encompassing all aspects of rehabilitation was a significant measure in this direction. This unit has also highlighted the need to learn from past experiences to minimise tlie damage resulting from earthquakes whose frequency of occurrence appears to be on the increase.

1.6 KEY WORDS

Ex-gratia — As an act of grace or favour, without further responsibility or liability.

Engineered Buildings — These are those structures that have been designed taking into account tlie various effects that would be caused due to earthquake.

Non-Engineered Buildings : These are buildings that have been built without any guidance from a qualified professional and generally consist of one/two storey residential buildings.

Code — Rules, e.g. Building Code which means rules for construction of buildings.

1.7 REFERENCES AND FURTHER READINGS

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1.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your 1'1-ogress 1

I) Your answer should include the following points:

- The non-engineered buildings suffered severe damage.
- Large scale damage to infrastructural facilities especially roads, communication net: work and power supply system.
- The steel bridges did not suffer much damage except the Gawana bridge on the road to Gangotri.

  The engineered buildings especially those in the irrigation project colony at Maneri and Mahitanda received only minor damage.

3) Your answer should include the following points:

- Necessary relief materials like food, warm clothes, medicines were provided to the affected villages with the help of army and other organizations like the Border Security Force, Indo-Tibetan Border Police and Border Roads Organization.
- The task involved the co-operation of many other social groups like the NCC Cadets, NSS volunteers, NGOs, the task force of Uttarkashi administration.
- Utilisation of five heavy and seven light army helicopters.
- Provision of food items like flour, pulses, rice, oil, sugar, milk, sliced bread etc. by the government.
- Repair of the damaged roads by the Border Roads Organization,
- Reconstruction of community centres to provide shelter to the affected community.

3) Your answer should include tlie following points:

- I-lousing construction and repair
- Strengthening of Infrastructure.
- Economic rehabilitation including replacement and reconstruction of dry wells, provision of bullocks, minor equipment etc.

Social rehabilitation in tlie form of special facilities for women, children, handicapped.

- Community reliabilitation.

Provision for technical assistance, training and equipment.

Check Your Progress 2

1) Your answer should include the following points:

- Preparation of action plans for different regions of the country and their periodic evaluation and update.
- Development of proper mechanism to ensure proper distribution of relief material.
- Planning of alternate approach routes for the community to escape during emergency.
- Identification of alternative methods/techniques for providing necessary relief materials like flood. clothes. medicines etc.
- Proper campaigns to make people aware of various aspects of earthquake management.
- Malting houses and buildings earthquake resistant either through proper engineered design at the construction stage or through retrofitting of the existing non-engineered houses.

2) Your answer should include the following points:

- Use of light weight building materials in tlie construction of houses.
- Construction of buildings with simple, regular layouts.
- Design of buildings by qualified engineers and their construction as per the provisions in the code.
- Provision for properly laid RCC slabbed roofs.

3) Your answer should include the following points:

- The basic purpose of relief measures taken up by the state government is to provide immediate relief to tlie community.

The various heads under which economic, relief can be provided in case of earthquakes are:

- Ex-gratia payments to the injured and to the next of kin of the deceased
- Damaged crops – compensation for damaged houses
- Cattle loss
- Free medicines, clothes and utensils
- Free food in the temporary relief camps
- Grant to replace damaged agricultural implements.

UNIT 2 FLOOD AND DRAINAGE

Structure

2.0 OBJECTIVES

After reading this Unit, you should be able to:

- identify tlie major flood prone areas in India;
- discuss the various aspects relating to floods like their location, frequency and intensity and damage resulting from floocls;
- explain broadly the management and techniques of flood disaster mitigation;
- comment on their effectiveness ; and
  highlight tlie lessons learnt from tlie experiences, for further improvement.

2.1 INTRODUCTION

As we have read in Unit 6 of the Foundation Course in Disaster Management, floocls and drainage congestion constitute a phenomenon that has disastrous effects at some place or the other in the country almost every year resulting in damage, inconvenience and even deaths. In this Unit, we shall discuss in some detail tlie flood scenario in India, tlie locations that are subject to such problems, tlie extent of tlie vulnerability and the damages experienced in tlie past due to tloods and drainage congestion for a better understanding of the ways to deal with the problem, and analyse the experiences so as to draw appropriate lessons for future. The Government enactments, as they exist at present and tlie ones that are under consideration along with the ways of handling flood and drainage problems will also be examined.

2.2 FLOOD PRONE AREAS IN INDIA

On tlie basis of the available literature, including reports of expert groups, commissions and studies sponsored by the government, it has been assessed that twenty five out of the thirty five States/Union Territories of India, are flood prone. These are Andhra Pradesh, Arunachal Pradesh, Assam, Biliar, Chhatisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Pondiclierry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttaranchal, Uttar Praclesli and West Bengal. However, tlie states tliat are most affected by floods are Assam, Biliar, Orissa, Uttar Pradesh and West Bengal. The flood effects are also serious in

- Social rehabilitation in the form of special facilities for women, children, handicapped.
- Community rehabilitation.
- Provision for technical assistance, training and equipment.

Check Your Progress 2

1) Your answer should include the following points:

- Preparation of action plans for different regions of the country and their periodic evaluation and update.

  Development of proper mechanism to ensure proper distribution of relief material.

- Planning of alternate approach routes for tlie community to escape during emergency.
- Identification of alternative methods/techniques for providing necessary relief materials like flood. clothes, medicines etc.
- Proper campaigns to make people aware of various aspects of earthquake management.
- Malting houses and buildings earthquake resistant either through proper engineered design at tlie construction stage or through retrofitting of the existing non-engineered houses.

2) Your answer should include tlie following points:

- Use of light weight building materials in the construction of houses.
- Construction of buildings with simple, regular layouts.
- Design of buildings by qualified engineers and their construction as per the provisions in the code.
- Provision for properly laid RCC slabbed roofs.

3) Your answer should include the following points:

- The basic purpose of relief measures taken up by the state government is to provide immediate relief to the community.

The various heads under which economic relief can' be provided in case of earthquakes are:

- Ex-gratia payments to tlie injured and to the next of kin of the deceased
- Damaged crops – compensation for damaged houses
- Cattle loss
- Free medicines, clothes arid utensils
- Free food in the temporary relief camps
- Grant to replace damaged agricultural implements.

UNIT 2 FLOOD AND DRAINAGE

Structure

2.0 OBJECTIVES

After reading this Unit, you should be able to:

- identify the major flood prone areas in India;
- discuss the various aspects relating to floods like their location, frequency and intensity and damage resulting from floods;
- explain broadly the management and techniques of flood disaster mitigation;
- comment on their effectiveness ; and
- highlight the lessons learnt from the experiences, for further improvement.,

2.1 INTRODUCTION

As we have read in Unit 6 of the Foundation Course in Disaster Management, floods and drainage congestion constitute a phenomenon that has disastrous effects at some place or the other in the country almost every year resulting in damage, inconvenience and even deaths. In this Unit, we shall discuss in some detail the flood scenario in India, the locations that are subject to such problems, the extent of the vulnerability and the damages experienced in the past due to tloods and drainage congestion for a better understanding of the ways to deal with the problem, and analyse the experiences so as lo draw appropriate lessons for future. The Government enactments, as they exist at present and the ones that are under consideration along with the ways of handling flood and drainage problems will also be examined.

2.2 FLOOD PRONE AREAS IN INDIA

On tlie basis of the available literature, including reports of expert groups, commissions and studies sponsored by the government, it has been assessed that twenty five out of the thirty five States/Union Territories of India, are flood prone. These are Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhatisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Pondicherry, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttaranchal, Uttar Pradesh and West Bengal. However, the states that are most affected by floods are Assam, Bihar, Orissa, Uttar Pradesh and West Bengal. The flood efiects are also serious in

Andhra Pradesh, Gujarat, Haryana, Punjab, Rajasthan, Tamil Nadu and the North-Eastern States. The National Flood Commission Report (1980) identified the country's tlood prone area as 40 million hectares. However not all areas are affected in a year and the situation keeps varying from time to time. On an average in a year about 8 million ha. get affected . A detailed analysis by a Non Government Organisation (NGO) identified 190 districts out of the total number of districts in India as prone to floods.

Acute drainage congestion is experienced in parts of Utlar Pradesh, Bihar, West Bengal, Haryana, Punjab and the deltaic areas of Andhra Pradesh, Orissa apart from some local areas in other states. The most flood prone areas in India lie in the Ganga, Brahmaputra and Barak river basins. The Indus and its tributaries cause flood problems in the North-west region of India. Among the Central India and Deccan rivers, the Narmada, the Tapi, the Godavari, the Krishna and the Cauvery are important ones. The regions covered by these rivers cause Ilood problems but these are not generally very serious ones. There are occasional floodings in some other smaller rivers like the Brahmini, the Baitarani and the Subarnarekha. Most of these rivers also cause problems of flooding and drainage in their lower, particularly the deltaic regions.

The National Flood Commission, based on an analysis of the flood affected area and population affected as reported by the various States (1966-1978) found that more than half the area affected in India by floods lie in the three States of Uttar Pradesh, Bihar and West Bengal. Similarly over half the population in these three states are affected by floods. The figures in this regard were equally high in the States of Orissa, Assam and Andhra Pradesh.

In a vast country like ours, the problem of floods varies from year to year and area to area. However broad generalisations were made by the Central Water Commission in respect of the identified flood regions of the major rivers such as the Brahmaputra, Ganga, the Northwestern rivers and the Central India and Deccan rivers .

The main problem in the Ganga-Brahmaputra region are drainage congestion, bank erosion, land slides, aggradation, channel changes and their regime changes. The Central India and Deccan rivers have well defined and stable channels but drainage congestion and damage in the flood plains including the Delta arc common problems.

The Central Water Commission has been maintaining detailed data and derives information on state-wise flood prone areas and damage statistics. They also publish such information periodically. The Flood Atlas of India published by them contains some very useful information. The National Flood Commission has also brought such useful details on flood prone regions of India and the efforts of administration towards flood management.

2.3 MAJOR FLOODS

India has been affected significantly by heavy floods from time to time.

During the past 50 years, the floods of 1954 caused widespread damages and attracted the attention of the public and the Parliament and brought into sharp focus the inadequacy of the measures taken to tackle the situation. The floods of 1954 marked the launching, at the national level, of the flood control programme. The Central Water Commission started receiving from all the State Governments details of damages caused by floods from 1953 and since then they have been compiling the flood damage details. The summary flood damage picture of India, as reported by the Chief Engineer, Flood Management, Central Water Commission at a National Workshop held in 1993, is as under:

Some Flood Damage Parameters (Period 1953-90)

SI. No.	Item	Average Damage in a year 1953-90	Maximum damage
1.	Area affected (Million ha.)	7.94	17.50 (1978)
2.	Crop area affected	3.66	10.14 (1988)
3.	Population affected (Million)	32.86	70.45 (1978)
4.	Houses damaged (Million)	1.22	3.51 (1978)
5.	Cattle lost (Nos.)	102.905	618.248 (1970)
6.	Human lives lost (Nos.)	1532	11,316 (1977)
7.	Total damage to crops. houses and public utilities	937.56	4630.30 (1988) (Rs. Crores)

Ref: "Theme paper – Disaster Management Training Country Workshop – July 1993 -- IIPA, New Delhi".

It may be emphasized that the intensity and extent of floods and the corresponding flood damages vary from year to year. Still the years 1977, 1978, 1979 and 1988 have recorded severe damages, as reported by the states. In the decade commencing from 1991, the severe floods of 1995 would be too recent to be forgotten. It will neither be possible nor necessary to discuss in detail all the floods that have been experienced but we could briefly set forth the salient features of two or three major floods, that occurred in recent times.

- 2.3.1 Location

Five states viz., Bihar, Uttar Pradesh, West Bengal, Orissa and Assam have been identified as most prone to floods. This does not mean that all these states will experience high floods in the same year or at the same time nor that the other states will not have high floods. It will only indicate that, in an average year, the flood damages reported from these states are likely to be a very significant fraction of the total damages reported in that year. But there are exceptions. For instance, the flood damage in 1977 in Andhra Pradesh alone was more than half the damage in India that year. In 1978, the flood damage in Uttar Pradesh alone was 56% of that experienced in India that year. During the period 1953 to 1990, the year 1978 witnessed a significantly damaging high flood. The area affected, the extent of loss to the population, houses as reported by the State Government were very high. The loss of human lives was the highest in 1977, which was essentially due to the very high loss suffered in Andhra Pradesh that year. Similarly the loss of cattle was the highest in the year 1979, which was mainly due to excessive losses in Andhra Pradesh, Gujarat and Rajasthan. However the total damage to crops, houses and public utilities was the highest in 1988.

During 1978, Uttar Pradesh, West Bengal and Bihar accounted for more than two thirds of the area and population affected in India. Over four fifth of the houses damaged in India also lay in these three states. Over 90% of the cattle loss that year was in West Bengal; three quarter of the loss of lives was in three states mentioned. In short we could say that over two thirds of the national damage due to the floods was in these three states viz., Bihar, West Bengal and Uttar Pradesh. In addition, contrary to normal or average picture, the area affected in Rajasthan was also very high that year, perhaps next only to that of the highest recorded in 1977.

The National Flood Commission had noted that in the triennium of 1976 to 1978 floods and calamities of that type were widespread affecting more states outside the traditional flood prone zone. This latter group includes Andhra Pradesh and Rajasthan and to a lesser extent Gujarat and Haryana. The year 1988 was marked by severe floods in the Ganga Brahmaputra river system. In fact the combined Ganga and Brahmaputra flows, that pass into the Bay of Bengal through Bangladesh created the severest flood conditions and the largest damage to date in Bangladesh. The Brahmaputra broke all previous high flood level marks all along the rivers in Assam also.

The Report of the Committee on Flood Management in the North-Eastern states indicates that the area, population affected, damage to houses and loss of human lives was the highest in 1988 during the entire period 1953 to 1989. The total damage in Assam that year was also the highest on record in this period. West Bengal and Uttar Pradesh also suffered but the damage was the severest in 1978 in respect of the extent of area and population affected.

2.3.2 Frequency and Intensity

The pattern of rainfall varies from year to year and location to location. The pattern of the river flows generated from precipitation and the run off into the rivers also varies from year to year. From a study of the behaviour of rainfall and runoff, wherever long periods of recorded statistics are available, many generalised inferences have been drawn. The frequency and intensity of floods have also been assessed for different locations based on such data, wherever structures are constructed or proposed across or along rivers, in order to ensure their reasonable safety. It must also be kept in mind that flood losses in the flood plains tend to vary with the type of use to which the land is put. Also the relative safety of the designed structures, embankments etc., is a matter of balancing between the costs and risks that could be taken. It will not be always possible to plan for the highest degree of safety for all floods, irrespective of the anticipated intensity or frequency. Within the limitations of present knowledge and requisite data, scientists and engineers predict the intensity and frequency of the flood of different orders of probability. They indicate the statistical probability in terms of one in hundred or one in fifty years return period, It should be possible, with the help of available data to estimate the likely intensity and frequency of floods at specified locations which would facilitate in designing, constructing and maintaining viable protection schemes. As an example it could be pointed out that in the case of embankments, the height of embankments for different flood frequencies and also the corresponding costs are worked out taking into account the damage likely for these relative frequencies. A common practice followed in many places is to design for a one in twenty five year frequency flood to protect predominantly agricultural areas whereas for protection of vital installations one in hundred year flood frequency is used.

2.3.3 Damage Caused by Floods

The damage resulting from floods is not only dependent on the intensity and frequency of the flood that occurs at a location but also is a reflection of the extent of human interference with nature such as construction of structures across or along the floodway and the manner of utilising the flood plains for human activities. The manner of assessing the damages is also to be taken note of. The damage statistics are presently maintained by the state governments, and are subject to various limitations. The states also maintain these details only on the basis of administrative jurisdictions, like taluk, village or district. Thus the flood damage statistics now available are mainly state-wise and year-wise; they do not indicate breakup event-wise, river-wise or reach-wise. Their scientific study and analysis become difficult and not always possible.

2.4 CAUSES OF DRAINAGE CONGESTION

Areas that are flooded when water due to rainfall and or river spill is not able to drain off as quickly as considered desirable, are referred to as cases of 'drainage congestion'. Stagnation behind embankments of water due to insufficient drainage capacity in sluices falls in the same category. Thus usually drainage congestion and flood are expressions used collectively in common usage.

Numerous large scale saucer shaped depressions are found in Uttar Pradesli, Bihar, West Bengal, Assam etc., which are locally called 'chaurs', 'jheels', or 'beels'. Due to meandering nature of a river, many oxbow lakes are also formed. These act as storages of flood water which do not get drained easily into the river after the floods subside, most of these become drainage congested areas, In peninsular rivers also nearer the sea coasts, there are similar areas of drainage congestion between laiown courses of rivers which create drainage problems. These get compounded by coastal drift which forrns bars across the seaface.

Check Your Progress – 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

I) Identify some important problems arising due to floods in India.

2) What do you understand by drainage congestion?

3) What are the problems arising out of assessment of damages due to floods?

2.5 FLOOD MANAGEMENT: MAJOR STEPS

Since tlie start of the National Flood Management on a planned basis in 1954, the main thrust of flood management efforts has been on structural measures to modify the floods and flood protection worlts. Essentially, these comprise the following:-

i) Embankments/flood walls

ii) Storage reservoirs

iii) Detention basins

iv) Channel improvements

v) Bank stabilisation and anti-erosion works;

vi) Town/village protection works

vii) Ring bunds

viii) Diversion works

The oldest and most common method is a system of embankments constructed along river banks to serve as artificial high banks during floocls. There is however divergence of opinion on tlie role of embankments and their side effects. Large floods are often due to intense rains for a few days followed by relatively drier spell. This factor is taken advantage of for moderating the flood through a storage reservoir by storing water during the period of high flows and releasing it after the critical condition is over. The effectiveness of reservoirs is however dependant on a number of factors, including the other competing uses, the reservoir operation rules, the relief and rehabilitation issues, silt load etc. Detention basins take advantage of natural depressions, swamps and lakes to which a part of the flood water can be diverted. Channel improvements enable better carrying capacity at lower levels and thus help lower tlie flood levels for the same order of flows or by elimination of acute curves and bends which often lead to breaches. Bank stabilisation worlts and anti-erosion measures train tlie river so as to check the tendency to erode and damage new areas. Anti-erosion worlts deflect the water current away from areas vulnerable to attack. Ring bunds help in keeping the inhabitants from inundation but have other disadvantages. The other methods such as village protection works and diversion works, though have certain limitations, are resorted to wherever possible. Notwithstanding the degree of effectiveness, these efforts have given some protection to about 14 mil lion ha. of flood-prone areas in India.

A summary of the progress of these worlts from 1951 to 1991 is given below:-

Embankments	15764 Km.
Drainage channels	31888 Km.
Towns protected	857
Villages raised	4705
Area benefitted	14.08 Million ha.
Cost	Rs. 2910 Crorcs

Over the years, it has been realised that flood management is also possible through other types of activities, such as : modifying the susceptibility to flood damage and modifying the loss burden. Flood plain management, flood proofing, disaster preparedness, flood forecasting and warning, and redevelopment are steps that attempt to modify the susceptibility to flood damage. In fact the realisation in recent years is that the nonstructural measures are indeed very effective in reducing

flood damages. These are also, in most cases, the least-cost solutions to the problem of mounting losses. Emergency measures like evacuation, flood fighting, public health efforts and redistributive measures like disaster relief, tax relief or flood insurance are steps towards modifying tlie loss burden. In the earlier period there was much dependence on structural measures. As damages continued to mount, the current emphasis is on the non-structural measures.

2.6 POST-FLOOD REHABILITATION MEASURES

The main thrust of disaster management should be shifted away from the present relief approach towards disaster mitigation. In fact it is increasingly felt that all development projects in vulnerable areas should be linked with and used to the maximum extent as disaster mitigation machinery. In a poor country like ours, relief doles and such recurring expenses without attacking tlie root cause by disaster mitigative efforts will be a wasteful luxury. Hence all post-rehabilitative measures should also aim at mitigation of disasters that are likely to arise in future.

In the field of floocl management in particular, we must realise that a lack of discipline in respecting the river's domain in the form of lloocl plain, without adequate safeguards is to be avoided. The approach to management of floods should include a package of measures like assessment of the vulnerability, delineation of vulnerable areas, publishing the information on vulnerability at different levels of probable floods, flood plain regulation etc.

In tlic present limited context of tlie disaster preparedness measures, after any flood disaster event, the many desirable steps would include the following:

i) A realistic assessment of damages;

i i recording the extent of the natural event, tlie flood level etc.

iii) resettlement of affected persons in areas which would be safe in a likely event of

similar nature, in future;

iv) reconstruction of safe and flood resistant buildings.

Natural disaster management, including flood disasters, in tlie late seventies involved an approach of risk management, instead of the earlier crisis management approach; thereafter it reoriented itself towards integrated disaster preparedness approach: This now involves reliable early warning arrangements, carefully planned emergency response and better community preparedness. Such changed emphasis aims at restricting unproductive components of relief activities and increased resources and activities for enabling the affected people to meet the next likely disaster in the future in a better manner. It will be seen that tlic strategy of disaster mitigation would lessen the impact of disasters in the long run.

2.7 LESSONS LEARNT FOR FURTHER IMPROVEMENT

Tlie experience of handling tlie flood management measures in the first three decades was carefully examined by a high level expert body, called tlie National Flood Commission and its findings were made available in 1980. It had made many valuable recommendations for effective flood damage reduction and offered suggestions for a flood management policy. Anyone interested in a study of the flood management in India would greatly profit by a careful study of its report as also the guidelines and instructions for tlie implementation of the report issued by tlie Government of India in 1981. Those who look forward to an update thereof

could also look up the reports of two committees set by the Government of India to study the flood situation in 1987, in the North-East and in lower Ganga basin as also Orissa rivers. The recommendations made in these reports are still valid to a significant extent. The revised approach to disaster management mentioned earlier is another relevant matter. The salient elements of tlie lessons drawn in flood management would include the following:-

i) Flood management sliould be viewed in a broad perspective forming an integral part of the overall water resources development and the economic development of the region.

ii) Various alternative measures, physical or otherwise, sliould be studied for flood management and the optimum combination of measures selected. Embankments, storages, detention basins etc., sliould be considered in a comprehensive manner to identify and weigh the positive and adverse effects.

iii) Measures to modify tlie susceptibility to flood damage sliould be increasingly adopted.

iv) Flood plain zoning which is one of tlie most effective ways of minimising flood damages should be adopted.

v) Adequate maintenance of completed works should be ensured, to avoid adding to tlie damage potential.

vi) Tlie active participation of the people concerned at all stages of a project for flood management should be ensured.

vii) Tlie importance of appropriate organisation, coordination machinery, training, research etc. has to be empliasised.

viii) Encouragement to disaster mitigation policies sliould also be urged.

2.8 GOVERNMENT ENACTMENTS PERTAINING TO FLOOD MANAGEMENT

Under tlie Constitution of India, the legislative jurisdiction of the Union Government on regulation and development of inter-state rivers and river valleys is subject to the extent to which such regulation and development under the control of the Union is declared by Parliament to be expedient in the public interest, Subject to this provision, the subject of water is within the legislative powers of the states. There have been no significant enactments or follow-up of available provisions so far by tlie Union Government. There is no comprehensive enactment by the states either on flood management. The National Flood Commission had recommended that the Central Government should prepare a model bill dealing with all aspects of flood management to serve as a guide to the State Governments. There were many other suggestions advocating legislation but there is no existing legislation dealing with flood management.

The National Water Resources Council adopted the National Water Policy in 1987. This contains many elements relating to flood management. However these do not have any constitutional or legal binding as yet.

An examination of the ways to deal with floods and drainage congestion brings out the fact that there is no unique solution to this problem which is applicable in all situations and locations. A package of available measures within the overall framework of water resource development is available and a specific measure or combination of measures in a given situation is a matter for careful study. In the same manner the mitigation of flood losses is a complex matter which involves in addition to nature's behaviour, human actions by way of intrusion into the

flood plains without adequate safeguards. The specific steps to be taken are also a matter of benefit-cost study of possible solutions considering the risk element that is involved in different degrees of protection under different probability levels. Thus this is a matter for expert multi-disciplinary study and decision making.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What are the major structural measures involved in flood management?

2) What are the components of post - flood rehabilitation measures?

3) Discuss the salient elements of lessons drawn in flood management.

2.9 LET US SUM UP

Vast areas of India are subject to problems of floods and drainage congestion. In particular, the states of Bihar, Uttar Pradesh, West Bengal, Assam and Orissa are likely to suffer more. Most of the time in a year large damages occur in one portion or the other of India. Essentially, the high precipitation concentrated over a few. days in a year and the inability of the active river channel to carry it away safely coupled with indiscriminate human encroachment into the flood plain are responsible for the mounting flood damages. There are a number of possible ways of dealing with the matter and the specific solution or package of measures is a matter for expert multidisciplinary study and decision making. While both structural and non-structural options are possible, the emphasis in recent years has been on non-structural measures and on planned disaster

mitigation efforts. The costs and benefits are linked with the extent of risk taken or permitted under different probability levels of severity of future floodings. People's participation at all stages of such projects enhances the chances of enlightened cooperation of the people in disaster preparedness and management.

2.10 KEY WORDS

Aggradation : Rise of the base of river due to silting.

Bank erosion : Cutting up of the river bank by the speeding water.

Benefit-cost analysis : An economic technique designed to compare inputs(costs) and the resulting outputs (benefits).

Channel : Water way of a stream, drain or river.

Flood fighting : Efforts to reduce the impact of floocls, such as temporary dykes, dowel banks, attending to scour, slough, wave wash etc.

Return period : The period after which a similar event could be expected to review.

Risk analysis : The process of identifying, and quantifying risks based on hazard assessment, vulnerability analysis, risk assessment and risk appraisal.

Run off : Water that runs over the ground surface to a rives, drain, or lake.

Risk management : The efficient use of resources to reduce the probability that a disaster will occur by either reducing vulnerability or modifying the hazard.

Statistical **probability** : Chance of happening calculated from past numerical data.

Vulnerability : The capacity to withstand, protect oneself from or recover rapidly from a potentially damaging event.

Oxbow lake : A lake formed by a bend in a river

Sluices : Sliding gates through which water is released at dams.

2.11 REFERENCES AND FURTHER READINGS

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2.12 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check your Progress 1

1) Your answer should include the following points:
   - Drainage congestion
   - Bank erosion
   - Land slides
   - Aggradation
   - Channel changes

2) Your answer should include the following points:
   - Drainage congestion is said to occur when the areas flooded with water due to rainfall and river spill are not able to drain off within a reasonable period of time, thus creating flood.

3) Your answer should include the following points:
   - The assessment of damage arising out of Floods is dependent mostly on the availability of damage statistics. These statistics are maintained by the state governments. But these are maintained only on the basis of administrative jurisdiction like taluk, village or district.
   - The flood damage statistics are available mainly state-wise and year-wise, They do not give details which are event-wise, river-wise or reach-wise.
   - Therefore, scientific analysis and study become difficult.

Checlt your Progress 2

1) Your answer should include the following points:
   - The major structural measures involved in food management are:
     a. Embankments/flood walls
     b. Storage
     c. Detention Basins
     d. Channel improvements
     e. Bank stabilisation and anti-erosion works,
     f. Town/village protection works
     g. Ring bunds
     h. Diversion works.

2) Your answer should include the following points:

   A realistic assessment of damages.
   - Recording the progress of the natural event and the flood level.
   - Resettlement of affected persons in areas which would be safe in a likely event of similar nature in future.
   - Reconstruction of safe and flood resistant buildings.

3) Your answer should include the following points:

- Flood management should be viewed in a broad perspective forming an integral part of the overall water resources development and the economic development of the region.
- Proper examination of various alternative measures of flood management and selection of optimum combination of measures.
- Measures to modify the susceptibility to flood damage should be increasingly adopted.

  Adequate maintenance of works that are completed.
- Ensuring the active participation of the people concerned at all stages of a project for flood management.
- Appropriate organisation, coordination machinery, training and research etc.
- Encouragement of flood mitigation policies.

UNIT 3 CYCLONE

Structure

3.0 OBJECTIVES

After reading this Unit, you should be able to :

- describe the major cyclones and damage caused by them;
- discuss the relief and rehabilitation measures;
- explain tlie rules regarding financial arrangements to mitigate cyclone disasters; and
- highlight tlie lessons learnt for further improvement.

3.1 INTRODUCTION

There is hardly any year when India is not visited by a severe cyclone (also called cyclonic storm or Tropical cyclone). Tlie Indian mainland is flanked on earth side by cyclone prone Bay of Bengal and tlie Arabian Sea. Furthermore, there are two cyclone seasons viz., Pre- monsoon (April-May) and Post- monsoon (October-December). That is why, every year a few cyclonic storms occur in tlie Indian territory: more in the Bay of Bengal than the Arabian sea, tlie ratio being 4:1 approximately.

Cyclones, resulting in torrential rain, exceptionally high winds and enormous storm surge, are among the most destructive disasters. This fact has been already discussed (in CDM-01) and the extent of large loss of human lives in association with tropical cyclones in the past has been listed. The purpose of this Unit is to provide more information on major cyclone disasters and the management systems, pertaining to relief and rehabilitation.

3.2 MAJOR CYCLONES IN INDIA AND DAMAGE CAUSED

The Andhra Pradesh cyclone of November 1977, Orissa cyclone of June 1982 and another Andhra cyclone of May 1990 that occurred in Machilipatnam are typical examples of a few cyclones that have caused large loss of lives and properties. But the super cyclone of October 1999 that devastated Orissa is the worst in a century i.e. since the time scientific observations and studies of cyclones began. These are dealt with in some detail in the following subsections.

3) Your answer should include the following points:

- Flood management should be viewed in a broad perspective forming an integral part of the overall water resources development and the economic development of the region.
- Proper examination of various alternative measures of flood management and selection of optimum combination of measures.
- Measures to modify the susceptibility to flood damage should be increasingly adopted.
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UNIT 3 CYCLONE

Structure

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- discuss the relief and rehabilitation measures;
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The Andhra Pradesh cyclone of November 1977, Orissa cyclone of June 1982 and another Andhra cyclone of May 1990 that occurred in Machilipatnam are typical examples of a few cyclones that have caused large loss of lives and properties. But the super cyclone of October 1999 that devastated Orissa is the worst in a century i.e. since the time scientific observations and studies of cyclones began. These are dealt with in some detail in the following subsections.

3.2.1 Andhra Pradesh Cyclone of November 14 - 20,1977

It was a very severe cyclonic storm which initially developed at a low latitude (6^0 N, 92^0 E) in the morning of 14 November, 1977. Tlie cyclone moving initially in a west north westerly direction, changed its course to north westerly direction by the 16^{th} evening. Continuing its north westerly movement it struck Andhra Pradesh coast at north of Cliirala around 1730 hours on 19^{th} November 1977. The cyclone attained a maximum wind speed of 140 knots (260 kmph) during its life period. A ship "Jagatswamini" while passing through the centre of the cyclone reported lowest atmospheric pressure of 941hPa (hecto pascal)at about 1200 IST on 17 November,1977. But the storm became more intense later when the central pressure would have been further lower and was estimated as 911 hpa. This was tlie cyclone of tlie highest intensity so far observed in the Bay of Bengal and the Arabian Sea. The cyclone caused loss of lives and properties on a very large scale.

Tlie cyclone liad devastating effects as indicated below:

1) There were heavy to very heavy rains and gales reaching 200km/hr which lashed Prakasam, Guntur, Krishna, East and West Godavari clistricts uprooting trees, bending telegraph posts, dislocating road and rail traffic, telecommunication and power supply in these coastal areas.

2) The fury of the cyclone can be gauged from the fact that the steel columns of thermal power stations at Vijayawada were sheared off.

3) About 20 villages in Divi Taluka and 8 villages in Kona area of Bandar Taluka in tlie Krislina district were washed away by the storm surge. (This is about 500 sq.km of the country side).

4) All standing crops like paddy, sugarcane, cotton, tobacco and coconut over an extensive area and harvested paddy in these coastal areas were damaged.

The losses and damage were finally assessed as:

Population affected (in lakhs)	71
Crop area affected (in laklis of acres)	36.04
Houses damaged/destroyed	10,10,335
Human lives lost	8504 + 43 (missing)
Cattle head lost	2,30,146
Goats and other live stoclc lost	3,44,058
Damage to public utilities (Rs. in crores)	171.66

3.2.2 Orissa Cyclone of June 1-4,1982

A very severe cyclonic storm struck the Orissa coast near Paradip on June 4,1982. Tlie cyclone was associated with wind speed of about 200 Kmph and storm surge of two to four metres height of sea water. The cyclone caused loss of lives and destruction of properties and facilities on a massive scale. Tlie damage caused is indicated below:

Population affected	7,323,000
Villages affected	15,536
Area affected	25,000 sq. km.
Deaths	243
Injuries	493
Cattle lost	11,468

Crop area damaged	1,589,000 hectares
Area saline inundated	89,0000 liectares
I-louses collapsed/damaged	819,000
Power lines lost	2,566 **km.**
Sub-stations damaged	314
Canal breaches	1,840
Embankment breaches	302
Embankment/channels	796 km.
Irrigation projects damaged	2,384
Roads damaged	13,478 km.
Public buildings damaged	5,591
Schools destroyed	6,876
Tube wells damaged	2,500
Drinking water wells damaged	1,600

3.2.3 Machilipatnam Cyclone of May 5-9, 1990

A very scvcrc cyclonic storm developed in tlic Bay of Bengal in tlie first week of May 1990, and crossed Andhra Pradesh coast near tlic mouth of the river Krishna on tlic 9th evening. This was one of the most devastating tropical cyclones in the Bay of Bengal that developed in tlic month of May in the prc-monsoon season.

Tlie cyclonc had a maximum wind speed of about 127 kts. A ship "Viswamohini" reported lowest pressure of 912 hPa at 1730 hours of 8 May while passing through. tlie centre of tlie cyclonc. This is the lowest pressure ever recorded in a cyclone in tlie north Indian Ocean. The cyclonc had generated a storm surge of 5 metres inundating the coastal areas upto about 20 km inland in Machilipatnam-Challapalli sector of Krishna district.

The cyclone of May 1990 possessed a very high destructive potential and caused cxtcnsive damage to highways, roads, bridges, power and communication lines, paddy and plantation fields over vast areas of Andhra Pradesh inspite of good preparedness by the government as well as public. Tlie loss of public and private properties was estimated as Rs.2300 crores. About 5160 villages covering a population of 77.8 lakhs were affected by the cyclone. However the loss of human lives in Andhra Pradesh due to the cyclonc was limited to 928. This was because of tlie timely evacuation of about 6 lakh people from the low lying areas. Tlie standing crops in 45000 hectares of land were severely affected and more than 14 lakh houses were either fully or partially damaged. A very heavy rainfall caused flash floods in coastal districts of Andhra Pradesh resulting in breaches of'roads and rails and extensive damages to bridges.

3.2.4 Orissa Super Cyclone of October 25-31,1999

October 1999 was a pal-titularly unfortunate month for the cyclone prone state of Orissa because it had to face the fury of instense cyclonic storms twice within less than two weeks and within 200 km of each other. Tlie devastated state had not yet completed tlie assessment of the damage done by the very severe cyclone that hit Ganjam district on October 17, 1999 carrying winds of tlie order of 180 kmph when another cyclonic storm – much more fierce – hit a wicle area of tlie Orissa coast on October 29, 1999 with super cyclonic intensity seriously affecting 15 prosperous districts of tlie state.

The super cyclone took birth far away in tlie Gulf of Thailand on October 24 1999. Moving across the Malaysian peninsula, it emerged in tlic North Andaman Sea as a well-marked low pressure area by the morning of October 25, 1999. It concentrated into a depression by the same evening. Moving west-northwest ward. it intensified into a cyclonic storm by the morning of October 26, 1999 when it was located northeast of Port Blair in the Andamans. Then onwards. it toolc a northwest warcl course and attained the stage of very severe cyclone in the late evening of October 27, 1999 when it was positioned about 600 km southeast of Paradip port on the Orissa coast. Within 24 hours i.e. by the late evening of' October 28, 1999 the storm had reached the super cyclone intensity with minimum winds of the order of 220 km in the storm and was about 400 km southeast of Paradip. The lowest central pressure in this storm was estimated to be 912 hpa, i.e. almost the same as in the Andhra Pradesh cyclone of 1977 described in Section 3.2.1 above. Tlie highest wind in the storm was estimatecl at 360 kmph. It crossed coast close to Paradip port around noon on October 29, 1999.

A very peculiar feature (which contributed a great deal to the devastation) of tlie storm was that even after crossing the coast and moving overland, it maintained its intensity at severe cyclone level (winds of the order of 90 kmph or more) for almost 48 hours. Therefore it persisted to lash the area with very heavy rain and winds. Furthermore, it moved eastwards overlancl, made a loop and emerged in tlie sea again by the night of October 31, 1999 when it weakened and finally disappeared.

According to the White Paper published by the Orissa Government, 13 million people in 97 blocks and 28 urban areas were seriously affected by tlie super cyclone. As many as 9885 persons were verified cleacl and 40 were reported missing. The number of dwelling units destroyed or damaged was estimated at 16.5 lakh. The affected crop area was about 18.5 lakh hectare and the damage caused to the agriculture sector was estimated at 1773 crore rupees. Almost the entire green cover, comprising more than 9 corore trees, disappeared due to the storm. The inundation due to saline water with storm surge exceeding 15 meters at many places polluted the drinking water sources. About 3.5 lakh cattle perished. In the white paper, Orissa Government sought an assistance of Rs. 6228 crore for the relief, rehabilitation and reconstruction worlts.

The Orissa super cyclone of 25-31 October 1999 was indeed the worst cyclonic storm to hit India in the 20th century.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) Explain the occurrence of Andhra Pradesh Cyclone of 1977.

2) Describe the Orissa cyclone of June 1982 and damage caused.

3) Why is cyclone a frequent phenomenon in India?

3.3 RELIEF AND REHABILITATION MEASURES

The basic responsibility for undertaking rescue, relief and rehabilitation measures in tlie event of natural disasters is that of the concerned State Governments. The role of tlie Central Government is supportive, in terms of physical and financial resources and complementary in sectors like transport, provision of warnings, inter-state movement of food grains and other essential commodities. The dimensions of the responsibility at the level of National Government is determined by factors like, the

i) gravity of tlie disaster;

ii) scale of relief operations required; and

iii) need of central assistance for augmenting the material resources at the disposal of tlie State Government.

For undertaking emergency relief operations and rehabilitation, relief manuals and codes are available for each of the states. These documents provide guidelines for undertaking relief and rehabilitation work immediately, in tlie case of natural calamities.

3.3.1 Administrative Response

A broad view of the administrative response at the national, state and district levels is given in CDM-01 course but is briefly repeated below:

For effective implementation of mitigation and relief measures, a Cabinet Committee on Natural Calamities has been constituted under tlie chairmanship of the Prime Minister.

There is a National Crisis Management Committee (NCMC) under tlie chairmanship of Cabinet Secretary consisting of Secretaries of different ministries concerned.

For dealing with matters relating to relief in the wake of major natural calamities, a Crisis Management group (CMG) has been set up under the chairmanship of Central Relief Commissioner (CRC) in tlie Ministry of Agriculture with representatives of the concerned Ministries and Departments. The responsibility is to review, every year, the contingency plans formulated by the Central Ministries/Departments, the measures required for dealing with a natural calamity and coordinate the activities of tlie Central Ministries and State Governments in relation to disaster preparedness and relief.

At the State level, there is a standing committee under the chairmanship of Minister in-charge to direct and control programmes for reducing the adverse impact of natural calamities.

At the administration level, there is a State level committee under the chairmanship of Chief Secretary to ensure prompt and adequate relief measures and reconstruction of damaged infrastructure. It also decides on the norms and items of assistance.

For coordinating relief activities, a separate Relief Department has been set up in many of the States headed by a senior officer of the rank of Principal Secretary/Commissioner. Tlie actual relief operations are undertaken at tlie district level by a group which is headed by District Collector. He is assisted by the field level organisations and voluntary organisations constituted at the block, tehsil and village levels.

The committees at the district level have adequate representation of people's representatives, concerned Departments, NGOs, other members of public and local self-government bodies.

3.3.2 Contingency Action Plan

A National Contingency Action Plan (CAP) lias been notified and this is updated every year. The CAP identifies the initiatives required to be taken by various Central Ministries/Departments in the wake of natural calamities, sets down the procedure and determines the focal points in the administrative machinery. At the State level, the State Relief Commissioner (or Secretary, Department of Revenue) directs and controls the relief operations through Collector or Deputy commissioner, who is responsible for all relief operations, coordination, direction and control at the district level.

3.3.3 Capacity Building through Relief and Rehabilitation Work

The growing awareness of the interrelation between disaster, environment and development has led to a shift in emphasis from relief to mitigation. The capacity to respond to the challenges of natural disasters is dependent upon tlie extent of preparedness to mitigate their impact and reduce their occurrence which is possible only through sustainable development efforts. Therefore the present day emphasis is to steer relief and rehabilitation work towards capacity building of the community so that future can be handled effectively.

Some of the long term mitigation measures like construction of cyclone shelters along the coast, construction of embankments, dykes and reservoirs, afforestation of the coastal belt, reconstruction of cyclone resistant houses, enforcement of building codes for cyclone proofing structures, insurance cover, land use zoning and legislation and education and training are among the items which could be taken up as a part of relief and rehabilitation work, which in the long run will be benc'ficial to the coastal population. Thus the present day relief and

rehabilitation measures are aimed not only to provide immediate help to the victims but also towards tlie requisite capacity-building of the community to fight future disasters effectively. Some of the reconstruction projects taken up after the devastating cyclones towards the beginning of this decade are formulated containing elements of mitigation measures. Tlie following are some recent examples of comprehensive reconstruction efforts with mitigation plan built into them.

i) The Cyclone Reconstruction Project (1990) was initiated in the coastal Andhra Pradesh. This consisted of such components as housing and public buildings, reconstruction of electricity transmission lines, drainage and rural water supply. It also includes such mitigation efforts as expanding road network, communication network, planning of shelter belt trees and building up of cyclone shelters. This project was completed in 1994.

ii) The Cyclone Reconstruction Project (1992) was started in Tamil Nadu, Kerala and Karnatalca. Under this Project, the houses destroyed during November 1992 cyclone have been suitably reconstructed with assistance from Housing and Urban Development Corporation (HUDCO), Government of India, tlie concerned State Governments and contribution from tlie beneficiaries.

3.4 FINANCING RELIEF AND REHABILITATION WORK: GOVERNMENT RULES

Schemes for financing expenditure on relief and rehabilitation in tlie wake of natural calamities are governed by tlie recommendations of Finance Commissions appointed by tlie Government of India every five years. Under the existing scheme in operation for tlie period 1990-95, each State has a corpus of funds called Calamity Relief Fund (CRF), administered by a State Level Committee,, headed by the Chief Secretary of the State Government. Tlie size of tlie corpus is determined having regard to the vulnerability of the State to different natural calamities and tlie magnitude of expenditure normally incurred by tlie State on relief'operations. Tlie corpus is built by annual contributions of the Union Government and tlie State Governments concerned in tlie ratio of 3:1. At present. tlic aggregate annual accretion in tlie State CRF amounts to Rs. 8040 million. The states are free to draw upon this corpus for providing relief in tlie event of any natural calamity, In the event of a major disaster warranting intervention at the national level. a provision exists for tlie Union Government to supplement the financial resources needed for relief operations. Many non-governmental and voluntary agencies also play significant roles during times of distress.

In addition to above, funds are also available through some of the on going developmental programmes in tlie country, like the Indira Awas Yojana and Jawahar Rojgar Yojana. Limited funds are also available from tlie Prime Minister's Relief Fund to provide immediate relief to tlie victims of natural calamities.

3.5 LESSONS LEARNT FOR FURTHER IMPROVENIENT

It has been observed that there is a good possibility of saving lives and properties from cyclone disaster by adopting suitable short and long term disaster mitigation measures and preparing the community to effectively handle cyclone

disasters. The cyclone reconstruction projects as were recently taken up in states like Andhra Pradesh also serve as an example in this direction. One of the crucial short term cyclone disaster mitigation measures include the timely evacuation of people and live stock which is the only prescribed measure to save lives and properties especially in the case of storm surges leading to coastal inundation. The benefit of such preparedness and evacuation was amply demonstrated in the case of two cyclones which struck the same place of Andhra Pradesh with almost the same intensity once in November 1977 and later in May 1990. The loss of human lives in 1977 November cyclone was about 8547 whereas the loss of human lives in May 1990 was limited to 928. The difference was mainly due to the better level of preparedness shown by the disaster management officials as well as public. In 1990 the people and government machinery were better prepared and unlike in 1977 about half a million people were evacuated to safer places on receiving of warnings.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) Discuss in brief the administrative response regarding relief and rehabilitation measures.

2) Briefly explain the role of contingency action plan.

3) Describe any two examples of comprehensive reconstruction efforts with mitigation plans built into them.

3.6 LET US SUM UP

The winds of a cyclone cause death and injuries from structural collapse or flying objects, with devastating effects on houses and other buildings, agriculture, critical facilities e.g. communication facilities and lifelines. Often loss of life from tlie cyclones is mostly due to drowning, either from the rise in sea water inundating tlie land or from floods resulting from excessive rainfall. This unit has given us an idea about the damages caused by cyclones witli tlie help of few examples. It throws light on tlie importance of relief and rehabilitation measures. It has briefly described tlie financing of relief and rehabilitation work.

3.7 KEY WORDS

Contingency Plans: It refers to series of assessments and evaluation as to tlie likelihood of an event occurrence, when and wliere it might occur, its possible magnitude and impact followed by tlie development of proposed plans of action involving;

a) identification of tlie potential threat, e.g., proximity of tlie cyclone, settlements on seismic faults or flood plains etc.;

b) identification of likely impact of disaster e.g. number of people potentially affected, damage to property etc;

c) anticipating and developing optimum response to such a threat, e.g., educate people to potential risk, develop notification and evacuation plans etc;

d) identification of existing resources, e.g., areas where shelters could be established, sources of food, location of reconstruction equipment.

White Paper: Government Report on recent investigations of an important matter or event.

Knot (kt): Nautical mile per hour (unit of speed over tlie sea)

Rehabilitation: It refers to action taken in two weeks or months, immediately following a disaster to restore basic services, construct temporary liouses etc.

Relief It means meeting immediate needs of food, clothing, shelter and medical care for disaster victim; assistance given to save lives and alleviate suffering in tlie shortest possible time following a disaster.

Hecto Pascal (hpa): Unit of atmospheric pressure

3.8 REFERENCES AND FURTHER READINGS

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3.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include tlie following points:

- It was a very severe cyclonic storm.
- The cyclone initially clcveloped in a low latitude on November 14,1977.

- It changed its direction by the evening of 16th November.
- It struck Andhra Pradesh Coast on 19th November .
- It was a cyclone of tlie highest intensity so far observed in the Bay of Bengal and the Arabian Sea.
- It caused a very large scale loss of lives and properties.

2) Your answer should include the following points:

- India is flanked on either side by sea areas (Bay of Bengal and Arabian Sea) where cyclones take birth.
- India has two cyclone seasons viz. Pre-monsoon (April-May) and Post-monsoon (October-December).
- That is why cyclones occur every year in India and some of these become severe.

3) Your answer should include the following points:

- India is flanked on either side by sea areas (Bay of Bengtal and Arabian Sea) where cyclones take birth.

  India has two cyclone seasons viz., Pre-monsoon (April-May) and Post-monsoon (October-December).

  That is why cyclones occur every year in India and some of these become severe.

Check Your Progress 2

1) Your answer should include the following points:

- The Cabinet Committee
- The National Crisis Management Committee
- The Crisis Management Group
- State Level Committee
- District Collector

2) Your answer should include the following points:

- A National Contingency Action Plan lias been notified.
- It identifies the initiatives required to be taken by central ministries/departments in the wake of natural disasters.
- It sets down the procedure.

  The plan determines the focal points in the administrative machinery.

3) Your answer should include the following points:

- Cyclone Reconstruction Project in tlie coastal Andhra Pradesh.
- Cyclone Reconstruction Project for Tamil Nadu, Kerala and Karnataka.

UNIT 4 DROUGHT AND FAMINE

Structure

4.0 OBJECTIVES

After studying this unit, you should be able to :

- explain tlie difference between drought arid famine;
- describe the major droughts in India;
- discuss the adverse impacts caused by drouglit;
- describe the relief and rehabilitation measures;
- highlight tlie government policies; and
- understand tlie lessons learnt from past experiences.

4.1 INTRODUCTION

There is no universally accepted definition of drought. According to Namias (1989), drought involves a scarcity of rain to the extent that it interferes with some sector of economy such as agriculture, water supply or other water related activities.

The severity of drought depends on:

- degree of moisture deficiency
- duration of dry spells
- extent of irrigation facilities; and
- size of the affected area

Famine is defined as the situation when food available to the people is extremely scarce and it leads to hunger and starvation, Thus drouglit and famine are not tlie same. Famine can occur due to mismanagement even when there is no drought. On the other hand, a drought if managed well will not turn into famine. The link between drought and famine can be broken through good drouglit management and enhancement of the purchasing power of tlie economically weaker sections of tlie society. That is why since independence there have been severe droughts but no widespread famines.

- It changed its direction by tlie evening of 16''' November.
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- India has two cyclone seasons viz., Pre-monsoon (April-May) and Post-monsoon (October-December).
- Tliat is why cyclones occur every year in India and some of these become severe.

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1) Your answer should include the following points:

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- Tlie Crisis Management Group
- State Level Committee

  District Collector

2) Your answer should include the following points:

- A National Contingency Action Plan has been notified.
- It identifies the initiatives required to be taken by central ministries/departments in the wake of natural disasters.
- It sets down the procedure.
- The plan determines the focal points in the administrative machinery.

3) Your answer should include the following points:

- Cyclone Reconstruction Project in the coastal Andhra Pradesh.
- Cyclone Reconstruction Project for Tamil Nadu, Kerala and Karnataka.

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4.2 MAJOR DROUGHTS EXPERIENCED IN INDIA

The worst drought on record in India is that of 1899 when tlie rainfall deficiency of monsoon season for the country as a whole was - 26.2% and 83% of the area experienced deficient rainfall during the monsoon season. However the drought of 1877 was a close contender because although tlie area affected was much less at 66.8%, the rainfall deficiency for the monsoon season was much worse at 79.1%. Thus, while the phenomenal drought of 1899 affected a larger area of the country, that of 1877 was more intense in the areas in which it occurred. Both these droughts led to serious famine conditions mainly because of the lack of communication, information and transport.

Three widespread droughts occurred in India in recent times during 1979, and 1982 and 1987. The country is lucky not to have faced large-scale droughts since 1987. This is mainly because the monsoon, which gives about 80% of the annual rainfall in the country, has been behaving fairly well all these years. However, tlie monsoon rains are highly variable both in time and space. That is why there are always some localised areas of low rainfall or local drought even in tlie years of very good monsoon rains. The most recent droughts of 1982 and 1987 are described here in some detail,

4.2.1 The Large-scale Drought of 1982

The drought experienced in 1982 was quite bad with a monsoon rainfall deficiency of -13.7% and 46.4% of the area suffering from deficient rains.

Although the monsoon started on time in 1987, its programme slowed down. Furthermore, the rainfall was meagre, especially in the first half of the four month monsoon season. To add to the problems, monsoon receded earlier. The north, north west and southern parts of tlie country suffered most. Among these the regions that suffered the worst rain deficiency were Himachal Pradesh (-50%), Saurashtra and Kutch (-46%), Jammu & Kashmir (-37%). West Rajasthan (-36%), Tamil Nadu (-36%), Bihar (-30%) and Vidarbha (-28%).

The food grain production, as a consequence, was adversely affected. A loss of 9.5 million tonnes was reported in the Kharif (monsoon) crop itself. As the efforts to increase food grain production in the following Rabi crop succeeded due to good drought management, the year finally ended with a short fall of only 3.8 million tons over the previous year's food grain production.

4.2.2 The Phenomenal Drought of 1987

The drought of 1987 is counted among the five "phenomenal" droughts on record, the others being 1877, 1899, 1918 and 1972. The monsoon season's rainfall deficiency was -19.3% and the area under deficient rainfall was 64.3%. Although tlie onset of monsoon over Kerala was almost on time on *2* June 1987 (i.e., only one day late), its advance was slow. The monsoon further delayed in advancing to the north and north west of India. There was an all time record delay for tlie monsoon to reach these areas, which are among tlie major food' producing zones of tlie country.

The worst effect of this drought condition was felt in tlie north, west and central regions. The areas which had rainfall deficiency of -50% or worse are indicated below:

Saurashtra, Kutch & Diu	-74%
West Rajasthan	-67%
Haryana & Delhi	-67%
Punjab	-58%
Himachal Pradesh	-51%
West U.P	-51%
East Rajasthan	-50%

The above mentioned regions account for about 20% area of the country and include prominent food producing regions of the country. The other parts of the country which suffered deficiencies of rainfall between –20% and –50% were: Jammu & Kashmir, Uttaranchal, East Uttar Pradesh, East Madhya Pradesh, Orissa, Vidarbha, Marathwada, Madhya Maharashtra, Kerala, Gujarat, Coastal Andhra Pradesh and Andaman and Nicobar Islands.

In terms of overall annual food grain production in the country for both Kharif and Rabi, the 1987 drought resulted in a loss of production of 3.0 million tonnes only as against that of 3.8 million tonnes in 1982. However, the drought of 1987 halted the momentum of agricultural growth established during the early 1980s. It affected 15 states and 6 Union Territories, damaging crops on all area of about 59 million hectares spread over 267 districts. Gujarat and Rajasthan were the worst affected states. Nearly 285 million people have been the direct sufferers of the adverse socio-economic impact of this drought and of these, around 92 million people belonged to economically weaker and socially deprived sections of society. The drought affected about 168 million cattle. The scarcity of cattle feed caused a serious problem and concern. All such major widespread droughts have resulted in a marked reduction in the foodgrain production giving a setback to the economy and food security.

4.3 RELIEF AND REHABILITATION MEASURES

National level efforts arc very important in dealing with drought and famine situations. Funds arc arranged through:

- Calamity Relief Fund (Structured grants to the States).
- National Fund for Calamity Relief (Started in 1995).
- Prime Minister's National Relief Fund (Discretionary Grant).
- NGOs

The main objectives of short term relief measures is to protect people's access to food through:

a) ensuring the availability of food in the affected area and

b) protecting the entitlements of all groups within the affected society.

Some of the important measures for maintaining food security are:

- . food subsidies
- price stabilization by preventing hoarding and starting Fair Price Shops
- employment generation programmes
- supplementary feeding programmes
- special programmes for livestock and other household assets

- complementary liealth programmes
- clean drinking water programmes
- general food supply and distribution programmes

The reduction of the impact of drought requires measures like:

- improved management;
- improved water resource management through digging new wells, improve existing wells, construct retention dams, construct subsurface dams to trap water in sandy riverbeds, recharge the aquifer water catchments which trap water and allow it to seep quickly down into the water carrying strata;
- plant drought-resistant crops;
- implement counter- desertification measures e.g. tree planting.

Rehabilitation involves assisting the affected people to increase their purchasing power through work programmes, to keep up their health, and to replace assets lost during the drought arid famine situation. These type of programmes arc necessary after severe periods of temporary food insecurity and famines when households have lost most assets, been forced to migrate and have experienced high rates of mortality. The programme involves health care services, counselling, providing material support like cooking utensils, making available transportation back to previous home sites, re-establish homes and productive activities.

The timing of rehabilitation intervention is specially important, e.g. seed distribution programme should be completed bcforc the start of the next sowing season. For achieving success, the intervention has to be planned and implemented alongside relief activities. The seed programme is a key component of rehabilitation efforts. The rationale of this programme is that since tlie affected people tend to exhaust their seed stocks either through repeated re-sowing or consuming them as food, the required seeds need to be made available to them.

During the drought of 1987, imports had to be resorted to the tune of 200,000 tonnes of pulses, 30,000 tonnes of butter oil, and 22,000 tonnes of skimmed milk powder. 7790 Fair price shops were set up in tlie drought affected areas within three months.

As scarcity of cattle feed caused a serious concern, cattle shelters and fodder banks had to be set up. Paddy straw was moved in from Punjab to Gujarat and Rajasthan to serve as substitute for fodder. In order to manage the drought situation, massive initiatives were undertaken for relief and rehabilitation measures by tlie Government of India and the concerned states. All these prompt and expensive relief and rehabilitation measures ensured that the phenomenal widespread drought of 1987 did not become a famine.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at tlie end of the unit.

1) List the two major droughts experienced in India.

2) Briefly describe the socio-economic impact of the drought that occurred in 1987.

3) Indicate any five important measures for maintaining food security.

4.4 GOVERNMENT POLICY RELATING TO DROUGHT MANAGEMENT

The experience of 1970s and 1980s shows that the drought management approach has shifted from crisis response to risk management, at all levels of the government. The emphasis has been on integrated disaster preparedness through early warning arrangements, planned emergency response and better preparedness. This policy proved very useful while dealing with the drought of 1987 which, incidentally, was the last major drought of the 20th century.

The risk management measures consist of the following components:

- Food subsidy through Public Distribution System.
- Availability of food grains from states or from central buffer stock.
- Supplementary feeding programmes.
- Drinking water and health programmes,
- Easy credit for agricultural sector
- Price stabilisation.
- Employment generation.

- Dissemination of information
- Special programmes for farming communities and for their livestock..

The major initiatives taken by the Government of India during the drought of 1987 are listed below:

Campaign for enhanced agricultural production in the next season through:

- Better Water management.
- Increased Area coverage.
- Upgraded technology package of seeds and fertilizers and extension service.
- Relaxed credit terms through the National Bank for Agriculture & Rural Development (NABARD).
- Special programmes for energising 150,000 pumpsets through Rural Electrification Programme.
- Additional supply of petroleum products to drought affected areas.
- Distribution of 137,000 mini kits in drought affected areas for enhancing the cultivation of vegetables.
- Works regarding Employment generation
- 54 major irrigation projects.
- 32 medium irrigation projects.
- Minor irrigation projects e.g. Soil conservation .
- Laying of road links.
- Provision of Drinking Water.
- Cattle feed.
- Subsidy to small and marginal farmers and growing fodder on 230,000 hactares.
- Free irrigation.

The Government of India has launched various development programmes to serve the long- term needs of the different sections of the drought affected communities. The important programmes are listed below:

- Desert Development Programme (DDP).
- Drought Prone Area Programme (DPAP).
- Food for Work Programme (FWP).
- National Rural Employment Programme (NREP).
- Rural Landless Employment Guarantee Programme (RLEGP).
- Integrated Rural Development Programme (IRDP).
- Accelerated Rural Water Supply Programme (ARWSP).
- Indira Awas Yojana (IAY).

- Jawahar Rozgar Yojana (JRY).
- Employment Assurance Scheme (EAS) - to assure 100 days of employment during lean agricultural season in drought prone, tribal and hilly areas.

These programmes targeted specially the poor inhabitants of rural areas and tried to combine development with drought management.

Section 18 of the National Water Policy (GOI 1987) dealing with Drought management, states as under:

18.1 Drought Prone Areas should be made less vulnerable to drought associated problems through soil-moisture conservation measures, water harvesting practices, the minimisation of evaporation losses, the development of the ground water potential and tlie transfer of surface water from surplus areas, where feasible and appropriate. Pastures, forestry or other modes of development which are relatively less water-demanding should be encouraged. In planning water resource projects, the needs of drought-prone areas should be given priority.

18.2 Relief works undertaken for providing employment to drought stricken population should preferably be for drought proofing."

Under tlie Government of India, the main responsibility for natural disasters as well as man made disasters, except drought at present rests with the Ministry of Home Affairs. The responsibility of drought management is with tlie Ministry of Agriculture. The Natural Disaster Management Division functions under tlie Ministry of Home Affairs. The Ministry of Water resources deals with and coordinates improved irrigation coverage in the various states of India.

The Central Government, with its large physical and financial resources is able to encourage emergency preparedness, provide crisis response and immediate assistance. Under the scheme of financing the disaster relief expenditure, while the execution of ,relief operations is the major responsibility of the concerned State Government, the Central Government supports and supplements the efforts by extending financial, physical and technical assistance.

As none would like the liistory of the Bengal Famine of pre-independent India to repeat itself in future, the need is to make the system, resilient, stronger and more efficient.

4.5 LESSONS LEARNT

The management of the drought of 1987 underlines the fact that by appropriate institutional support and proper co-ordination of efforts, crises could be met confidently and the policies could be translated into practice most expeditiously. This experience also embodied the re-orientation in the approach to drought management and marked a major departure in terms of caring for the quality of life and not merely confining to providing sustenance to mitigate hardship. Prolonged drought may undermine the self-confidence and self-reliance of affected communities. The affected people should be assisted and supported to replace tlieir assets lost during the temporary phase of food insecurity and where it is required, their livelihood should be re-established. Response requirements involve major commitment and expenditure of resources. A long-range mitigation measure is the policy of providing irrigation facilities to supplement the rainfall and thus to ensure agricultural production in all vulnerable areas of India. This will have to be a continuous effort and made an integral part of the development programme of the area.

Extensive socio-economic development of drought prone areas would provide a solution in the long term. However, the short term needs must aim at generating new skills and further avenues of employment, in order to enhance the purchasing power of the affected population, especially tlie weaker sections of the society.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) Mention the salient points pertaining to drought management contained in the National Water Policy of Government of India.

2) Highlight the major initiatives undertaken by the Government of India during tlie drought of 1987.

3) Briefly discuss the lessons learnt for further improvement in drought management.

4.6 LET US SUM UP

This unit has brought out tlie distinction between drought and famine. In order to increase the understanding regarding major droughts and famine in India, two representative droughts of 1982 and 1987 have been dealt with. It has thrown light on tlie relief and rehabilitation measures. In addition, it has highlighted the government policies pertaining to drought. Lastly, this unit has developed a clear understanding about the lessons learnt for further improvement.

4.7 KEY WORDS

Central Buffer Stock: The Central Government maintains a stock of foodgrains that feeds the Public Distribution system through Fair Price Shops on which the economically weaker sections of society depend. This has improved the benefits of this system specially during serious disaster situation, like major droughts. The buffer stock is replenished through open market purchases at harvest times and it is generally not allowed to fall below 12 million tonnes.

Pasture: Land suitable for grazing of cattle.

Subsidy: Money contributed by government to keep down prices of essential commodities.

Price Stabilization: Keeping prices under control; prevention of undue increase in prices of essential articles during difficult times.

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4.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- The large scale Drought of 1982
- The phenomenal widespread Drought of 1987

2) Your answer should include the following points:

- Economic impacts such as reduced income of farm lands, fall in industrial output, unemployment, inflation and higher prices, decreased agricultural output, loss of livestock, reduced prices, poor purchasing power.
- Social impacts i.e. malnutrition, poor hygiene, ill health, migration and increased stress and morbidity.

3) Your answer should include the following points:

- Price stabilisation by preventing hoarding and starting Fair Price Shops;
- Food subsidies.
- Increasing purchasing power through Employment generation programmes.
- Special programme for livestoclc and other household assets.
- General food supply and distribution programmes.

Check Your Progress 2

1) Your answer should include tlie following points:

- Drought prone areas should be made less vulnerable to drought associated problems through various means.
- Modes of development, that demand less water, should be encouraged in tlie planning process.
- In planning water resource prospects, preference should be given to tlie needs of drought prone areas.
- Relief works involving construction projects should aim at drouglit proofing of tlie area.

2) Your answer should include the following points:

- Campaign for enhancing agricultural production.

  Relaxed credit terms.
- Special program for energising pump sets.
- Distribution of agriculture mini kits.
- Employment generation works.
- Provision of drinking water.

3) Your answer should include tlie following points:

  Appropriate institutional support arid proper co-ordination of efforts provide positive results.

- The affected people should be supported and assisted.
- Rehabilitation needs should be properly assessed.
- Proper response needs long time commitment of resources and should preferably be made integral part of tlie development programme of the drought affected area.

NOTES

UNIT 5 LANDSLIDES AND SNOW AVALANCHES

Structure

5.0 OBJECTIVES

After studying this Unit, you sliould be able to:

- discuss the occurrence of landslides and snow avalanches in India with reference to the likely regions, frequency, and intensity
- explain the kind and magnitude of damage due to these disasters
- describe the possible measures for relief and rehabilitation; and
- highlight the lessons learnt from these disasters and the need for rules and regulations to reduce the risks.

5.1 INTRODUCTION

As we all know, a large part of India consists of mountainous terrain. In the north, there is the extensive Himalayan mountain system extending all along from the west to the east. Its lofty peaks rise to more than 8000 metres height. The middle ranges of the Himalayas are about 5000 metres high on the average while the foothills rise to about 6000 metres. The Himalayas abound in glaciers and are the origin of many rivers and streams. There is abundant rainfall and snowfall often accompained by strong winds.

The peninsular region of India starts from the Vindhyachal ranges and consists of the Deccan Plateau which slopes eastwards. On its edges, this great plateau is bound by the mountain ranges of the Eastern Ghats and the Western Ghats. The Nilgiri mountains are in the southern parts of the plateau. The west-central parts of tlie country have the ranges of the Aravali mountains.

Many of these mountain systems are relatively new (in the geological sense) and are still growing such as the Himalayas. The rock systems are therefore fragile,

Given these special geological and geographical features and combined with the heavy rainfall system of the two monsoons (the summer monsoon and the winter monsoon) and also the not-so-rare occurrence of earthquakes, it is but natural that the mountainous areas of India are vulnerable to the hazards of landslides. In the snowy regions of the Himalayas, snow avalanches are the additional dreaded disasters.

In the earlier part, i.e., Block 3 of the Foundation Course, we have defined land slides and snow avalanches, described their characteristic features and discussed the effects and causes of landslides and snow avalanches. In this Unit, we will discuss these two disaster phenomena in more cletail and with specific reference to India. We shall also discuss relief and rehabilitation measures, as also the lessons learnt from past experience.

5.2 MAJOR DISASTERS: LANDSLIDES AND SNOW AVALANCHES IN INDIA

Landslides and snow avalanches affect tlie remotely located, often isolated, small communities in villages or hamlets in the mountain regions of the country where external assistance takes time to reach in times of emergency when the normally difficult terrain and tracks ,may become almost impossible to negotiate. Many a times, even the information about the occurrence of such events and the damage done takes days to reach tlie district and state headquarters. Because of these reasons, landslides and snow avalanches assume the status of major natural disasters even though the affected area and population may be rather small.

5.2.1 Vulnerable Areas, Frequency and Intensity

Landslides: Landslides are a frequent and recurring phenomenon in the various hill ranges of India from Kerala to tlie Himalayas. Arcas prone to landslides include the Eastern and Western Ghats, the Nilgiris. the Vindhyachals, the mountains in the northeastern States and the great Himalayan range. The incidence of landslides in these regions is a recurring feature especially during and after spells of heavy rains. As the geological history of the rocks and the rainfall regime have strong bearing on the incidence of landslides, there are variations in the occurrence of landslides in different parts of the country as is indicated in Table 5.1 given below.

Table 5.1 : Incidence of landslides in India

Region	Incidence of Landslides
Himalayas	High to very high
Northeastern Hills.	High
Western Ghats and the Nilgiris	Moderate to high
Eastern Ghats	Low
Vindhyachals	Low

Landslide Zonation Mapping is a modern method to identify landslides prone areas and it has been in use in India since the 1980s. In this method, the vulnerability of different parts of a landslide-prone region is assessed in terms of past occurrences, steepness of slopes, conditions of rocks, and rainfall rates and the different areas are given "ratings" like Very High, Higli, Moderate, Low, Very Low, which indicate the likelihood of occurrence of landslides in those areas. Some of the regions for which such zonation mapping has already been completed or is nearing completion are :

North Sikkim

Kathgodam-Nainital

Garhwal Himalayas including Yamuna Valley

Satluj Valley in Himachal Pradesli

The roads in Himachal Pradesli, Jammu & Kaslimir and Uttaranclial are particularly prone to landslides. The phenomenon assumes alarming proportions in the hill districts of north Bengal, Sikkim and tlie northeastern States.

Snow Avalanches: The Himalayas are well known for the occurrence of snow avalanches particularly tlie Western Himalayas i.e., the snowy regions of Jammu & Kashmir, Himachal Pradesli and Uttaranclial. Broadly speaking, an area of about 200,000 square kilometres in these three States is vulnerable to snow avalanche disasters. Snow avalanches also occur in the eastern parts of the Himalayas but tlie denser forest and vegetation cover on the eastern and tlie northeastern Himalayas (clue to heavy rains in these mountains) act as binding force and inhibit excessive accumulation and slippage of snow mass, The western Himalayas liave many vulnerable sites prone to snow avalanches where hundreds of lives are lost and the social and economic life is disrupted every year. Tlie formation zones in this region are located between 3000 and 5000 metres height.

In Jammu & Kashmir, the most affected areas are in tlie higher reaches of Kashmir and Gurez Valleys, Kargil and Ladakh and some of the major roads there. In Himachal Pradesli, the vulnerable areas are : Chamba, Kullu, Lahoul-Spiti and Kinnaur. Specific villages highly prone to snow avalanches have been identified in these districts of Himachal Pradesli. In the Garhwal Himalayas in Uttaranchal, parts of Tehri-Garhwal and Chamoli districts suffer from snow avalanche problem. Just as zonation mapping is done for areas vulnerable to landslides, Zone Planning is done for snow avalanche sites and three types of zones are identified pertaining to the frequency and intensity of snow avalanches around an avalanche site. In other words, Zone Planning provides a means to assess the anticipated danger due to snow avalanches at the vulnerable site. The tliree types of snow avalanche zones are :

1. Red Zone : The most dangerous zone where snow avalanches are most frequent and have an impact pressure of more than 3 tonnes per square metre.
2. Blue Zone : Where the avalanche force is less than 3 tonnes per square metre and where living and other activities may be permitted with construction of safe designs but such areas may have to be vacated on warning.
3. Yellow Zone : Where snow avalanches occur only occasionally.

It is important to note that the word "Zone" appears in two meanings in the context of snow avalanches., Firstly, the different areas covered by a snow avalanche during its life cycle are called zones, e.g. Starting Zone and Run out Zone as discussed in Unit 9 of Block 3 of CDM-01, Foundation Course. Secondly, the word zone is also used to describe the places of most occurrence, less occurrence and least occurrence, e.g. Red, Blue and Yellow Zones described above.

5.2.2 Kind and Magnitude of Damage

There is no doubt that anything that comes in the way of a landslide or snow avalanclie will suffer severe damage and may even be totally buried or wiped out. Anything located on top of a landslide will also not survive when the rock or mud slips out from below it.

Landslides: More often, the major landslides are combinations of rockslide and rockfall. They all involve movement of mass (soil, debris or rock). The process of movement of mass may vary from slow soil creep to abrupt and sudden rockfall. Landslides, also known as landslips, range from low angle and rather slow slides to sudden vertical falls.

Based on the type of movement, relative rate of movement and kind of material involved, landslides can be designated into 5 kinds as follows :

- Slump with earth flow
- Debris slide
- Debris fall
- Rock Slide
- Rock fall

Landslides, being more widespread in different mountainous or hilly regions of the country (as against snow avalanches which are confined to the snowy regions of the Himalayas), cause damage which is more varied and more widespread. Increased population, spurt in quarrying, mining and construction activities near unstable hill slopes, ill-conceived developmental activities in the vulnerable hilly areas, have resulted in more landslides and greater damages. Apart from the catastrophic damages suffered by communities living on or near unstable hill slopes as their houses along with persons and property may be destroyed by a landslide, the most crippling damages due to landslides are suffered by (i) roads and (ii) productive soil. Damage to roads leads to considerable inconvenience and economic loss. The disappearance of land and the cultivable top soil takes away the agricultural potential of the affected area thus depriving them of their already meager livelihood.

Landslides are also known to result in blocking of streams or overflowing of lakes thus causing flash floods because large volumes of debris falling in a lake or reservoir cause its water to overflow or the temporarily blocked stream may suddenly release the huge quantity of impounded water to cause a devastating flash flood downstream,

Snow Avalanche: In case of specific kinds of snow avalanches, the resultant damage is quite characteristic. For example, the "slab" type snow avalanche, in which massive slab or slabs of hardened snow come hurtling down, the hit is very hard and smashes anything that takes the hit. It is on record that in 1975, a group of mountaineers climbing the Dhaulagiri region of the Himalayas saw a massive "mattress" of snow 15 metre thick poised for collapse as a slab type snow avalanche.

On the other had, "loose snow" kind of snow avalanche covers a large area. Due to the fragile nature of the rocks of the still-growing Himalayan mountains, the snow avalanche may also carry large quantity of debris comprising loose soil, small stones, and large boulders. "Airborne" avalanches occur on the slopes of the greater Himalayas and are one of the most devastating kind affecting large areas in the valleys.

While occurrence of snow avalanches is dependent on the amount of snow, the nature of the terrain and the prevailing meteorological (weather) factors, the magnitude of damage done depends directly on the population density and the nature of human activity in the region hit by a snow avalanche. Every year, literally thousands of snow avalanches are triggered off at numerous avalanche sites in the higher hills of the three most vulnerable States viz., Jammu & Kashmir, Himachal Pradesh and Uttnranchal. Though it is not possible to get complete reports of damages and casualties because avalanches occur in remote areas, the Snow & Avalanche Study Establishment (SASE) of the Defence Research & Development Organization (DRDO) in Manali (Himachal Pradesh) has been monitoring snow avalanche activity over important mountain ranges in the Himalayas. SASE is also the nodal organization for forecasting snow avalanches. It issues forecasts 18 to 24 hours in advance of the likelihood of avalanches

identifying tlie likely areas. The warnings are issued to tlie Defence Services and para-military forces as also to the civil population in the area. The statistics collected by SASE on the loss of lives due to snow avalanches during the 20 year period (1974-94) are given in Table 5.2 below :

Table 5.2 : Loss of lives in snow avalanches (1974-94)

Year	Number of Deaths Reported
1974-75	11
1975-76	23
1976-77	S
1977-78	14
1978-79	258
1979-80	6
1980-81	50
1981-82	110
1982-83	132
1983-84	39
1984-85	6
1985-86	72
1986-87	NIL
1987-88	259
1988-89	12
1989-90	42
1990-91	24
1991-92	I.I
1992-93	11
1993-94	13

It will be seen from the above Table that the years 1978-79 and 1987-88 have been the worst on record in terms of human casualties due to snow avalanches. All the three States (J&K, I-I.P., and Uttaranchal) suffered the wrath of snow avalanches in March 1979. In 1-I.P., 235 persons were reported killed in Lahoul-Spiti district alone. The loss of properly, cattle and forest assets ran into crores of rupees. Bamni village near Badrinath. was completely buried under snow. Destruction in J&K was also enormous. The snow avalanches of 1988 were also very damaging. On a single day (17 March 1988), 52 persons were killed in Zanskar and 57 in Kargil (J & K). It is noteworthy that both in 1979 and 1988, major damages were in March when the risks of snow avalanche increase as the accumulated snow starts melting and there is fresh heavy snowfall combined with strong winds.

About 2500 km of major roads in the Himalayas are exposed to the dangers of damage due to snow avalanches. Continuous avalanching in winters disrupts communications by road blocks or road damages. Jammu-Srinagar, Srinagar-Leh and Manali-Leh roads are particularly vulnerable to such obstructions. At times, the avalanches deposit as much as 20 metre deep snow on these roads which are the supply lifelines in these areas.

A very devastating type of damage occurs due to flash floods when debris from snow avalanche blocks a water stream, or even a river, temporarily impounding large volumes of water which, on overcoming the blockage, rushes to inundate large areas downstream. A prominent example of this type of damage occurred in March 1979 itself when flash floods generated in Saraswati and Alaknanda rivers due to snow avalanches caused extreme damage to roads and agricultural lands in the Vishnuprayag area of the Garhwal Himalayas.

5.2.3 Relief Steps Taken

Reduction of losses (life as well as property) would by itself be an immense relief. So the basic question behind any possible relief is : how might the losses on account of landslides and snow avalanclies (or any other natural disaster for that matter) be reduced? This can be achieved through the following four fundamental steps :

a. Modify the Cause, i.e., reduce the forces of nature or their intensity to the extent practicable.

b. Modify the Hazard, i.e., channelize or divert the forces of nature as much as possible.

c. Modify the Loss Potential, i.e., prepare, plan and warn to tlie fullest extent.

d. Modify the Impact, i..e., rehabilitate and reconstruct quickly and wisely.

In tlie particular context of landslides and snow avalanches, we can achieve (a) above to some extent by artificial release of landslides at weak points and by blasting off unusual accumulations of snow and by building protective fences and restraining structures such as "cribbing" or "piling" at sites known for landslides or snow avalanches. Modification of hazard as mentioned at (b) above can be done by reopening the flow of water in a stream blocked by a landslide or snow avalanche before it assumes the dangers of a flash flood. Modifying the loss potential (Item "c" above) needs long term preparation and constant vigilance. These would involve awareness of hazard and landslides and snow avalanche, formulation of forecasts, arrangements to receive and clisseminate warnings, and action plan to face the hazard when it occurs. The final item (d) above pertains to relief steps immediately after the event, i.e., to rehabilitate and reconstruct quickly (to reduce hardship to the affected community) and wisely (to reduce tlie adverse impacts during any future recurrence of disaster).

Essentially, the relief steps comprise tlie following

1) Search and Rescue
2) Medical assistance to the injured
3) Disposal of tlie dead
4) Food and Water
5) Emergency shelter for the homeless
6) Opening up access roads if blocked; and restoration of communication channels
7) Psychological counselling of the survivors who have lost their close relatives
8) Repair of houses and facilities
9) Assistance (technical and financial) to restart economic activity to restore regular work and income
10) Reconstruction through proper planning.

5.2.4 Measures for Rehabilitation

Measures for the rehabilitation of a community affected by landslide or snow avalanche will depend very much on the extent of the damage done by the disastrous event.

If the damage has not been severe, the rehabilitation will take the form of (a) short-term relief to restart normal activities and (b) taking long-term measures so that any future landslide or snow avalanche does not hurt the community at all or at least, not as much.

We have already listed the short-tern1 relief steps in the preceding section. As regards the long-term measures, these will comprise the following :

1) Reducing the hazard proneness of the site through engineering measures such as strengthening or modifying the slopes, removing fragile and unstable pol-lions, securing snow accumulations by snow fences, snow nets or by cribbing, and improvement of drainage.

2) Stopping indiscriminate quarrying and mining in mountain areas.

3) Afforestation of zones prone to landslides and snow avalanches so that trees and vegetation provide a binding force to prevent slippage of debris, rock, and snow.

4) Creation of a voluntary, community-based preparedness-system of watch, monitoring and alert. This will not only be useful in times of a disaster but will provide enough self-confidence (and thereby self-reliance) which is an essential objective of an effective rehabilitation programme.

5) Provision of assistance for economic rehabilitation by arranging work, employment, loans, and grants.

In the extreme case of severe damage to a community by a landslide or snow avalanche, the site may be rendered totally unusable. In that case, rehabilitation takes the form of relocation and reconstruction, In such an event, the new site should be carefully chosen so as to minimize vulnerability and risks.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the Unit.

I) Which areas in India are particularly vulnerable to landslides and snow avalanches?

2) Describe briefly the kind and magnitude of damage resulting from snow avalanches.

3) What are the relief steps that need to be taken in the aftermath of landslides or now avalanches?

5.3 LESSONS LEARNT

The most important lesson learnt is that landslides and snow avalanches are among the serious and frequent disasters occurring in India. This is because the large mountainous regions (the Himalayas, the Eastern and Western Ghats, the Nilgiris, and even the Vindhyachals) are prone to landslides. Snow avalanches are common in the Himalayas, especially the Western parts of the Himalayas.

Secondly, there are preferred sites where due to reasons of geology and climate, such disasters occur often. It is useful to identify such sites and prepare zonation maps.

Thirdly, flash floods resulting from the blocking (and later release) of a hill stream or a river by the debris of a landslide or snow avalanches can create a dreaded disaster.

However, a very important lesson learnt is that there are relief steps that are possible in pre-disaster as well as post-disaster stage. Careful zonation mapping and pre-disaster engineering steps will go a long way to reduce tlie frequency of occurrence and the intensity of impact of landslide or snow avalanche. A community which has been hit by a landslide or snow avalanche will need long-term rehabilitation process to make it recover from the trauma of the disaster and to render it safe from future catastrophes of this type.

5.4 GOVERNMENT RULES

The responsibility to deal with landslides and snow avalanche lies witli tlie State Government. The Central Government moves in to assist the State Government depending on the seriousness of the situation. The District Administration (the District Collector) is the nodal functionary on behalf of the State Government and they can requisition the assistance of the Defence Services should the situation warrant it.

However, there seem to be no government rules as such specifically for landslides and snow avalanches. When these occur, these are treated as a natural disaster and dealt with accordingly., Most of the actions lie in providing short-term relief and rehabilitation to the affected communities.

Landslides and snow avalanches have been receiving considerable attention in research mode by central agencies such as the Department of Science & Technology (DST), Central Road Research Institute (CRRI), Central Building Research Institute (CBRI), Geological Survey of India (GSI), the Indian Institutes of Technology (IITs), and University of Roorkee. The Snow and Avalanche Study

Establishment (SASE) of the Defence Research & Development Organization (DRDO) specializes in the studies of snow avalanches. These institutes have prepared zonation maps by integrating multiple data bases such as topographical data, geological data, remote sensing data, geo-technical investigation data, climatological data and actual occurrence data. Hazard zonation mapping based on this technique of integrated multiple database is used for forecasting arid forewarning. As already stated in Section 5.2.2 above, SASE is tlie nodal organization for forecasting of Snow avalanches.

Strict enforcement of existing rules and framing of new rules to stop indiscriminate quarrying and mining near vulnerable slopes and to stop deforestation in high risk areas will go a long way to reduce the hazards due to landslides and snow avalanches. The houses and roads in the vulnerable zones should be built only according to the prescribed building codes which need to be enforced strictly.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the Unit.

1) What are the lessons that you have learnt from tliis Unit?

2) What are the government rules to deal with disasters due to landslides and snow avalanches?

3) Can you suggest some specific aspects which should be covered by government rules in order to reduce the hazards due to landslides and snow avalanches?

5.5 LET US SUM UP

This Unit brings out the fact that landslides and snow avalanches arc among the major disasters that-affect the-mountainous regions of India. The areas prone to these disasters and the frequency and intensity of these disasters have been discussed. The kind and magnitude of damage resulting from landslides and snow avalanches have been described. Possible relief steps and rehabilitation measures have been indicated. Specific aspects on which strict rules and enforcement are required have been mentioned.

5.6 KEY WORDS

Climatological Data : Data pertaining to climate.

Cribbing Making a bin type retaining wall consisting of interlocking members of steel, concrete or wooden logs and used to stabilize slopes and to protect road cuts in the high hill.

Quarrying Digging or blasting for collecting building stones.

Flash Flood Sudden, but short-lived torrential flood carrying an immense load of solid debris.

Formation zone : Where the avalanche starts; also called starting zones.

Slump Mass movement involving an actual breaking away of rocks leaving **a** fresh mark on a hillside.

Zonation Mapping : Mapping map of identified zones.

5.7 REFERENCES AND FURTHER READINGS

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5.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1. Your answer should include the following points:
   - Areas in India particularly vulnerable to landslides are: I-Iimalayas, Eastern & Western Ghats, Nilgiris.
   - Areas particularly vulnerable to snow avalanches are: Himalayas especially the Western Himalayas in the three States, viz., J&K, H.P. and Uttaranchal.
2. Your answer should include the following points:
   - Damage from-snow avalanche depends very much on the kind of the snow avalanche, e.g., slab type or loose snow type or air-borne type.
   - Slab type avalanche smashes everything in its way or airborne or loose snow type covers a very wide area.
   - Roads suffer the worst damage.
   - Sometimes if the avalanche falls in a lake or reservoir or blocks a river or stream, it can result in a flash flood.

3 Your answer should include the following points.

- Essentially, the relief steps comprise the following:
  - Search and rescue
  - Medical assistance to the injured
  - Disposal of the dead
  - Flood and Water
  - Emergency shelter for homeless
  - Opening access roads and restoration of communication
  - Psychological counselling to survivors
  - Repair of houses
  - Assistance to restart economic activities
  - Reconstruction through proper planning

Check Your Progress 2

1. Your answer should include the following points:
   - Landslides and snow avalanches are serious and frequent.
   - There are preferred sites where these occur
   - These can also give rise to flash floods.
   - Yet, relief steps are possible.
2. Your answer should include the following points:
   - There are no government rules as such.
   - Even where there are rules (e.g., to regulate quarrying and mining near mountain slopes), these are not enforced strictly.
3. Your answer should include the following points:
   - Stringent rules and strict enforcement are required to stop indiscriminate quarrying, mining, and blasting near unstable slopes of .mountains in disaster prone areas.
   - Similarly there should be stringent rules and strict enforcement to prevent deforestation in vulnerable areas.

UNIT 6 FIRE AND FOREST FIRE

Structure

4.0 OBJECTIVES

After studying this Unit, you should be able to:

- recognize the seriousness of tlie hazards due to fire and forest fire;
- understand the characteristics associated with fires in forests, coal, oils and buildings;
- appreciate the extent and severity of damage due to such fires and the methods of fire prevention and protection; and
- have a general idea of government rules for precautions against fire hazards.

6.1, INTRODUCTION

In tlie Foundation Course (CDM-01) in tlie Unit 10 of Block 3 dealing with fire and forest fire, a basic idea was given about the different types of fire hazards indicating tlie causes and impacts. A number of precautions, which would prevent tlie occurrence of fires or retard their spread, were also listed.

The occurrence of fires and forest fires seems to be on tlie increase and they cause very considerable damage and human misery including death and disfigurement as also disruption of economic development. Therefore, it is necessary to increase our understanding of the phenomena of fires and forest fires.

4.2 MAJOR TYPES OF FIRES IN INDIA

6.2.1 Forest Fires

The first thing to note is that except in rare cases of lightning strike, forest fires in India are almost always man-made. The main causes are: smokers throwing 'beedi' or cigarette butts, or travellers, shepherds or picnic-makers leaving behind burning or smouldering embers.

Forest fires seldom occur in rain forests or deciduous broad leaf forests. But all coniferous forests and even the evergreen broadleaf forests in hot and dry regions often develop conditions suited for spread of forest fires. Of course, the basic requirement is that both the air and-the burning fuel (grass, bush, fallen leaves, branches of trees, deadwood) should be dry. Hot sunny days with low humidity and strong breeze are conducive to tlie rapid spread of fire in a forest. Many trees in forests give out oily or wax-like substance, which helps burning and intensification of forest fire.

Once started, forest fires are seen to travel as much as 15 km per hour downwind side while spreading slowly sideways too. Extinguishing a forest fire is not easy. Generally forest fire once started, continues until there is heavy rain or tlie burning fuel is finished.

In almost all cases, a forest fire starts as a "surface fire" in which dry leaves, small bushes and deadwood lying on the ground in a forest get burnt. Flames may rise to about one to two metres at the most. But if surface fire intensifies, thicker bushes and small trees start burning and flames may reach heights of about five metres. On further intensification, bigger trees start burning and flames may reach the tops of tall trees burning the top portions (the crown) of tall trees. Such very intense forest fires are called "crown fires" and are extremely destructive. Sometimes tlie trunks of big trees explode while burning in such intense fires.

Burning forests give out considerable amount of smoke, gases and hot air going upwards. These also carry burning embers up in tlie atmosphere and hurl them in tlie neighbouring areas upto distances wliicli could even be one or two kilometers away. . This depends on the strength of prevailing winds. Such burning embers, thrown out of fiercely burning forest fires are very liazardous as these can start fresh fires either in the neighbouring forest areas or even in the residential areas or agricultural fields near the forests.

6.2.2 Coal Fires

Coal is a common and cheap source of energy and is utilized through the process of burning. In other words, coal needs to be burnt so that it can be utilized as a source of energy. But this property of coal makes it a liazardous substance when large amounts of coal burn accidentally and without much control on tlie resultant coal fire. Thus, coal fire can occur either in large stocks of coal (coal pits or coal dumps) or in coal mines below the ground surface. Therefore, the coal mining areas such as those in Bihar, West Bengal, Orissa and Madhya Pradesh and Andhra Pradesh are prone to such disasters.

Coal fires generally get started through negligence or ignition of combustible gases. Sometimes, soft coal (especially in deep mines or big dumps) gets so hot due to gases that it may itself start a coal fire (without an external source of fire or ignition) particularly when the atmosphere around is very hot and dry. Such occurrences are called "self-ignition".

In many areas of coal mines (e.g., Jharia in Bihar), there are underground fires burning in coal mines for decades and travelling along the coal-bearing areas below the ground. Such instances transmit considerable heat to the ground surface wliicli often cracks and emits gases and smoke which-heat and pollute tlie area and make it unfit for-living. Thus, coal fires burning inside coal mines cause, double destruction – firstly by destroying the coal inside the mine and secondly by making the area on the ground surface hot, polluted and unfit for living or economic activities.

6.2.3 Gas Fires

The increasing use of cooking gas in houses and hotels both in cylinders and through pipes is indeed a fire hazard. This gas is also used in cars in some cases. Compressed Natural Gas (CNG) is being introduced in a big way in public buses. These gases are mostly supplied in compressed form and-transported by trucks. . Some industrial gases are also inflammable. All these constitute a ,widespread fire hazard.

6.2.4 Oil Fires

Inflammable liquids such as kerosene oil, diesel, petrol, spirit, liquor, ghee, other oils, paints, tar and certain chemicals are prone to fires which can be grouped together in the category of "oil fires". Such liquids catch fire easily through naked flame or an electric spark. Then they burn on the surface and spread out, thus spreading the flames as well. If the oil is in a container, there could be the vapours of the oil and these are also inflammable. This could lead to an explosion in the container. In fact, many such inflammable liquids are also prone to self-ignition because they undergo oxidation on coming in contact with the oxygen in the air. This heats tlie liquid. If the temperature rises enough, the "flash point" is reached when the liquid starts burning by itself. Therefore, such hazardous liquids or oils are stored carefully away from residential areas or crowded places. Further, good air circulation, cooling and ventilation is to be ensured to avoid the danger of oil fires. Petrol storage depots, airports, and oil tankers are particularly vulnerable sites.

6.2.5 Building Fires

Building fires are the most common among the fire disasters. Increasing population, increasing concentrations of population in closely built small houses of *jhuggi-jhoparpatties* or in multi-storeyed buildings in cities, increase tlie fire hazard. Unnecessary accumulation of combustible or inflammable articles or hazardous material add to the danger. Hotels and Cinema houses need special mention in this context. Lack of water or equipment for fire fighting allows the fires to burn fiercely. Hot and dry seasons add to the possibility of fires as also the careless use of electrical equipment, naked wires and loose joints. An electric short-circuit or a spark is often responsible for large-scale fire disasters the like of which are reported every summer from many cities. A large number of building fires owe their origin to the residents smoking in bed and falling asleep while smoking. Accidents in kitchens are also among the major causes of fires in buildings.

In their start and further spread, the fires in buildings are as varied as the buildings tliemselves. For example, buildings can house residential units or apartments, hotels, schools, colleges, hostels, laboratories, business houses, industrial establishments and factories, stores and shops. Buildings may be closely situated in a colony or be independent bunglows or farmhouses with considerable vacant area around. Buildings could also be multi-storeyed. Heating systems and air-conditioning plants, especially in large and-tall multi-storeyed buildings add to the fire hazard. The air conditioning ducts offer easy path for fumes, gases and smoke to be conveyed to other parts of the building quickly and false ceilings of inflammable material add to the hazard. In fact, choking due to smoke-or-soot is the cause for the majority of deaths in a fire incident.

As indicated above, the electric installations and the wiring can cause fire in buildings when these get heated due to overload. People often do not realize that putting extra electrical load above the permissible limit causes overheating or break in the insulation in the electrical equipment which can either result in a spark or explosion or burn due to overheating.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of tlie Unit.

I) What are tlie most common causes of tlie start and spread of fires and forest fires?

2) What are the major types of fires in India?

3) Wliat are the basic requirements for spread of forest fires?

4) In forest fires what are termed as "Surface Fire" and "Crown Fire"?

5) What do you know about underground coal fires?

6) Can there be an oil fire without an outside source of fire'?

7) How does increasing population in urban areas add to fire hazards in buildings?

8) What are the major causes of start of fire in buildings?

6.3 LOCATION, FREQUENCY AND INTENSITY

As regards location, no place is free from the hazards of tire but the risk is more in congested areas, badly arranged stores, near combustible or inflammable material, badly maintained electric installations, multi-storeyed buildings, coal mines, forests and in locations with hot and dry climate over long periods of time. Based on these fundamental considerations, it is easy to appreciate that major fire disasters occur in crowded large cities with multi-storeyed buildings and large clusters of *jhuggi-jhoparpatties* and in vulnerable places like coal mines, industrial areas and stores of combustible and inflammable substances and chemicals.

There is no inherent frequency in tlie occurrence of fires or forest fires but it is clear that ignorance, carelessness, negligence, and bad maintenance add very considerably to tlie possibility of occurrence of fire disasters. Complete or reliable data for the entire country are not available but it has been estimated that about 30 lakh fire incidents occur in India annually resulting in about 15,000 deaths every year. These figures appear unbelievable but these are reasonably correct estimates. In Delhi, for which reasonably correct figures arc available, about 400 fire events are reported every year on the average. There are more fire incidents during the summer months when on tlie average about 30 calls are attended by the Delhi Fire Service. An extreme example relates to 17 and 18 June 1997, when tlie number of fire incidents reported was 53 and 70, respectively.

The intensity of a Fire event clepencls very largely on the nature and amount of tlie combustible and inflammable material available for feeding tlie fire. Hot and dry weather conditions add to the intensity of a fire event. Strong winds fan tlie fire and make it spread rapidly downwind.

6.3.1 Damage Done

As already mentioned, more than 30 lakh fire and forest fire events of various sizes occur every year in the country. These result in physical damages running into thousands of crores of rupees. It is very unfortunate that fire related deaths also run into thousands per year in the country. Besides, a large number of clomestic animals are also killed or maimed in fires.

Forest fires destroy very large areas, depleting natural resources, taking a heavy toll of life especially the wildlife. Forest fires destroy valuable bio-diversity.

6.3.2 Prevention and Protection

Prevention, is better than cure – so goes tlie old saying. In the context of fires also, prevention is definitely better than protection. But if a fire does happen, protection becomes most important. Protection from lire consists essentially ofdeteciion of tlie tire as early as possible and extinguishing it as soon as practicable. **Thus, safeguarding life and properly from fires and forest fires involves three basic aspects, which are:** (i) **Prevention; (ii) Detection and (iii) Extinguishing.**

Prevention

Rcsearcli into causes of fires and forest fires, identifying methods of preventing different types of iires and devising new techniques of fire prevention are part of the specialized studies in different branches of engineering. But now the idea of absolute fireproofing or complete prevention of fires whether it is coal, oil, gas, buildings or forests, is considered to be impractical because one cannot decongest the buildings nor stop everybody from careless habits of smoking or burning small fires in or near forests, nor even put a total ban on fireworlts which seem to be a must during festive occasions like Diwali. Therefore, the present day emphasis is on creating conditions or designs so that hazardous materials will be stored safely, fire sources will be handled carefully, electric equipment maintained properly, and fittings and fixtures made of such material that will not catch fire easily or burn slowly. Further, the buildings should be so designed that fires will be isolated in that portion of tlie building where it started and not spread immediately to the whole building. Finally, periodical inspection and rectification of defects are very important part of the fire prevention process.

Above all, creating awareness among people is tlie most important part of fire prevention. Every person should be made aware of tlie serious risks and dangers to him or her, the family, the home and the work place from fire hazards. Proper awareness will enable one to avoid conditions that would start a fire or spread of

fire. Basically, this means keeping fire source and combustible or inflammable material separated and under correct conditions of control. Non-Governmental Organisations (NGOs) and the media can play a very helpful role in spreading the awareness among the public. Periodic "fire drills" would also spread such awareness. Schools could play an important role in creating awareness from the early stages.

Detection

Detecting a fire, as early as possible after it starts, is the most crucial step in protection from fire hazards. The three principal indicators of a fire are: (i) smoke, (ii) heat, and (iii) flame. The success of early detection of a fire lies in recognizing one or more of these indicators of a fire. Detection can be planned through (i) self-help by every person by being vigilant around him or her, (ii) a system of alert volunteers for a specific place like a forest or a coal godown or a crowded place like circus or a religious or social congregation, and (iii) automatic detectors or sensors such as heat sensors or flame detectors or smoke detectors in multi-storeyed buildings, markets, cinema halls, hotels, factories, offices or computer centres.

Extinguishing

Once a fire or forest fire has been detected, immediate action is required to stop it from spreading and to extinguish it totally. Towns and cities have fire brigades. But every moment is precious and fire should be tackled immediately till professional fire fighters arrive on the scene. Where there are no fire services, the citizens have to deal with the fire themselves.

For extinguishing a fire, the basic strategy is to isolate the fire that has started, to stop it from receiving oxygen by preventing its contact with air and to cool the area so that the fire is extinguished.

In most cases, fires are extinguished by water and/or sand. In case of oil fires, special foam chemicals are used. Electric fires are extinguished, by switching off electricity and using carbon-di-oxide or halon gases to extinguish the fire. Forest fires are extinguished tnostly by beating the burning bushes with handtools and by cutting a strip through forest to prevent fire from spreading. In case of fierce forest fires, huge quantities of water or special chemicals are dumped over burning forests with the help of specially equipped helicopters. But such fierce forest fires generally do not occur in our country. Moreover, this method is very costly.

6.3.3 Lessons Learnt

The most important lesson to be learnt is that no place is immune to fire and every person has to be always alert to the possibility of a fire hazard. Further, almost all fires and forest fires are man-made. It takes the careless or unwise action of one person to begin a destructive fire. Therefore, it is the sacred civic duty of every citizen to ensure that he or she does not cause a fire or a forest fire to begin or spread.

Secondly, combustible and inflammable material should be stored, handled and transported safely to avoid the risk of fire.

Thirdly, all electric equipments and wiring should be maintained properly so that the risk of short circuit or spark is avoided.

People passing through or visiting forests should not leave burning or smouldering embers behind. Smokers should be careful to extinguish cigarette or beedi butts completely before throwing away. They should never smoke in bed.
Buildings in crowded localities, especially multi-storeyed buildings, should be properly designed and maintained. The exit routes should not be locked or otherwise obstructed and these should be well marked by "signs".

Early detection of a tire is a very crucial step in fire protection and this should be ensured through individual alertness, volunteer system and automatic fire detection systems.

6.4 GOVERNMENT RULES

Fire prevention and protection often become "State" subjects which means that the responsibility lies primarily with the State Governments. Therefore, the main rules for fire prevention and protection are laid in the form of Slate Regulations or Municipal Bye-laws. However, at the national level, there is the National Building Code Part IV which deals with fire prevention, protection and guidance by specifying standards for construction, plumbing, electric installations including wiring, safety, sanitation, lighting, ventilation, heating and air-conditioning. As already explained, absolute fire-proofing is not a practical proposition. Therefore, Building Code presents a compromise between fire safety and cost of construction.

At the initiative of the Delhi Fire Service, the Delhi Administration and the Ministry of Home Affairs of Government of India, the Parliament passed the Fire Prevention Act 1996 making it essential to provide the minimum prescribed protection measures for getting buildings certified before these are declared fit for occupation. In addition to rules by Government, there are also the guidelines from such organizations as the Loss Prevention Association of India, the Bureau of Indian Standards, the Institute of Fire Engineers (India), the Central Building Research Institute, the National Safety Council, and Insurance Companies.

However, all the rules apply only in cities and towns where there is some kind of municipal control. There also, the rules are not always adequately enforced and are flouted more than observed. But for the vast rural areas of the country, fire prevention and protection depends entirely on the Initiative, alertness and resourcefulness of the local. individuals and the community. No wonder, we have such large numbers of fires occurring in our country, year dfter year.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the Unit.

1) What types of locations have greater risks of fire?

2) What are the three basic aspects in fire safety?

3) What are the rules governing fire safety?

4) What are the important lessons that you have learnt after studying this unit?

6.5 LET US SUM UP

Fires and forest fires 'are very destructive disasters and are almost always manmade. While there are distinct features of each fire event depending on the nature of the burning material (coal, gas, oil, building, forest etc.), location (crowded area, multi-storeyed building, village, jhuggi clusters, forests, etc.), weather conditions (hot, dry, strong winds); the common result is loss of life and property and misery for the surviving victims. Multi-storeyed buildings, jhuggi clusters and large congregations such as marriage and religious gatherings, where there is abundance of thatched or tented housing and where there is fire kindled for cooking or fireworks, etc., are specially vulnerable to fires. Electrical short-circuiting, sparks from loose connections, and burning cigarette and beedi pieces are very common causes of starting fires. Needless to say, fires also pollute the atmosphere.

Fire safety or fire protection involves three important aspects, viz., (i) prevention, (ii) detection and (iii) extinguishing. Public awareness of what to do before fire, during fire and after fire is of critical importance. Municipalities and Government Departments make Bye-laws and Building Codes to guard against fires. But vast rural areas are not covered by these rules.

6.6 KEYWORDS

Rain Forests — Dense forests created by a climate of heavy rains.

Coniferous — Mountain area tree which bears cones sucli as pine tree. .

Deciduous — Those plants and trees that shed their leaves annually and thus collect a lot of dry leaves on the ground creating a fire hazard.

Evergreen — Always green; trees having green leaves, all the year round. Such trees also shed their leaves but only after new leaves have appeared. Therefore, such trees also, in dry climates, produce dry leaves wliicli can burn.

Humidity — Dampness; Amount of moisture in the air.

Embers — Burning or smouldering pieces of coal, wood etc.

Jhuggi-jhoparpatties : Clusters (large groups) of huts, temporary shelters built from wooden planks, thatched roofs, plastic sheets etc. all of which are combustible.

Building Code — Rules by wliicli local authorities control the construction or alteration of buildings.

Bye-laws — Rules made by municipal authorities.

Media — Through which information can be conveyed to tlie public. For example, newspapers, magazines. radio, television.

Thatched : Made of hay or straw.

6.7 REFERENCES AND FURTHER READINGS

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6.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

I) Your answer should include the following points:

- Human negligence or human indifference
- Strong winds
- Dryness (low humidity)

2) Your answer should include the following points:

- Coal Fire
- Oil Fire

- Gas fire
- Building Fire
- Forest Fire

3) Your answer should include the following points:
   - Dry fuel (leaves, grass, bush branches of trees)
   - Dry weather
   - Strong breeze

4) Your answer should include the following points:
   - Surface Fire: when dry grass, leaves, deadwood and small bushes burn.
   - Crown Fire: when, on intensification, forest fire starts burning the tops of tall trees.

5) Your answer should include the following points:
   - These burn inside coal mines and spread inside over large areas
   - These burn for decades
   - These generate intense heat even on ground surface which cracks thereby emitting gases and smoke
   - On one hand coal is destroyed inside the underground coal deposits while on the other it becomes unfit to live or have economic activities on the ground surface.

6) Your answer should include the following points:
   - Yes, through self-ignition

7) Your answer should include the following points:
   - Closely built houses
   - Multi-storeyed buildings
   - *Jhuggi Jhoparpatties*
   - Accumulation of combustible and inflammable material

8) Your answer slioulcl include the following points:
   - Bad electric connection or electric equipment
   - Smoking in bed and throwing burning cigarette or beedi carelessly
   - Kitchen accidents
   - Use of combustible and inflammablematerial in furnishing and decoration
   - Storage of hazardous chemicals without adequate safety.

Check Your Pi-ogress 2

1) Your answer should include the following points:
   - Congested areas
   - Badly arranged stores
   - Electric equipment not maintained properly
   - Multi-storeyed buildings
   - *Jhuggi-jhoparpatti* clusters

- Coal mines
- Oil Storage areas
- Forest

2) Your answer should include the following points:
   - Prevention
   - Detection
   - Extinguishing

3) Your answer should include tlie following points:
   - Municipal Rye-laws
   - Building Codes
   - Fire Prevention Act
   - Guidelines from organisations such as Loss Prevention Association of India, Bureau of Indian Standards, Institute of Fire Engineers (India), National Safety Council, Insurance Companies.

4) Your answer should include tlie following points:
   - Almost all fires and forest tires are manmade
   - While it is almost impossible to ensure total prevention of fires and forest tires or to make absolute fire-proofing of buildings, preventive precautions can help in reducing the occurrence of fires and forest fires and also reduce tlie damage to life and property when fires occur.
   - Multi-storeyed buildings and crowded places like hotels and cinema halls should be properly designed.
   - Electrical equipment should be well maintained
   - Early detection of fire and forest fire helps.
   - Rules and guidelines pertaining to construction of buildings and fire prevention should be strictly followed.

UNIT 7 INDUSTRIAL AND TECHNOLOGICAL DISASTERS

Structure

7.0 OBJECTIVES

After studying this unit, you should be able to :

- understand the subtle difference between industrial and technological disasters;
- learn about tlie types of industrial and technological disasters and their special features;
- highlight the case of Bhopal Gas Leak disaster; and
- discuss chemical and biological warfare disasters.

7.1 INTRODUCTION

The industrial and technological hazards do not have a very well defined definition. In general, both these types are the result from accident, failure, mishap or misuse of some kind of technology. The disaster may be brought about by causes like leakage, spills, radiation fallout, explosions and fires, structural failure and transportation mishaps. All the technological innovations have certain amount of risks and very well defined benefits, as the use of the available technologies in appropriate manner make life easier and enjoyable. For example, the transportation sector is serving the mankind in a big way through comfortable and short duration journeys for long distances; at the same time the accidents involved in this sector cannot be ruled out. The major reason behind the large number of accidents is either machine fault or the failure of human beings in one form or the other. The case is almost similar with all disasters involving usage of technology which is getting more and more complex.

However, for the sake of convenience in study, industrial hazards cover the on-side and off-side disasters emanating from large installations or undertakings. All other hazardous events occurring at public places or private premises while using or transporting technical devices or methodology are grouped as technological disasters.

7.2 SPECIAL FEATURES OF INDUSTRIAL AND TECHNOLOGICAL DISASTERS

Industrial and technological disasters are characterised by tlie following special features:

Predictability: Industrial and technological disasters have no predictability as such because of the inherent nature of tlic causes indicated under introduction above. In case of tlie machines and equipment, there is a concept of "mean time between failures (MTBF)" but it is not necessary tliat every mechanical or equipment failure will lead to a disaster. In fact, the technological and industrial systems are designed to shut oft' partially or totally once there is a sub-system failure. In major industries or technological installations, there are more than one safety systems. But disasters do occur due to a combination of technical circumstances or due to human fatigue or failure. In any case, there is no usable concept of predictability in industrial and technological disasters.

Contributory Factors: Most of the industrial and technological disasters are attributable to human error (due to erroneous judgment or operator fatigue or negligence in operation and/or maintenance) or due to system failure (malfunction of equipment or machine or structural failure). The probability of their occurrence is not predictable as explained above. However, there are factors that aggravate tlie chance of occurrence.

These arc:

- Lack of proper maintenance of the installations
- Lack of adequate training of operational and maintenance staff
- Lack of awareness of the serious consequences of negligence
- Lack of safety rehearsals
- Fatigue of overworked staff
- Deactivation of safety systems for repair or maintenance without alternate safety cover
- Sabotage from within or outside

Hence eternal vigilance is tlie key to reduce the chances of occurrence of industrial and technological disasters.

Typical Adverse **Effects**

Industrial and technological disasters lead to adverse effects that are typically spread over a smaller area as compared to natural disasters but tlie resultant human misery and economic loss are sometimes more colossal and cruel. The common adverse effects are:

(i) Physical damage which may extend to neighbouring areas

(ii) Large number of casualties involving deaths and serious injuries requiring urgent medical attention on a large scale

(iii) Trapped persons requiring special techniques and equipment for retrieval and treatment

(iv) Environmental degradation of air, water and land which sometimes may take years to be rectified and may therefore, necessitate relocation of the population

(v) Loss of employment of not only the involved persons but also of the affected area at large.

Immediate Post-disaster Requirements

Industrial and technological disasters occur without any notice and tlie disaster management system has to be brought into action as early as practicable. Therefore, the first and foremost requirement is that tlie incident should be brought to the notice of the local and district authorities (Civil and Police) immediately by the fastest communication methods available Simultaneously, fire fighting has to commence because most of the industrial and technological disasters result in fire. However, tliese being different from normal household or building fires, need special equipment and fire-retardant material depending on tlie causes and nature of the fire. In most cases of fires resulting from industrial and technological disasters, tlie fire personnel need to wear special protective gear and masks.

Search and rescue, medical attention including trauma care and evacuation become essential immediately.

Industrial and technological disasters need a thorough clean up mission to retrieve and salvage as much as possible and to arrest tlie spread of adverse environmental effects.

7.3 THE INDUSTRIAL HAZARDS

The accidents in various types of industries like manufacturing, power production etc. and in storage and transportation of various hazardous materials used in tliese industries fall under this category. Tlie risk involved under this category is defined as tlie chances of death or injury per person per number of hours exposed.

Tlie major disaster threats have emerged in the chemical and nuclear industries. The manufacturing, processing, transportation, distribution/storage and tlie application/use of many products of tliese two areas are hazardous. Tlie following paragraphs highlight some aspects under these two major groups.

7.3.1 The Chemical Hazards

The chemical industry is massive throughout the globe, manufacturing a liuge quantity of chemicals annually. At present four and a half million chemicals are registered with the 'Chemical Abstracts', and thousands of new chemicals are created every year. Tlie creation of new chemicals becomes imminent for higher standards of every day life. The advances in this particular industry are due to substantial demand. In our country, the cliemical industry is about US$20 billion-a-year industry. Tlie chemical industry faces multiple risks involved with production, transportation, storage, usage and disposing off tlie effluents containing residual chemicals.

Tlie studies conducted on tlie chemical disasters' show that tlie incidence of chemical emergencies and disasters are on increase throughout tlie world. Even the risks involved within tliese types of industries are higher due to the involvement of larger amounts of materials involved. For example, the tonnage carrying capacity of the sea going petrochemical tankers increased seven times during the period 1960-1980. Similarly, trucks carrying chemicals, even petrochemicals, have increased along with tlie liiglier carrying capacity. Thus, tlie risk involved in the increased capacity is automatically liighcr.

From tlie technological hazards points of view, 1984 was the worst year, where three major disasters took place in the world. In these three disasters, about 3,500 people died. These disasters were:

i) Bhopal (India,2/3.12.84) – more than 2000 deaths, 34,000 eye infections, 2,00,000 people left the city. Release of toxic gas from the factory in the urban area. The Bhopal disaster have been discussed in the Section 7.5 in detail.

ii) Mexico City (Mexico, 19.11.84) – 452 deaths, 31,000 homeless and 3,00,000 evacuated from the site. LPG explosions in a high density residential area near the industrial site.

iii) Cubatao (Brazil, 25.2.84) – 500 deaths in the petroleum spillage and fire in an illegally built town near tlie industrial site.

7.3.2 The Nuclear Hazards

The nuclear power industry was developed because initially, it seemed to offer a relatively dependable and inexpensive source of energy. The history of nuclear industrial development is about half a century old. After a few accidents in this industry like Chernobyl (former USSR), the industry is being considered as a major hazardous one. Majority of developing countries including India are using nuclear power increasingly to get rid of continuously increasing need of imported sources of energy. According to the International Atomic Energy Agency (IAEA), developing country's present share of world's installed nuclear power plants is about 7.0%. A total of 21 developing countries either have nuclear power plants in operation or have the plants in construction or planning stage. This number will be increasing in future. As per the estimates of IAEA, nuclear energy production is growing at an average of 2.8 to 3.9 percent per year worldwide in the period of 1989-2005.

Besides, tlie in-plant 'nuclear plant' problems, risks are associated with tlie transportation and disposal of nuclear wastes over long distances including other increasing byproducts of the nuclear plant processes.

7.4 TRANSPORTATION ACCIDENTS

As mentioned in the preceding section, transportation is very much involved in industrial and technological activity. Therefore, transportation accidents constitute a special category of industrial and technological disasters, Tlie accidents in various modes of transport like roadways, airways, railways and seaways fall under this category. . The risk involved under this category is defined as the chances of death, or injury per kilometer travelled.

The public transport systems in present times are much safer in comparison to few decades ago. The innovation in tlie safety systems have reduced the chances of occurrences of disasters considerably. With all available sources, tlie number of deaths in the transportation sector are on the rise due to increased number of travellers and enhanced travelling distances. Tlie mobility at present is very high due to increased businesses and higher tourist activities throughout tlie globe. The transport related risk is also high due to higher occupancy of the vehicles used for travelling by air, rail or road ways. Even a majority of passenger vehicles have large capacity to accommodate tlie large number of passengers. Thus any accident results in more deaths or injuries. One example of this type of disaster is tlie mid air collision over Charkhi Dadri near Delhi in November,1996.

Mid-air Collision between Saudi-Kazakh Aeroplanes:

On November 12, 1996 around 6.40 P.M. two planes owned by Kazakh Airlines(KZA 1907) and Saudi Airways (SVA 763) collided in tlie air near Charkhi Dadri, 80 Km north-west of Delhi. The following is the fact sheet of the disaster:

- Collision height - about 5000 metres above mean sea level.
- Average speed at impact - 500 km. per hour
- Total people ltilled - 351 (312 on board the Saudi Airways Boeing 747 and 39 in the Kazakh Airlines JL-76)
- Radius of debris - about five kilometre
- Separation between the debris - about seven kilometres between the two planes
- Approximate weight - about 500 tonnes of the wreckage

The chronology of the events leading to the disaster can be summarised as. following:

- Saudi Airlines fliglit took off from the Indira Gandhi International Airport at Delhi at 6:33 P.M. for Dahran and Jeddah, with 312 persons on board. Tlie Air Traffic Controller at Delhi airport tells tlie pilot to climb to a height of 14000 ft. and standby.
- At the same time, a Kazakh Airlines plane coming to New Delhi witli 39 persons on board is cleared to descend to 15,000 ft. by tlie Air Traffic Controller.
- Both tlie pilots confirmed the stipulated heights as given by tlie Air Traffic Controller . Within a minute, the radar in the control room liad two blips on screen, indicating two planes approaching each other and merge witli each other. Tlie blips disappeared from tlie screen just after merger.
- A US plane saw the bright glow in tlie sky and two fire balls falling down to the ground.
- As the debris was spread over five Km radius area, without proper road connection, it took about 2 hours by tlie local authorities, to reach the debris site.
- Tlie local people started the rescue and search operation immediately after tlie disaster.
- There was'no survivor.
- Tlie cause was faulty equipment in aircraft and pilot error.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers witli those given at the end of the Unit.

1) What do you understand by industrial and technological disasters?

2) What are the various types of industrial hazards?

3) Describe any disaster related to transportation sector.

7.5 INDUSTRIAL DISASTERS: A CASE STUDY OF BHOPAL GAS LEAK DISASTER

One of the most disastrous events since the history of chemical industry occurred in Bhopal, the capital city of Madhya Pradesh, on the night of December 02, 1984. in the factory of Union Carbide of India Ltd. (UCIL) due to leakage of Methyl Iso Cynate (MIC) gas. UCIL, a subsidiary of the multi national company Union Carbide Corporation (USA) was in the business of manufacturing agricultural pesticides among other things. MIC was required in these manufacturing activities and was therefore, manufactured and stored at the UCIL plant in Bhopal.

Characteristics of MIC

MIC has very special characteristics which make the chemical very hazardous. Some of the properties of the MIC are:

- It is extremely volatile and vaporises very easily
- It can boil at a temperature of 38degrees C, so it is very important to be kept cool.
- It is chemically very active and reacts violently with water.
- It is highly toxic, it is about 100 times lethal than cyanide gas,
- It is heavier than atmospheric air, it stays near the ground after release.

The Disaster

During the night of December **2-3,** 1984, about 45 tonnes of MIC (Methyl ISo Cynate) gas leaked from the UCIL (Union Carbide of India Ltd.) plant at Bhopal. MIC was stored in the underground tanks, which became contaminated with water. The contamination produced chemical reaction, followed by a rise in gas pressure and a subsequent leak. The chronology of the events leading to one of the most disastrous events in the history of chemical industry is as follows:

Chronology of the Event

December 2, 1984, was a routine day at the UCIL factory in Bhopal

- MIC was stored in an underground tank. The pipeline washing started at 9:30 p.m. as a routine maintenance operation
- Between 10:30 – 11:00 p.m. : workers engaged in pipeline washing became aware of a leak. Little attention was however paid considering it a normal leak. A casual attempt was made to trace the source of leakage, but of no use. The leak continued.
- Around 12:15 – 12:30 a.m.: The pressure in the MIC tank shot upto 55 pounds per square inch (which was the maximum the gauge could read). The temperature had also shot up to 200 degree C and was increasing. An operator saw that the concrete above the tank was cracking. About 12:30 a.m., the relief valve of the tank gave away arid large quantities of MIC gas leaked into the atmosphere.
- The workers at the factory realised the risk of a massive disaster. They tried to activate the safety systems available at the factory at about 12:30 a.m. The three safety systems available within the factory arid their condition at that time were as under:
- Turning on the flare tower to burn off toxic gas. This system was not in working condition as a piece of pipeline leading to the tower had been removed for maintenance.
- Using the vent gas scrubber, which was considered the main line of defence. It was also not in an operational condition.
- Transferring the MIC from the tank into a nearby spare tank. The gauge of the spare tank indicated that the tank already contained something. This gauge indicator was found defective, later on.

After failure in all the three safety systems, tlie workers attempted to douse the leaking gas with water spray. The water spray reached a height of 100 ft. from the ground, while the leak was at 120 ft. above the ground. At 1.00 a.m., realising that nothing could be done to stop the leak, the workers at the plant fled.

- At about 1CO a.m. thousands of people living around tlie plant were awakened by the suffocating, burning effects of the gas. As on three sides, tlie UCIL plant was surrounded by slums and other poor settlements, the people living in these colonies were the worst sufferers.
- There was no warning or guidance to the general public around this time. There were two types of alarms in the factory, one mild siren for workers and one loud public siren. The public siren was started only at about 2:30 a.m.
- About 2.00 a.m., a large number of people were rushing out of tlie town through the highways leaving Bhopal. The mad rush on the main roads of the city resulted in stampedes. About two lakh people had fed the city by 3:30 a.m.. The gas clouds dissipated around 3:30 a.m..
- By 4:00 a.m. hospitals were crowded with suffering people.

In the wake of the tragic disaster, a large number of people lost tlieir lives and received injuries, many to their lungs and eyes. According to the Government reports, 1754 persons had died and 200,000 were injured.

Removal of dead bodies of livestock

The real problem was the removal of dead bodies of livestock, which was still littered on the streets and houses of tlie affected areas. About 20 dumpers and six

cranes were pressed into service to remove 790 buffaloes, 270 cows, 483 goats, 90 dogs and 23 horses. During the burying operation of dead bodies, adequate care was taken to check the spread of epidemic.

Emergency Response and Relief Operations

The preparation for coping with a major accident of unprecedented dimensions affecting the surrounding communities like this one was minimal. After the event the immediate response was chaotic and inadequate. Information regarding the gas release was late and incomplete. The police and medical services were unaware initially that there had been a release of MIC gas. No one knew about the adverse effects of tlie gas release and tlie treatment methods of the affected persons.

For the relief purposes of the affected persons a relief commission was created directly under the Chief Minister. Two additional collectors were made incharge of relief and rehabilitation respectively. Tlie main duties of the additional collectors included tlie proper field work coordination and to ensure the implementation of administrative directives. Various gas affected localities were divided into seven administrative zones. Each zone was under tlie administrative control of a deputy collector.

Tlie next of liin of the dead persons were paid immediate ex-gratia compensation of Rs. 10,000. The poor families in the gas affected wards were paid an cx-gratia of Rs.1500. Wheat and rice were distributed free in tlie affected local'ities. The local administration faced problems in the absence of reliable socio-economic surveys which made tlie identification of poor families very difficult.

The gas relief commission and the state department of industry launched scliemes to provide alternative employment for the affected people.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the Unit.

1) Write a note on Methyl Iso cyanate.

2) Explain in detail the Bhopal gas leak disaster.

3) Explain the various relief measures taken up by the administration after the Bhopal gas leak disaster.

7.6 CHEMICAL AND BIOLOGICAL WARFARE DISASTERS

The threat of chemical and biological warfare has been talked about frequently in the past years but the likelihood of such occurrence has assumed serious concern in the emerging terrorism dominated environment. Such tactics have been rightly given the name of Weapons of Mass Destruction (WMD).

7.6.1 Chemical Warfare/Terrorist threat

i) Poisons

Chemicals, in the form of poisons, have been used as agents of harm since times immemorial. These assume disastrous proportions when used for large scale or mass killings. Such situations can arise either inadvertently, or through ignorance or in a criminally planned manner. Inadvertent use of poisonous substances – by children in many cases or mixing of toxic chemicals or poisons in country liquor, are well known examples. In times of strife, there are threats of poisoning the water supply of entire town or city and hence special vigilance is to be maintained around water works and water tanks in case of actual or perceived threats of this type.

ii) Toxic Gases

Quick acting, toxic gases have been envisaged as the means of immobilizing or killing large segments of population and are reported to have been manufactured and stored by many countries during wars or war like situations although it is not very clear if these were used as Weapons of Mass Destruction (WMD) so far. The chemicals, in the form of gases, that have been usually talked about in this context are the following:

(a) Nerve Gases are basically highly toxic insecticides and act by inhibiting important enzyme activity in human body, These are generally the compounds of fluorophosphoric acids with alcohol and known as esters. In a well reported case, the Aum Shinri Kyo cult in Japan released Sarin nerve gas in Tokyo subway in 1995. It resulted in the death of 12 persons and many more had to receive medical treatment for extended periods.

(b) Phosgene is the name given to carbonyl chloride and is a poisonous gas used in certain chemical and dyestuff manufacturing processes. It acts on human body by damaging the lungs quickly.

(c) Hydrogen Cyanide interferes with the transfer of oxygen from the blood to the human tissue. This was the killer agent in the Bhopal gas tragedy of 1984 when the Methyl Iso Cyanate gas in contact with the moisture in human eyes, nose and lungs generated hydrogen cyanide which blocked the supply of

oxygen to these organs and blinded and killed thousands. That was a chemical accident but a similar scenario of a chemical disaster can be created by a terrorist or enemy agent.

(d) Mustard gas is also called yperite and is chemically identified as dichlorodiethyl sulphide. It lias a faint odour of garlic. It causes conjunctivitis in tlie eyes leading to blindness and creates very painful blisters on the skin.

Release of a poisonous gas at single point or even a multipoint ground based release may affect only the people in tlie vicinity or tlie down wind communities. However, aerial spray from low flying vehicles such as helicopters or crop-spraying light aircraft is a more dangerous proposition.

If people can get away quickly or otherwise limit exposure to tlic poisonous gas and can receive prompt medical attention. chances of survival with manageable injuries will be quite high. But this will depend upon the ability of the medical personnel to correctly identify tlic toxic gas from the first symptoms on the victims and tlie availability of antidote medicine in tlic required quantity.

The All India Institute of Medial Sciences in New Delhi lias established tlie National Poisons Information Centre in its premises to collect and disseminate information about different poisonous substances.

7.6.2 Biological Warfare / Terrorist threat

In tlie context of biological disasters, mention is often made of botulism, small pox, Venezuelan Equine Encephalitis (VEE) and anthrax; tlie last one being tlie one that has recently come into great prominence because determined efforts appear to have been made to use it as a weapon of harming targeted individuals and terrorizing tlie general public although there lias been no evidence of its use as a weapon of mass destruction.

(a) Botulism is perhaps the most lethal biological agent. It is made by a bacterium and spreads through contaminated air, food or wntcr. Death occurs within-24 hours due to paralysis of breathing muscles. Antibiotic treatment, to be effective, must start before symptoms appear.

(b) Small Pox: Even though small pox as a disease has been eradicated from the world, the virus has been preserved in a few reputed laboratories and is kept under high security. The Sear is that if it comes in tlie hands of a terrorist organization, it may be released through aerosol spray. The problem is that there is no effective drug treatment and vaccination programmes have long been stopped.

(c) Venezuelan Equine Encephalitis (VEE) is fatal among humans and there is no known cure so far. It kills through inflammation of brain tissues.

(d) Anthrax is caused by tlie spore forming the bacterium Bacillus Anthracis and is really a disease associated with herbivorous animals. The disease occurs naturally in areas where people raise livestock. Humans contract the disease tlirougli cuts in tlie skin or by breathing in anthrax spores or by eating antlirax-infected meat. If anthrax spores are collected in a concentrated form and spread in the atmosphere on a large scale quietly, as a colourless odourless and invisible spray, it can certainly turn into a biological disaster because it spreads rapidly when it is inhaled into the lungs. At that stage, it is difficult to control although antibiotic treatment of anthrax is available. Tlie problem here also is that the antibiotic treatment must start before tlie development of symptoms of fever and cough, otherwise the mortality rate is almost 90%.

7.6.3 Nuclear Warfare/Terrorist Threat

Even though many countries possess nuclear arsenal, yet on a realistic assessment it is sensible to think that these may never be used as has been seem for over a half century that such lethal weapons liave been in existence. But the possibility, always remains of some terrorist organizations making a crude device. Noting the complexities of design and manufacture and the need for a long distance delivery system, the use of a nuclear device by terrorists would perhaps be a remote possibility. Even if it takes place, the incident would not pose problems more complex than those associated with a technological accident in a nuclear power plant. which we have discussed earlier.

7.6.4 Institutional Arrangements

A Nuclear Biological and Chemical (NBC) Warfare Girectorate has been set up by the Defence Services. An inter-services coordination committee monitors the activities.

The Defence Research and Development Establishment (DRDE) of the Defence Research and Development Organization (DRDO) is the premier establishment for studies in toxicology and biochemical pharmacology and development of anti-bodies against bacterial and viral agents.

7.7 LET US SUM UP

This Unit brings out the fact that industrial and technological disasters result from accident, failures, mishap or misuse of some kind of technology. The disaster may be brought out by the agents like technical spills, radiations fallout, explosions and fires, structural failure and transpol-tation mishaps. Special features of industrial and technological disasters have been discussed in some detail. A case of Bhopal Gas leak disaster has been presented. Finally, cliemical and biological warfare disasters have been discussed.

7.8 KEY WORDS

Bacterium : Microscopic or even smaller single-called organisms occurring in enormous numbers every where in nature in air, water, land, sea, plants and animals. They can start chemical changes including disease and decay.

Hazardous Industry : An industry using raw materials which by themselves, produce such products which could lead to massive disasters and heavy loss.

Spores : Minute reproductive bodies produced by plants or animal cells.

Herbivorous : Animals that feed on plants and vegetation.

Toxic Leak : Uncontrolled leakage and eventual spread of a hazardous gas, e.g., Ammonia, Chlorine, and other more toxic gases which can be fatal and can cause asphyxiation, i.e., difficulty is normal breathing. Some of the gases – like the Methyl Iso Cyanate in Bhopal Gas Tragedy can leave far reaching disabilities among survivors.

Trauma : Sudden shock either physical or mental or both.

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7.10 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include tlie following points:
   - There is only a subtle difference between industrial and technological disasters.
   - While almost all industrial disasters are also technological disasters, all technological disasters are not industrial, e.g., transportation accidents.
   - Industrial disasters have on-site and off-site aspects.

2) Your answer should include the following points:
   - Chemical hazards
   - Nuclear hazards

3) Your answer should include the following points:
   - A major transportation disaster occurred near Delhi in November 1996 when two aircrafts collided in mid air about 80 km from airport.

     One aircraft was ascending while the other was descending.
   - There was no survivor and all the 351 persons on board tlie two aircraft perished.
   - The cause was faulty equipment in aircraft and pilot error.

Check Your Progress 2

1) Your answer should include tlie following points:
   - MIC is very volatile
   - It boils at 38^0 C and has to be kept cool

     It reacts with water violently
   - It is highly toxic-much more lethal than cyanide
   - It is heavier than air and spreads near ground surface;

2) Your answer should include the following points:
   - It occurred on the night of December 2, 1984

     All three safety systems were either inoperative or did not work
   - Gas leaked and spread around
   - There were populated areas on three sides of the factory
   - Nobody seemed to know the defensive methods against the gas
   - 1754 persons dead and 2,00,000 were injured.

3) Your answer should include the following points:

- Affected persons were treated in hospitals
- Next of kin of dead were paid Rs. 10,000/-
- Poor families were paid Rs. 15001- per family for immediate expenditure
- Dead bodies of cattle were buried to avoid epidemics
- Employment schemes were launched for surviving persons.

UNIT 8 EPIDEMICS

Structure

8.0 OBJECTIVES

After going through this Unit you should be able to:

- explain an epidemic situation
- identify the causes for occurrence of epidemics; and
- list tlie steps involved in the control of epidemics

8.1 INTRODUCTION

You have already learnt in tlie earlier unit on epidemics (Unit 12, Block 3, CDM-01) about its meaning, causation and tlie control measures for preventing epidemics. In tliis unit, we shall describe two epidemic situations in tlie recent past, which liave been in the national and international media headlines. You will also learn about tlie magnitude and causative factors of these epidemic situations. Towards tlie end of this unit, the lessons learnt from these particular situations will be highlighted.

8.2 MAJOR EPIDEMICS IN INDIA

India is endemic to many diseases such as Malaria, Kala-azar, Cholera, Tuberculosis. These erupt in epidemic form when conditions are favourable for their spread. Epidemics are disasters by themselves but these can emerge in tlie aftermath of other disasters as well.

In the recent past, two epidemics, viz., plague and dengue inflicted tlie Indian population very badly at Surat and Delhi, respectively. I-lowever, these occurred by themselves and were not tlie result of any other natural disaster.

8.2.1 The Surat (Gujarat) Plague Epidemic - 1994

Plague is a disease known to mankind from ancient times. India lias undoubtedly a long history, which is replete with plague epidemics and havoc caused by them. This recent outbreak of plague generated a tremendous concern in and outside the country. No other disease so amenable to prevention and control lias generated such serious concern in contemporary times. If its present epidemiological picture is appropriately examined, it does not deserve the attention it received. The reason for its larger than life size attention in the media in the country and outside, and tlie reason for tlie controversies which plagued this plague outbreak are possibly due to an inappropriate perception of tlie

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changing epidemiology of plague in modern era, when we have powerful management and diagnostic tools to contain the disease.

This outbreak occurred in Surat on 19th September, 1994. Following the sudden increase in the number of admitted cases with acute onset of fever, chest pain, cough, hemoptysis and deaths between 19'" and 20th September, 1994 in different city hospitals, a sense of deep concern arose. As no history of rat fall could be elicited and typical bubonic cases were not seen, primary pneumonic plague outbreak was considered a possibility. The clinical presentation and the course of the disease pointed towards the pneumonic plague.

Though stray cases were reported from other parts of the city, the major concentration of the reported cases came from the two adjacent localities of Ved Road and Katargam where the population were by and large Maharashtrians, the sanitation was very poor and the localities were highly congested slums. Furthermore, these areas are situated adjacent to river Tapti which was flooded between 7th and 9th September, 1994 due to heavy rains. About five lakh cusecs of water was released from the Ukai reservoir which led to the heavy water logging of the area. When the flood water started receding on 14th and 15th September, 1994, the people of the localities started cleaning the areas and perhaps many of them handled dead wild rodents and animals. The Ganapati festival was observed with pomp and grandeur on 18th September, 1994, when a large procession passed through the area and thereby getting infected probably.

While the first patients were hospitalized on September 19, the panic was so great that by September 29, about 2 lakh persons (one-third of the population) had fled the city.

During the period of the outbreak, 52 deaths were recorded from Surat city of which majority occurred before 25th September, 1994. A total of 1088 cases were suspected, about 146 were presumptive cases and 52 deaths due to plague took place during the period from 19th September, 1994 giving an overall case fatality rate of 4.8%.

A study was carried out in Surat city during 8-19 November, 1994. Several identifiable risk factors were studied like occupation of the people, their visits outside Surat during the incubation period, exposure to a case, participation in the Ganapati procession festival, participation in cleaning operation, any associated illness, consumption of antibiotic, which could be accountable for the sporadic spread of the epidemic. The surprising thing was that the National Capital Delhi was also hit by the plague soon thereafter, although located faraway at about 1000 kin. from Surat.

Control Measures

Apart from identifying the patients and providing them proper medical treatment and care, a massive cleaning and sanitizing operation was conducted by the Municipal Corporation of Surat under the inspiring guidance of its Chief Executive whose efforts at cleaning up the city and thereby protecting it from epidemics were lauded nationally and internationally.

8.2.2 Dengue Epidemic in Delhi - 1996

Dengue epidemic struck the Capital from mid-August to end-November, 1996, with Dengue Haemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS), the worst ever in India's history. The virus, viz., Type II Dengue was identified as the causative agent in a number of clinical samples. There were in all about 10,000 cases with nearly 400 deaths as reported from all parts of the city.

The following reasons were identified for tlie dramatic emergence in India of Dengue/DHF as a major public health problem:

1) Ineffective Mosquito Control Programmes
2) Major demographic and social changes, the most important being uncontrolled urbanization, excessive population growth and urban decay characterised by substandard housing and inadequate water and waste disposal systems; and
3) Inadequate medical and health services.

Dengue fever is caused by the bite of a mosquito known as Aedes Aegypti which profusely breeds in coolers, storage tanks, earthen pots and other receptacles with rainwater or stored clean water. There are a large number of other possible breeding places of Aedes Aegypti, viz., flower vases, neglected cups of jugs, household collection of water, neglected features of buildings, uncovered cisterns, wells. roof gutters, cracks in the masonry, traps of drains, flush tanks, ant traps, water receptacles of various kinds, rain filled empty cans or food tins, leaking water supply, water meters, sluice water chambers, water for birds, broken bottles, garden tanks, tree chambers, tree holes, fountains, troughs, a variety of dumps for engineering goods, trees, scraps and many more.

Control Measures

Following the report of six deaths due to dengue at the All India Institute of Medical Sciences in The Times of India on September 13th, 1996, the Municipal Corporation of Dellii (MCD) deputed two senior officers from tlie Antimalaria Department to collect the details. Containment measures were immediately taken in tlie localities from where these cases were reported. By September 14, 1996, the total number of cases admitted as DHF in Dellii was 11,

The MCD and the New Delhi Municipal Committee (NDMC) took the following measures:

1) I-louse to house survey for detection of vector breeding sources
2) Intensification of anti-larval operation
3) Focal spray with pyrethrum extract
4) Intensification of health education Activities

Public notice by way of newspapers to educate tlie people regarding dengue and to control the domestic breeding of mosquitoes was done. Likewise equipment like spray pumps, fogging machines were put in operation in large numbers. Control room for monitoring the situation and distribution of pyrethum solution to the NGOs was also takcn-up.

In the year 2001, dengue again seemed to appear in Delhi and a few cases were reported in October. Timely campaign against breeding of mosquitoes by public education and public health measures ensured that tlie disease did not attain epidemic status.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the Unit.

1) Explain the reasons for the outbreak of plague in Surat in 1994.

2) Give reasons for the emergence of Dengue/DHF in India.

8.3 LESSONS LEARNT

8.3.1 Plague

1) The diseases of the past can make their resurgence if favourable environment conditions are present. Efforts to prevent the resurgence of such deadly diseases have to be made by way of good sanitary conditions, hygiene and cleanliness.

2) The decaying material including dead animals in the unsanitary conditions that usually prevails after the occurrence of destructive natural disaster situations such as earthquakes result in the spread of diseases/ epidemics as was seen in the case of the Latur earthquake of 1993.

3) People living in poor sanitary conditions, congested slums and overcrowded localities are more' prone to communicable diseases like plague.

4) Migratory population and people participating in crowded functions during festivals and processions create conditions conducive for the spread of such diseases.

5) Surveillance and monitoring programme for the diseases like plague are lacking at present. For want of required data/information on various causative factors, these epidemics cannot be forecast, thus further deterring timely preventive measures.

6) Public needs to be educated about the signs and symptoms of likely diseases so as to enable the early detection and preventive measures of such diseases.

7) Local health authorities have to keep a constant vigil on the epidemic prone areas.

8.3.2 Dengue Fever

1) The outbreaks of dengue including dengue hemorrhagic fever (DHF)/dengue shock syndrome (DSS) can be anticipated through a system of surveillance and monitoring of Vector densities.

2) A check on the spread of epidemics by means of adequate control and monitoring measures before and after the occurrence of epidemics has to be ensured.

3) Breeding conditions and the vector around Delhi and in other parts of the country pose a constant threat of dengue in India. Desert coolers. water storage tanks and utensils, leaking water supplies, wells and fountains, rain water collections and water bodies, tyre dumps, junk cans, rain-soaked and uncleared garbage dumps, etc. provide excellent places for Aedes breeding.

4) DHF has become endemic and would surface periodically because of tlie very high vector breeding. The only practical approach to avoid future epidemics lies in preventive vector control with main reliance on source reduction and sanitation.

5) Extensive training programme to update their knowledge and skills in this area is essential for health workers.

6) We must accept and face the reality that dengue can surface again and to prevent future outbreaks, especially in tlie absence of any specilic antiviral treatment or vaccine, sustained preventive community measures is the only key to success. Public education in this regard is very essential.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of tlie Unit.

1) What are tlie lessons learnt after the outbreak of plague in India?

2) I-las dengue become endemic in some parts of tlie country? If yes, what should be done?

8.4 LET US SUM UP

In this unit you have learnt about the two major epidemic situations of the last decade.

The Plague epidemic occurred in Surat in the year 1994 whereas dengue fever epidemic gripped the country's capital in 1996. You have learnt that in both these epidemics not only large number of people were affected but a significant number of persons also lost their lives. The likely causative factors have been explained and tlie important lessons learnt Iiave been highlighted.

8.5 KEYWORDS

Bubonic	A disease situation involving swelling of glands in the body
Anti-larval operation :	Action to kill tnosquitoes at the larva stage itself.
Endemicity	A condition or illness that is common among the people throughout the year.
Haemorrhagic	Disease in which blood flows oul
Epidemiology	The study of the occurrence of a disease in human population.
Vector	Insect that spreads disease, e.g., mosquito
Pneumonic	Pertaining to pneumonia which is a disease in which lungs get infected and develop swelling.

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8.7 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

I) Your answer should include the following points

- The surroundings were generally very unclean and unhygienic.
- The flood that preceded the plague outbreak brought dead bodies of wild rodents and animals.
- While cleaning up the area,. people came in contact with these dead rodents and animals.

2) Your answer should include the following points

- Dengue spreads through the Aedes Aegypti type of mosquito which breeds in clean but stagnant water, the like of which is available in and around houses.
- Effective mosquito control programme is a major reason for the emergence of dengue.
- Inadequate medical and public health services have also contributed to the emergence of dengue.

Check Your Progress 2

1) Your answer should include the following points

- Good sanitary conditions are essential to avoid plague.
- Crowded places should be avoided.
- Regular surveillance and monitoring are necessary.
- Such epidemics can start after major natural disasters also.
- Public education is essential.

2) Your answer should include the following points

- Yes, dengue is endemic in Delhi and other parts of India.
- Strict monitoring and control of breeding of mosquitoes has to be ensured.
- Public education is necessary.

UNIT 9 DISASTER MAPPING

Structure

9.0 OBJECTIVES

After you have read this Unit, you should be able:

- to learn about maps and mapping techniques;
- to understand tlie usefulness of disaster mapping;
- to appreciate the importance of disaster mapping as a tool for risk assessment and damage evaluation for different types of disasters;
- to explain Geographical Information System (GIS) in the context of disaster mapping; and
- to describe disaster mapping as a powerful tool Tor disaster management.

9.1 INTRODUCTION

Disaster mappingis a tool for assessing, storing and conveying information on the geographical location of a disaster occurrence and spread of tlie effects or probable effects of disasters.

Every year in a country like India, natural disasters like foods and cyclones are fairly frequent. Earthquakes also occur time and again. The occurrences of such disasters, their intensity, tlie area/region of their occurrences and their impact has to be assessed, so as to have information/data about the damages caused by them to tlie area/population specific or probable damages or impact likely to be caused. Proper mapping will be helpful not only for pre-disaster preparedness but also in rescue and relief operations with greater accuracy and speed.

With the data/information collection, storage, retrieval becoming highly technological and scientific, new specialized techniques like Geographical Information System (GIS) are increasingly used for disaster mapping and these are proving to be very useful.

9.2 DEFINING A MAP

Map is defined as a representation of a portion of earth's surface in a two-dimensional depiction. Accordingly, mapping denotes tlie making of a map i.e. setting out various physical geographical features on a map. A map may show fixed features such as cities or mountains or variables such as temperatures or populations. Maps can be on computers (GIS). Pre-disaster and post-disaster maps will show the impact of disaster. In order to be precise and accurate, most maps are geo-referenced, i.e., they are portrayed with reference to universally standardized geographic references, as in latitude, longitude and altitude.

9.2.1 Techniques to Read and Interpret Maps

Traditionally, maps have been prepared based on physical surveying. These maps are then presented as hard copies, i.e., they are printed on paper, using colours, symbols, labels and other drawing elements to represent geographic facts. Such a map is on 'scale', which means that its dimensions are proportionate to tlie actual area it represents. A typical town may be conveniently represented on a scale of 1:20,000, meaning that one unit length on tlie map represents 20,000 unit lengths in reality. In other words, a distance of one c.m. sliown on tlie map represents 20,000 c.m., or 200 m, of actual distance on ground. Various land uses, activities, zones etc., are shown with different colours, the colour code being explained in a legend, or ltey, on the map itself. Different structures or specific locations are shown using various symbols, which again are explained in tlie legend. A compilation or collection of maps is called atlas.

The usual problem with such maps is that they are tedious and time consuming to prepare, difficult to update and inconvenient to maintain. Therefore, now-a-days remote sensing is becoming popular as a means of collecting data for map preparation, and Geographical Information Systems (GIS) is being used for storage. analysis and retrieval. Under remote sensing techniques, maps are prepared using satellite data or aerial photographs, and are then digitised and stored on computers using GIS software. Once this is clone, they can be retrieved and viewed on the computer any time. They can easily be enlarged or reduced, and even printed in multicolour format.

Disaster maps usually show risk zones or disaster impact zones. These could include flood zone maps, seismic zone maps, industrial risk zone maps etc. A number of such maps may be overlaid on a base map of tlie area to give a composite disaster map that covers the risk of a number of types of disasters because many geographical areas are prone to more than one type of disasters. The vulnerability atlas oi' India Contours are useful maps of this type covering various disasters.

9.3 TECHNIQUES FOR AREA MAPPING

Area mapping involves four basic steps. First is tlie task of data collection. This would include spatial clata on physiography, hydrology, geology, population distribution, land use and activity pattern, structural conditions and socio-economic data. Some of the data, mainly tlie physical clata, can be collected through remote sensing. The tlata would then have to be verified on ground. Thereafter the data would need to be plotted on a spatially referenced medium. either on paper. or using computers. After proper coding, the relevant information would be added to the map.

9.4 ZONING OF SEISMIC ACTIVITY

Zoning of seismic activity is a highly technical field and requires collection and detailed study of a time-series data on earthquakes stretching over decades, or even centuries. The seismic history of an entire region has to be analysed in dctail. and depending on the frequency and intensity of seismic activity in different parts of the region, seismic zoning is carried out for that region. The presence of active faults and ridges in the subterranean region are also studied and act as determinants in the process of seismic zoning. Seismic zoning has to be updated alter every major seismic activity in low seismic zones. as happened in the case of Latur Earthquake in Maharashtra.

9.5 INDUSTRIAL ZONING AT MICRO SCALE

As compared to seismic zoning, which has to be carried out at regional scale, industrial zoning can bc carried out at a micro scale due to the comparatively localised impact of industrial disastcrs. This is known as micro-zonation. Industrial risks may arise due to the hazardous process involved in the industry, oi during storage, or transportation of hazardous materials. Depending on the nature of risk, as well as tlie activity pattern and intensity in tlie vicinity, risk zones arc identilied. The risk dire to air pollution is generally most widespread. That of water may extend over longer distances in case of surface water, but would be more channelled. The risks of land degradation, and subsurface water and also noise pollution are more localised.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) What do you understand by Disaster Mapping?

2) Briefly explain Seismic and Industrial Zoning.

9.6 MAPPING PROMINENT DISASTER PRONE AREAS

Drought

Earl) warning of drought conditions will help to undertake contingency agricultural strategies and to organise relief where and when it is most needed. Drought relief management efforts have been greatly helped by remote sensing and disaster mapping techniques. The condition of the crops as also the amount of water in tlie water bodies or even the extent of moisture in the ground can be mapped with the help of remote sensing techniques. Targeting of potential ground water sites for taking up emergency well digging programmes has been made possible by the use of satellite data. The success rate of such wells had been significantly higher than when using ground methods alone. The first phase of the Drinking Water Mission of Government of India consisted of district-wise groundwater potential maps using high-resolution Landsat/IRS data.

Long-term drought proofing programmes calling for base-line information on the natural resources of the district or river basin have been greatly helped by the use of satellite data. A drought monitoring project recently taken up by the Department of Space in collaboration with the State concerned covers management of water resources. agricultural and land resources and fodder resources, and integrates natural resource physical data base and socio-economic and demographic data base. Data from IRS satellite in 1:50,000 scale was used to generate resource data.

Resource maps such as soil, land-use and hydro-geomorphology have been prepared using IRS data on 1:50,000 scale. Other maps such as slopes, drainage and watershed, transport network and settlement location and rainfall data have been prepared from the secondary data available on Survey of India topographical sheets and with tlie Census Department. The socio-economic data has been collected from the respective district administrations. The conventional resources of information, socio-economic and demographic data arc integrated with the resource data obtained from the IRS satellite imagery in order to prescribe appropriate land use, fodder and water management practices.

Floods and Cyclones

Each year cyclones bring copious rains, which submerge lands. Rivers overflow during flood times and inundate land. The extent of such submersion varies from time to time depending upon the intensity of flood flows. The traditional method of mapping areas that gets flooded (for different levels of probabilities are lo use a map of suitable scale (1:15,000) on which inundation information is added. Over a long period it would be possible to indicate different probabilities of flooding in these maps. The Central Water Commission in cooperation with the State has done pioneering work in India in this regard and has published the Flood Atlas of India long ago (CWC-1987). In recent decade or two, satellite data has been mostly used for mapping and monitoring the flood-inundated areas, flood damage assessment, flood hazard zoning, and post-flood survey of river configuration and protection works. Near real time flood mapping was performed in the year 1986 in respect of tlie unprecedented historic Godavari floods, as well as floods that occurred in parts of Ganga basin lying in Bihar and Uttar Pradesh. Near real time was continued during the flood period of 1987 in respect of various rivers like Ganga, Ghagra, Kosi, Gandliak, Mahananda, Brahmaputra, Teesta, Jhelum etc., in different parts of tlie country.

Floods in Jhelum and Brahmaputra rivers and in Orissa State during 1992 were mapped. Recent availability of satellite data has helped flood mapping inspite of cloud cover. This data has been used recently (1993) for flood mapping of the Brahmaputra, North Bengal and Punjab floods. Floods in Jhelum and Kosi have also been mapped.

Efforts are also being made to compute the flood damage in various parts of the country by combining remotely sensed data and conventional ground data. A pilot project is under progress in a part of Brahmaputra Basin. An analysis of database on flood inundation during successive years can help delineate areas susceptible to floods of differing magnitudes. Preliminiary flood risk zone maps along Kosi and Brahmaputra rivers have been made using multi-year satellite imagery corresponding to differing Rood magnitudes and return periods. This provides valuable inputs to regulating food plain land use.

High-resolution satellite data has been used to map post-flood river configuration in order to identify vulnerable reaches of embankments to enable corrective action. Erosion prone areas along the Brahmaputra river have been identified through multi-year satellite data to delineate river reaches for flood protection works.

Volcanic Eruption and Fires

Though volcanic disasters are not common to India, Andaman Islands have two volcanoes that have been silent. These arc tlie Narcondum and Barren Islands. The Barren Island volcano remained dormant for nearly 200 years and erupted in March 1991, which continued till November 1991. The volcanic eruption was monitored using Multidate satellite data of both day and night passes. Tlie extent of reach of lava flows was monitored.

Satellite imagery in tlie infrared regions and actual ground/aerial photographs has been employed to map areas damaged by forest tires. The data has been used to study and map a number of forest fires and to monitor the vegetation regeneration over burnt areas. The 1 I-day repent cycle provided by tlie Indian Remote Sensing Satellites (IRS) has been found to be extremely valuable in monitoring tlie forest fires.

Earthquakes

Earthquake phase data collected by tlie National Seismic Telemetry Network for the past one hundred years were analysed using a computer, and epicentral parameters were determined. Tliese locations wcre shown in maps.

The epicentral maps are used for preparing seismic hazard map. Seismic zoning map is the basis for the code for designing earthquake resistant structures. Apart from tlie earthquake clata, geological factors, soil data etc.. are used for preparing tlie building codes. Upgradation of this code is a continuous process for which purpose tlie building code is reviewed From time to time. I-lowever, in order to assess the exact nature of risk, several other important factors such as gravity, magnetic, geodetic, and climatic data arc necessary. These data are then used lo prepare microzonation maps. which are used, for urban and rural planning.

Landslide

Landslide zonation map comprises of a map demarcating tlie stretches or areas of varying degrees of anticipated slope stability or instability. The map thus shows tlie factors conducive to landslides and, hence it has an inbuilt element of forecasting and is therefore of probabilistic nature. Depending upon the methodology adopted and tlie comprehensiveness of the input data used, a landslide hazard zonation map be able to provide help concerning one or more of relevant aspects such as location, type of occurrence of landslide, and affected people area and mass movement of slope mass.

One of tlie early projects on zonation was carried out by the Central Road Research Institute, New Delhi in 1984, in which hazard zonation techniques were used to choose a most suitable alignment from the possible alternative alignments on landslide affected stretches in Sikkim area. Subsequent monitoring has shown that the choices made have proved successful. During 1989, a landslide hazard zonation map was prepared for a part of Kathgodam-Nainital highway. This map was prepared with the objective to evolve a suitable maintenance strategy to keep the hillslopes along tlie road free of landslide problem.

Preparation of a comprehensive landslide liazard zonation map requires intensive and sustained efforts. The problem is highly interdisciplinary in nature. A large amount of data concerning many variables, covering large slope areas has to be collected, stored, sorted and evaluated. Finally, the degree of risk of sliding has to be evaluated and zonation maps prepared. The use of aerial photographs and adoption of remote sensing techniques helps in the collection of clata. For storage, retrieval and analysis, adoption of computerised techniques is useful.

Hazard zonation maps have multifarious uses, some of which are listed below:

- In the preparation of development plans for townships, dams, roads, and other development.
- General purpose Master Plans and Land Use Plans.
- Discouraging new development in hazard prone areas.
- Choice of optimum activity pattern based on risk zones.

  Quick decision making in search, rescue and relief operations during disaster and post-disaster situations.

Clearly such maps have a large number of users, including several Government Departments, and private agencies as well as NGOs involved in any type of development, construction of disaster- management work.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

I) What do you understand by a 1:50000 Scale maps?

2) Briefly describe the usefulness of hazard zoning.

9.7 LET US SUM UP

Disaster Mapping is an important and powerful tool at all stages of disaster management. Now clisaster mapping utilizes new and more accurate techniques such as remote sensing and Geographical Information System (GIS). Disaster Mapping leads to zoning for various disasters such as floods, earthquakes, industrial disasters etc. Composite disaster maps include the impact of a number of different disasters likely over the same area.

9.8 KEY WORDS

IRS - Indian Remote Sensing Satellite

Risk - Possibility of something unpleasant or undesirable might happen like floods, earthquake, cyclone, etc.

Geomorphology	-	Study of origin, development and characteristics of land.
Hazard	-	Something that is dangerous like earth tremor, flood, cyclone, etc.
Spatial	-	Relating to area or space.
Zoning	-	Earmarking an area of land or sea from the point of the occurrence of the disaster.
Remote Sensing	-	Techniques such as Satellites which record data about a distant location
Composite	-	Disaster maps including tlie occurrence and impact of a number of different Disaster disasters over the same area.
Mapping Physiography	-	Scientific description of the physical features of the earth.

9.9 REFERENCES AND FURTHER READINGS

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9.10 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

I) Your answer should include the following points:

Disaster Mapping is a tool for

- Assessing
- Storing and
- Conveying, the information on the geographical location of a disaster occurrence and its impacts.

3) Your answer should include tlie following points:

- Industrial Zoning involves preparations of regional scale (or micro scale) maps, indicating industries of different types and the nature and extent of the adverse effects that may arise from any disaster to or from these industries.
- Seismic zoning is on a much larger scale such as tlie entire country, which is divided, into various seismic zones on the basis of the magnitude and frequency of occurrence of earthquakes in the country.

Check Your Progress 2

I) Your answer should include the following points:

- One unit of length on the, map represents 50000 units of length on the actual ground.
- This means that one-cm distance on this map means 500 metres or half kilometer actually.

2) Your answer should include the following points:

- Preparation of development plans
- Preparation of Master Plans and Land Use Plans
- Discouraging construction in hazardous areas
- Quick action during search, rescue and relief operations in disaster and post-disaster situations

UNIT 10 PREDICTABILITY, FORECASTING AND WARNING

Structure

10.0 OBJECTIVES

After studying this Unit, you should be able to:

- discuss the time and space variability inherent in the occurrence of disasters;
- explain the status of predictability of specific disasters;
- describe the existing forecasting and warning arrangements; and
- highlight the importance and significance of warning.

10.1 INTRODUCTION

The earlier units have provided basic understanding of the various disasters and tlie adverse impacts that they make on tlie people and national infrastructural assets, All types of disasters do not occur at all places - or at all times. The occurrence of disasters is highly variable in time and place. Even tlie same phenomenon - if and when it recurs - would differ in intensity, coverage, duration and impact. This inherently variable nature of disasters makes it very important that we study the predictability, forecasting and warning aspects of disasters. These aspects will be covered in this unit.

10.2 PREDICTABILITY, FORECASTING AND WARNING: MEANING AND INTER-RELATIONSHIP

10.2.1 Predictability

Predictability of a disaster is the key to understand its nature and thereby to assess the chances of its occurrence and the fury of the event. Predictability is an attribute really applicable to natural disasters. For man-made disasters, it is the human error or mechanical fault or organisational failure that is responsible. Therefore, there is no concept of predictability as such for man-made disasters. Mock drills, regular inspections and updating of precautionary measures take the place of predictability, forecasting and warning in case of man-made disasters.

2) Your answer should include the following points:

- Preparation of development plans
- Preparation of Master Plans and Land Use Plans
- Discouraging construction in hazardous areas
- Quick action during search, rescue and relief operations in disaster and post-disaster situations

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10.2.2 Forecasting

For natural disasters that have a fair amount of inherent predictability, forecasting is the next step in disaster management. Forecasting has to be based on sound scientific principles and operationally proven techniques. It has to be done by authorised agency or individual who, besides being competent, responsible and accountable, is conscious of the end-use of the forecast and the dependence of the success of disaster management on the forecast. In order to be effective, the forecast has to be clearly worded and it should be transmitted quickly to the user.

10.2.3 Warning

Once a forecast is available regarding an anticipated disaster event, it has to be converted quickly into an area-specific and time-specific warning, Furthermore, the warnings also need to be user-specific because the capacity of different users to withstand the impacts of a disaster are different. For example, the general warnings for the public would be different from those required specifically for the safety of a railway bridge during cyclone conditions because a strong structure such as a railway bridge is designed to withstand certain level of high winds and to permit a certain amount of river water flowing under it. The warnings in this case have to be issued only if the anticipated winds and river-flow are expected to go beyond the specific safety thresholds. I-lowever, for the public, where houses of various types and strength have to face cyclone fury, tlie warnings will have to be in terms of the anticipated winds and rain in the hope that the individuals and communities will be prepared and take prompt action with the help of government and non-government organisations wherever the anticipated impacts are likely to prove dangerous.

A warning has no value unless it reaches the users quickly and well in time. Therefore, quick communication is very important at the warning stage.

10.2.4 Inter-relationship

The inter-relationship between predictability, forecasting and warning is self-evident and should have been clear from the discussion in the preceding paragraphs. To repeat, a warning can only be issued on the basis of a useful and reliable forecast and a disaster can be forecast only if it has an inherent predictability about it.

Even if an event is predictable, a useful forecast is available, the appropriate warning Iias been issued, and it has reached the users in time; the whole exercise will be fruitful only if the warning is believed and acted upon by the user. Therefore, credibility is very essential at every stage of the process of forecasting and warning. That is why the concerned agencies responsible for forecasting and warning of disasters strive hard to build credibility for their forecasts and warnings so that users develop confidence in these and take required action immediately and effectively.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) Why is predictability basic to tlie process of warning?

2) Why is it necessary that warnings should be area-specific, time-specific and user-specific?

3) How are Predictability, Forecasting and Warning inter-related?

10.3 ACTIVITIES AND TECHNIQUES WITH REFERENCE TO SPECIFIC DISASTERS

All natural disasters take their toll whether they are floods, cyclones, earthquakes, droughts, landslides, avalanches and forest fires. Therefore, it is necessary to discuss the predictability, forecasting and warning with reference to each of these phenomena.

10.3.1 Predictability

Predictability of Floods and Droughts

It is useful to consider these disaster phenomena together in the context of predictability because both floods and droughts are manifestations of the same weather element, viz., water. Floods occur due to excess of water whereas lack of water results in droughts. Therefore, the predictability of floods and droughts in fact means the predictability of water, i.e., rain and run off. Further, as about 80% of the annual rainfall occurs in the summer monsoon season of June to September, the predictability of floods and droughts depends heavily on the predictability of tlie monsoon rains in the particular area.

There are additional aspects, which determine whether a particularly heavy rainfall will result in floods or scarcity of rain will create drought. For example, repeated occurrences of heavy rainfall over an area already soaked with rain will certainly give floods. Excess water in a river, due to heavy rains in the upper regions of the river, will create flood downstream. Absence (or lack) of drainage in any area will aggravate flooding there. Similarly, repeated seasons of scanty rainfall will lead to drought conditions.

Therefore, predictability of floods and droughts hinges on (i) the predictability of rainfall (predictability of the monsoon); (ii) whether the earlier rainfall in the area has been frequent or infrequent; (iii) whether any river flowing through the area is bringing excess water from upstream regions; and (iv) whether there is a drainage problem resulting in accumulation of water in the area.

As these aspects are either predictable or monitorable, it is reasonable to conclude that floods and droughts have a reasonably good predictability.

Predictability of Landslides, Avalanches and Forest Fires

These three phenomena are being discussed together because these are basically the hazards of mountain areas. Furthermore, rainfall (or snowfall) plays a crucial role although man-made causes increase these hazards to a very large extent.

Landslides arc in fact downslide movement of soil and rock under the influence of gravity. Erosion due to rainfall and floods, or excess loading due to heavy snowfall, or weakening of ground due to stream erosion, mining quarrying, or earthquake tremors create landslides. In case of avalanches, snow loading and strong winds are the basic causes. Laclc of rainfall and the resulting dryness over large forest areas sustain forest fires triggered by natural causes such as lightning strike or friction, or by man-made causes such as a burning matchstick or cigarette. Strong winds fan tlie forest fire and spread it. While rain. snow, dryness and winds are predictable, factors such as erosion, excess loading and man-made causes are not predictable. Thus, the overall predictability of clisasters such as landslides, avalanches and forest fires is less as compared to floods and droughts.

Predictability of Earthquakes

Earthquakes are caused by volcanic activity or geological activity. These changes take place deep inside the earth and the processes are not yet fully understood. Therefore, earthquakes are not predictable to the extent that the place and time of their occurrence can not be anticipated. However, the general areas where earthquake activity occurs are known and on a statistical basis, it is possible to indicate that a major earthquake could perhaps occur sometime somewhere within a large region. But, as mentioned above, it is not possible to predict the location or time of an earthquake. Therefore as of now, earthquakes have no predictability in a practical sense.

Predictability of Cyclones

Cyclones have the highest predictability among all the disasters. This is mainly because the scientists know quite well how cyclones are formed and how they behave. As soon as formed over the ocean, cyclones can be detected and tracked continuously with the help of modern instruments such as weather satellites and weather radar. The accompanying hazard of storm surge is also predictable through techniques which take into account the parameters of the approaching cyclone as well as the characteristics of the coast including the coastal slope under the sea in the area where the cyclone is expected to hit the coast.

10.3.2 Forecasting

Forecasting of Floods

For forecasting floods in tlie major rivers of tlie country, tlie nodal agency is tlie Central Water Commission (CWC) under tlie Ministry of Water Resources of the Government of India. CWC's headquarters are in New Delhi with field stations located in the major interstate river systems. Flood forecasting for rivers means basically that an estimate is made of the future stages or water levels in the river at selected points along tlie river during flood season. The aim is to forecast the crest and its time of occurrence at a place along tlie river. For this, it is necessary to have liydrological data (characteristics of the river basin and the flood plains) and hydrometeorological data (rainfall in the catchment area, weather forecast, current levels of water and flow along the river). Tlie meteorological data related to weather and climate and tlie weather forecasts are provided by the India Meteorological Department (IMD) of Government of India to CWC who use this information, along with the hydrological data generated by their own organisation, to formulate flood forecast.

For floods other than river floods such as flash floods, blockage of water due to inadequate drainage, forecasting takes the shape of monitoring because forecasting of such local events is not practical and the only effective method is to mount a monitoring and reporting system locally.

Porecasting of Droughts

Droughts are a slow developing and creeping process as against floods, which are quick and rapid.

As already mentioned, it is basically the scarcity (or absence) of rains that initiates a drought situation. Long absence or less than normal quantity of rainfall creates a Meteorological Drought, which is forecast on the basis of the forecast of rainfall. But if tlie rainfall continues to be scanty or totally absent to the extent tliat tliere is scarcity of water in rivers, ponds and wells, it is called Hydrological Drought. If tlie dry conditions make the land parched to the extent that no seeds can be sown, standing crops (if any) wither and there is scarcity of water for irrigation, it is termed as Agricultural Drought and it is forecast by taking into consideration tlie condition of the crops and soil moisture in addition to the forecast for rain in tlie coming days.

Forecasting of Landslides, Avalanches and Forest Fires

The basic forecast in these events is that of rainfall (or snowfall) and strong winds but additional factors have to be kept in view. For landslides, tlie strength of the rock and any damage already occurred at ground have to be considered. For avalanches, any undue accumulation of snow at a place or in a form where it could eventually break and come down heavily has to be watched.

For forest fires, the extent of dryness of the forest wood and the accumulated dry material (leaves, twigs, grass) has to be taken into consideration because these could get ignited either by a liglitning stroke or by other causes.

Forecasting of Earthquakes

As already discussed, there is no technique available at present by which the place or time of occurrence of an earthquake can be forecast.

Forecasting of Cyclones

The system of forecasting cyclones is quite well developed. The weather forecasters (meteorologists) are able to detect the formation and subsequent movement of cyclones on weather charts that they prepare regularly based on observations of atmospheric pressure, temperature, humidity and winds. Simultaneously, they locate and track the cyclones through satellites and high power cyclone detection radar. The images of cyclone through satellite and radar enable a constant monitoring of the intensification or weakening of the cyclone.

Even then, Forecasting of the movement of a cyclone and tlie place where it will hit the coast is a highly skilled task. Cyclones do not travel in straight lines. Their tracks are curved and they often make small loops as they go along. Cyclones do not move with tlie same speed all along their path. Sometimes they slow down or remain stationary or suddenly increase their speed. Therefore, a cyclone is kept under constant surveillance and the forecast is frequently updated - generally every hour and more frequently if considered necessary.

10.3.3 Warning

Warning of Floods

Tlie Central Water Commission (CWC) through its Flood Forecasting Centres issues flood warnings. The State Governments, based on the local experience. fix a "Danger Level" for a river at certain places such as near cities or bridges. CWC issues flood warnings when the river level at a given place reaches or is expected to reach the "Warning Level" which is usually one metre below the "Danger Level". CWC issues flood warnings in the form of "Daily Water Level and Flood Forecast Bulletins". During flood seasons, State Governments set up control rooms at State and District Headquarters which receive the warnings from the Flood Forecasting Centres of CWC and transmit the warnings to the affected areas. The Flood Forecasting Centres also broadcast the warnings through All India Radio as well as Doordarshan and also publish in newspapers for widest possible publicity. The warnings are regularly updated as new observations and forecasts become available.

Warning **of Droughts**

As droughts develop slowly and are caused primarily by continuing deficiency in rainfall or other sources of water, the resulting situation needs to be watched and effective relief action is to be initiated as soon as sowing of seeds or standing crops begin to get affected. Therefore, there is no warning system as such for droughts. However, the Agriculture and Revenue Departments of the states remain watchful during the dry weather seasons and the situation is monitored regularly especially for those areas. which arc known to be drought prone due to local climatic conditions, scarcity of ground water and absence of irrigation facilities.

Warning **of Landslides and** Avalanches

As discussed, heavy rains and heavy snowfalls initiate these phenomena. Further, these occur more frequently in areas, which are prone to these disasters due to the peculiar local geological features such as weakness of soil or rock. Therefore, warnings of heavy rainfall/snowfall combined with careful watch by local people serve .as an effective alerting system. A local volunteer system is found to be of great benefit and is followed even in the developed countries.

Warning of Forest Fires

Periods of extreme dryness combined with absence of rain/snow are the first indication of the hazard of forest fires. Accumulation of combustible material (such as dry leaves and wood) on the ground adds to the problem. In most cases in our country, forest fires start due to human carelessness. In such circumstances, a system of advance warning is not feasible and usually the smoke or flame is the first warning.

Warning of Earthquakes

As earthquakes cannot be forecast as yet, there is no warning system for earthquakes at present. However, there are areas, which are known to be prone to earthquake activity. Such areas liave a standing warning so to say. The country is divided into zones representing the extent of hazard depending on the number and severity of earthquakes that have occurred in the past. Regions with a history of strong earthquakes are more hazardous and special care needs to be taken in constructing structures such as multistoried buildings, bridges and dams. If areas, which have experienced major earthquake activity in the past. remain undisturbed for long periods of many years, this can be taken as a warning (on a statistical basis) that an earthquake could occur somewhere and sometimes in the area. But this can only be taken as a general warning because the exact place and time of the next earthquake in the area cannot be indicatecl.

Another warning indication is the continued occurrence of tremors at a place although it is not possible to be sure whether the tremors are indicative of an impending earthquake or they denote nature's method of releasing the earth's internal stress in short bursts of tremors.

In certain cases, some warning signals occur before an earthquake such as unusual behaviour of animals and reptiles, sudden lowering or rising of water level in wells and widening of existing natural cracks in the earth's surface.

Warning of Cyclones

Cyclone warnings are issued by the India Meteorological Department (IMD) through its Area Cyclone Warning Centres (Mumbai, Kolkata and Chennai) and Cyclone Warning Centres (Ahmedabad, Bhubaneshwar and Visakhapatnam). In the first stage of warning, a 'Cyclone Watch" is maintained during the cyclone seasons in the pre-monsoon and post-monsoon and post-monsoon months. In tlie second stage, "Cyclone Alert" is issued 48 hours (two days) before the expected commencement of bad weather along the coast. Warnings to ports and fishermen start earlier. The ports display the warnings by hoisting special visual signals to warn boats and ships. Warnings are updated regularly according to the progress of the cyclone, which is kept under constant observation through satellite and radar equipment. "Cyclone Warnings" are commenced 24 hours before the anticipated landfall i.e. the anticipated time the cyclone is expected to hit the coast. These cyclone warnings are updated every hour and more frequently if the situation so demands. Finally about 12 hours before the storm is expected to fall below the cyclone category i.e. the winds fall below the speed of 60 km/h, "post-landfall scenario" is issued.

Cyclone warnings are sent to the ports, airports, railways, State and District authorities. These are issued to press and broadcast through radio and television. For quick and effective communication of cyclone warnings to the field areas likely to be affected, a special system called Disaster Warning System (DWS) has been implemented in the coastal areas. By this system, cyclone warnings in local language are broadcast from the Area Cyclone Warning Centre of IMD to the field

area directly via INSAT and this warning is received through a small apparatus installed at schools or district offices or panchayats in the coastal region. A large number (about 300) of such apparatus have been installed on the east and west coasts in area prone to cyclones, and more are to be installed.

10.4 IMPORTANCE AND SIGNIFICANCE

While it is not possible to prevent the occurrence of disasters, it is certainly possible to reduce the resultant disastrous effects through adequate preparedness and timely action. The effectiveness of timely action is greatly enhanced through accurate forecasts and prompt warnings. Herein lies the importance and significance of forecasts and warnings of disasters. However, it is to be noted that forecasting and warning are possible only for those disasters, which have some inherent predictability.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) List the factors on which depends the predictabilily of floods.

2) Which is the most predictable natural disaster and which one is not predictable at present?

3) Although earthquakes cannot be predicted, these are certain indications that could alert the people to the possibility of an earthquake. List these.

10.5 LET US SUM UP

For effective management of disasters, we need aclcquate, reliable and timely warnings which can be formulated only on the basis of accurate Sorecasts. Further, accurate forecasts can be made only for those disasters that are predictable. Hence, there is a close and significant link between Predictability, Forecasting and Warning in respect of any disaster phenomenon. As man-made clisasters occur mostly due to human error or mechanical failure and are, therefore, not predictable it is not possible to issue a timely warning for such disasters.

Among the natural disasters. cyclones are the most predictable and therefore cyclone warnings prove most effective. Earthquakes are not predictable as yet and hence usable warnings are not possible in advance.

In our country, the Central Water Commission through its Flood Forecasting Centres issues flood warnings. The India Meteorological Department (IMD) through its Area Cyclone Warning Centres arid Cyclone Warning Centres issues cyclone warnings.

10.6 KEY WORDS

Crest : Peak

Erosion : Movement *of* soil or rock from one place to another under the force of running water, moving ice, rain, snow, or wind.

Flash Flood A flood that develops quickly and also recedes quickly with almost no advance warning. It happens due to exceptionally heavy rainfall over a small area. **In** the hilly areas, accumulation of large quantity of water (rain water or river water) due to blocking of a narrow stream also results in flash flood when the blockage gives way under intense force of the accumulated water.

Hydrological Pertaining to hydrology - the science and engineering of water resources,

Hydrometeorological : Pertaining to the atmospheric aspects of hydrological matters especially those related to water resources and floods.

Meteorological Pertaining to the atmosphere or the science of the atmosphere.

River Stage A measure of the height of the water surface in a river at a given place.

Storm Surge : An abnormal rise of the sea across the coast under the influence of a cyclone. This results in destruction and flood due to enormous 'quantity of saltish seawater crossing over to inland areas.

Weather Radar electronic equipment for detection and tracking of weather phenomena such as rainstorms and cyclones.

Weather Satellite : A satellite having the capability to take pictures of weather over the earth and transmit these pictures to a receiving station on the earth. Usually weather satellites are also equipped with instruments to measure other weather parametors such as temperature of cloud tops.

10.7 REFERENCES AND FURTHER READINGS

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10.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- Predictability is the key to understand the nature of any disaster phenomenon and thereby to assess the chances of its recurrence.
- Unless a disaster has predictability, its occurrence cannot be forecast and therefore warning will not be possible.

2) Your answer should include the following points:

- Place-specilic so that people there are prepared and relief agencies are ready for action around the specific area instead of being dispersed over a large area.
- Time-specific so that proper precautions can be taken around that time because people cannot remain in a state of high preparedness indefinitely for long periods.
- User-specific so that the persons likely to be affected or those concerned with relief work can be alerted specifically and quickly.

3) Your answer should include the following points:

- A useful warning can be issued only on the basis of an accurate forecast, which, in turn, is possible, only if the particular disaster phenomenon has inherent predictability.
- Throughout the chain of predictability, forecasting, and warning, creclibility is essential at every stage so that the forecast and warning are believed and acted upon.

Check Your Progress 2

1) Your answer should include the following points:

- Predictability of rainfall (i.e., monsoon).
- Whether there has already been rain in the area.
- Whether any river is bringing excess water from upstream.
- Whether there is a drainage problem in the area.

3) Your answer should include the following points:

- Cyclone is most predictable.
- Earthquake is not predictable at present.

3) Your answer sliould include the following points:

- Tremors
- Abnormal behaviour of animals and reptiles
- Sudden lowering or rise of water level in wells
- Widening of natural cracks in the earth's surface.

UNIT 11 DISASTER PREPAREDNESS PLAN

Structure

11.0 OBJECTIVES

After studying this unit, you should be able to:

- state the importance and significance of Disaster Preparedness Plan;
- describe the nature and scope of Disaster Plans; and
- discuss the essential features of Long-term and Short-term Plans.

11.1 INTRODUCTION

Disasters cause sudden disruption to tlie normal life of a community and cause damages to property and lives to such an extent that normal social and economic mechanisms available to the community get disturbed. People and officials are both caught unawares and in the circumstances sometimes tend to lose their sense of initiative and direction. Consequently, relief work is hampered and unnecessarily delayed.

In such cases, tlie existence of a well thought out and tested disaster-preparedness plan is very useful. The officials then have at their hand, a complete set of instructions, which they can follow and also issue directions to their subordinates and the affected people. This has the effect of not only speeding up the rescue and relief operations, but also boosting tlie morale of the affected people.

Disaster plans are also useful pre-disaster situations, when warnings have been issued. The plan also serves as guidance to officials and precious time is saved which might otherwise be lost in consultations with senior officers and getting formal approval froni authorities.

11.2 IMPORTANCE AND SIGNIFICANCE

The need for disaster preparedness plan is self-evident, National and international experience mostly indicates that where plans did not exist or planning was inadequate, tlie ill effects of disasters have been worse than would have otherwise been the case. A senior disaster management official is said to have remarked after a recent cyclone: "When we look back on the cyclone and what it did to our country, there is no doubt that hundreds of people are alive here today because we had proper disaster plans".

A disaster preparedness plan essentially contains measures to be taken before, during and after disaster strikes. It contains an inventory of what materials are available where and with whom, and the delegation of responsibilities and

coordination mechanisms among various government officials and departments, It gives location of temporary shelters and guidelines about partnerships with other bodies like NGOs, social workers and international agencies. Thus, in an emergency situation, authorities have a ready guide at hand and are fully aware of the steps to be taken. Creating awareness among the people and preparing the communities to deal with anticipated situations are the most important objectives of a disaster preparedness plan. Disaster Preparedness Plans also contain certain long-term, wide-ranging measures to be carried out. It includes measures like construction of embankments along rivers, retrofitting of houses, periodic inspection of critical river stretches, establishing a system of communication, construction of relief centres, and land use measures.

A plan has to be practical if it has to succeed. For this purpose, it needs to be reviewed carefully at periodic intervals and amended as necessary in tlie light of the experience gained. Competent plan execution by the administration has numerous advantages. It ensures that development and disaster preparedness do not disturb each other but complement each other. It also ensures that, should disaster strike, the time taken to return to normalcy is minimized and that loss of life and property is minimum.

Check Your Progress 1

Note: i) Use tlie space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

I) What do you understand by Disaster Preparedness Plan?

2) What is the importance and significance of Disaster Preparedness Plan?

11.3 CHARACTERISTICS: NATURE AND SCOPE

There is no rigid or standard format for disaster preparedness plans. In fact, the reverse applies, in that the format needs to fitthe circumstances in which the plan is being made and the requirements, which it is designed to meet. The essential point is that tlie disaster preparedness plan should be exhaustive but also practical. Hence certain common features tend to apply to most plans. These are discussed below:

Clarity of Aim

The aim needs to be carefully and accurately selected, because it determines the whole thrust and scope of the plan. All information, guidelines, directions and instructions, which are included in the plan, need to be in line witli the aim.

Realism

The plan must be realistic in the sense that it relates to an accurate assessment of the disaster threat and tlie vulnerability of the community and that it takes into account the scale and capability of counter-disaster resources which are available. In most cases, the plan will be used under difficult disaster circumstances when, perhaps, communications are adversely affected; therefore, the plan should be able to respond to various contingencies during a disaster scenario.

Level of the Plan

The plan must be accurately related to the level with which it is concerned, e.g., Village level, Block level, Taluka or Tehsil level or District level.

Flexibility

Disaster circumstances tend to vary and do not necessarily follow set patterns, counter-disaster plans also need to be flexible. Flexibility is best achieved by planning to cope with the full range of possible disaster threats and ensuring that, within the overall plan, response arrangements can be rapidly adapted to new and changing circumstances. Planned decentralization, where appropriate, is a useful way towards achieving flexibility.

Coordination

Since coordination of efforts is a key factor in counter-disaster activities, the plan should include an optimum system for direction/coordination.

Assignment of responsibility

It is critically important that responsibilities are clearly and unambiguously defined and assigned in the plans. This reduces to a minimum tlie possibility of misunderstandings, duplications and omissions in the various activities the plan covers. Of equal importance is the fact that clear definition of responsibilities significantly helps in achieving coordination of effort.

Ease of Use

The plan should be formulated in such a way that it is easy to understand and easy to use. References within the plan should be clear and readily identifiable. Also, the text of the plan needs to be kept as clear and concise as possible, with annexes being used for very detailed information.

Plan Components

There are a number of options for dividing the plan into sections or components. One way this can be achieved is to have:

i) A main plan (or main action plan) which contains the primary parts of the plan, such as the anticipated disaster threat, vulnerability of the community (including its strengths and weaknesses in relation to each anticipated disaster

scenario), tlie main requirements for dealing with the threat, resources, organisation, direction and coordination, warning, operational implementation of tlie plan, counter-disaster operations, recovery policy, and post-disaster review process.

i) Sub-plans which are a part of the main plan but which may be required to amplify parts of the main plan which need special consideration, sucli as evacuation, relief camps, public information, arid so on.

iii) Special plans which tnay be required to deal with special contingencies such as an outbreak of common or rare disease, which would require specialist personnel arid procedures, Such special plans would normally be designed to work in harmony with the main plan arid utilize the overall counter-disaster effort as necessaty.

Viability

The Plan should include arrangements for periodically reviewing so that it is kept up-to-date and fully viable for the purposes for which it is designed.

Structure of the Plan

A typical disaster preparedness plan is structured as follows:

(i) Contents

(ii) Authorization

(iii) Map References

(iv) Introduction

- (a) The Disaster Threat
- (b) National Policy and State Policy
- (c)' General Concept for Disaster Action

(v) **Aim** of **the Plan**

(vi) **Definitions**

(vii) **Relationships** with other Plans

(viii) Main requirements for dealing with Disasters in the area

(ix) **Emergency** Powers

- (a) Disaster Legislation
- (b) Other Legislation

(x) Counter-Disaster Resources

- (a) Within the area
- (b) In tlie neighbourliood

(xi) **Organisational** Structure and **Responsibilities**

- (a) Prime Minister
- (b) Chief Minister/Administrator (of Union Territory)
- (c) . Nodal Ministry at tlie Centre and State
- (d) National Disaster Management Structure
- (e) State or Regional Disaster Management Committees-
- (f) District Disaster Management Structure

(g) Non-government Organisations active in the area and their specializations and resources

(11) Other community based organisations in the area

(i) Defence Services and Para Military Forces available in the area for Disaster Management work

(j) International Assistance Arrangements

(k) Coordination of Planning, Organisational and Operational Measures-Control Room

(I) Media cooperation

(xii) Preparedness Measures

(a) General

(b) National Level

(c) State Level

(d) District and/or Community Level

(e) Training and Public Awareness Programmes

(xiii) **Communications (General and Emergency)**

(xiv) **Operational Direction and Coordination**

(a) Responsibility for Operational Direction and Coordination

(b) National Emergency Operations Centre – Control Room

(c) State Emergency Centres – Control Room

(d) District Emergency Centre (Control Room)

(e) Field Control Rooms

(xv) **Warning Arrangements**

(a) General

(b) Agencies Originating Warnings

(c) Transmission of Warnings

(d) Dissemination and Public Broadcast of Warnings

(e) Notification of de-alert or All-Clear messages

(xvi) **Operational Implementation of Plan**

Stages of Implementation

(xvii) **Counter-Disaster (or Response) Operations**

(a) Precautionary Measures

(b) Activation of Emergency Operations Centres (Control Rooms)

(c) Direction and Coordination of Operations

(d) Information Requirements

(e) Operational Requirements in disaster stricken areas

(f) Operational Action - National Level

(g) Operational Action – State, Regional and Local Levels

(h) Period of Disaster Operations (Emergency Phase)

(xviii) **Recovery**

(a) Statement of Policy for Recovery

(b) Responsibility for Recovery Programme

(c) Cross-referelice to Recovery Plan (if applicable)

xix) **Post-Disaster** Review

(a) Responsibility

(b) Debriefing

(c) Review of Plans and Organisations

(xx) **Support Measures**

(a) Training

(b) Public Awareness

(xxi) **Annexures**

(a) Distribution Lists

(b) Telephone Numbers, cell phone numbers and addresses of functionaries

(c) List of Resources

(d) Functional Diagrani of Organisation

(e) Allocation of Roles and Responsibilities to Resource Organisations

(f) Guidelines for International Assistance Arrangements

(g) Communications

(h) Detailed Information on Warning

(i) Precautionary Measures on R'eceipt of Warning

(j) Guidelines on Training

(k) Guidelines on Public Awareness

(l) Format for Departmental Standard Operational Procedures

(m) List of media persons and agencies with telephone numbers

Check Your Progress 2

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of this Unit.

l) What are the main cliaracteristics of a Disaster Preparedness Plan?

2) List at least five main items in the structure of a Disaster Preparedness Plan.

11.4 METHODS FOR PREPARING PLAN

11.4.1 Short-term Plan

Short-term plan comprising relief to be provided immediately following a disaster is generally based on past experiences. Short-term plans are action based and aimed at restoring normalcy in the shortest possible time.

One of the foremost requirements of any plan would be to define the area where it would be applicable and. the agencies that would be responsible for its implementation and coordination. Once the boundaries are defined, the following inputs would be required:

(i) The amount of resource material likely to be required as relief based on the statistics on the intensity and spread of various disasters in the area in the past ten year period.

(ii) Certain areas are prone to disaster and each time relief is provided, a number of short-comings come to light; these become lessons to serve as inputs for future planning of relief and rescue exercises.

(iii) Short-term Plans should be based on the vulnerability of the area to particular types of disasters. Forecasts on future disasters, if available, should be usefully interpreted into action plans.'

(iv) Short-term Plans should incorporate suggestions and capabilities of all departments concerned of the District/State, Non-Government Organisations and Community Based Organisations. Therefore, plans may be prepared by setting up committees at appropriate level to include their inputs.

11.4.2 Long-term Plan

The situation may not always warrant long-term plans, but such plans should have the ability to build a culture of disaster mitigation and be aimed at reducing vulnerability of the area. As such any long-term plan should include policy directives on preparedness as well as post disaster reconstruction and rehabilitation phases (the latter as afollow up of the short-term contingency plans). The following are the basic attributes of a long-term plan:

(i) The foremost requirement for' the preparation of a long-term plan is estabiishing its need in an area, Need may be established on the basis of the vulnerability of the area, resource availability and trade off between the cost of its implementation and other competing needs for overall development. In this context the long-term disaster mitigation plan or rehabilitation plan, as part of overall development plan becomes significant.

(ii) In case of rehabilitation plan, the level of damage that has taken place in the community decides whether long-term intervention is required or not. The strategies of the Rehabilitation would depend considerably on the damage assessment report.

(iii) A detailed survey of the community, which studies their needs and expectations in detail and seeks out their traditions and customs which they would lilte to preserve, has to be carried out. This would serve as an important input in deciding an intervention strategy that is acceptable to tlie community.

(iv) Tlie long-term plan should seek an objective of achieving overall development and by satisfying basic needs - shelter, economic and social - of the community. Reducing disaster vulnerability should be a means to achieve the objective of overall development and not an end in itself.

(v) Long-term plans being resource intensive, many of tlie interventions decided therein are limited by the availability of resources. For example, in many cases, where the need for rehabilitation through relocation is established, tlie same may not be implemented due to lion-availability of land.

(vi) Long-term plans may be implemented successfully only through partnersliips with NGOs and with active community participation. The involvement of these bodies should be at the outset itself in deciding the interventions required.

Check Your Progress 3

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at tlie end of this Unit.

1) What are the items on which a Short-term Plan should be based?

2) Explain tlie steps in preparing Long-term Plan.

11.5 LET US SUM UP

A well-coordinated, comprehensive disaster preparedness plan is a very essential part of any programme of disaster mitigation. Since a disaster management plan contains guidelines on how to act in, before and after disaster strikes, it gives a sense of direction in times of crises and contributes a great deal towards minimizing damage in disaster situations. However, not all plans are successful or utilized. If a

disaster-preparedness plan is attractively-presented, clear and easy to read, it will be referred to. On the contrary, if tlie plan is a jumbled document, overwhelmed by masses of statistics, no one will bother to read it, let alone act on it. Since there is basically no rigid format for a disaster preparedness plan, this flexibility should be utilized to the maximum and plans should be practicable in the specific area they are intended for. Plans can be both long-term and short-term. Depending on the disaster they are targeted at and the time period, different methods are used to make these plans.

11.6 KEY WORDS

Decentralisation - transferring the responsibility from central control to lower levels in an organized and planned manner.

Viability - the capability of the activity/plan to do what it is intended to do.

Counter-disaster resources- resources for combating disasters or their effects.

Coordination - organizing activities/people together to work properly.

Flexibility - the ability to change easily and adapt to different conditions and circunistances as they occur.

Realism awareness of the facts about the situation.

Stakeholders - all those (Government, NGOs, Public) who are involved and interested in disaster management.

11.7 REFERENCES AND FURTHER READINGS

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11.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

I) Your answer should include tlie following points:

- Disaster preparedness plan comprises exhaustive information and guidelines for use during all phases of a disaster situation viz., pre-disaster, during disaster and post-disaster phases.
- Disaster preparedness plan should be easy to understand
- It can be a national plan or a state plan or a district plan or a community plan.

2) Your answer should include the following points:

- The situation during or after disaster is chaotic and difficult to deal with unless there is a plan of action to follow.
- As the plan is prepared in consultation with all involved agencies (government or non-government), the coordination is ensured which is vital for maximum results.

Check Your Progress 2

1) Your answer should include the following points:

(a) Clarity of Aim

(b) Realism

(c) Level of the Plan

(d) Flexibility

(e) Coordination

(f) Definition of responsibility

(g) Viability

2) Your answer should list at least five out of the 21 items (i to xxi) mentioned under "Structure of the Plan" in Section 11.3.

Check Your Progress 3

1) Your answer should include the following points:

- Resources likely to be required based on experience of past ten years.
- Lessons learnt during past disaster situations.

  Vulnerability assessments.
- Suggestions and proposals of stakeholders.

2) Your answer should include the following points:

- Establishing the need for a long-term plan.
- Assessing damages in the past cases.
- Surveying the community for their long-term needs according to their tradition and custom.
- Coordinating long-term disaster preparedness plans with development plans of the area.

  Seeking partnerships with NGOs and the people in the area.

UNIT 12 LAND-USE ZONING FOR DISASTER MANAGEMENT

Structure

12.0 OBJECTIVES

After studying this Unit, you should be able to:

- understand the relationship between land-use zoning and disasters;
- know how faulty allocations of land-use can often become the cause of disasters, both man-made and natural; and
- describe how judicious land-use zoning can help not only in disaster mitigation, but also in disaster relief operations.

12. INTRODUCTION

The rapid growth and spread of population in hazardous areas is a matter of increasing concern because it leads to mounting costs of disasters in terms of lives lost and damage to property and investments. Besides, the high residential densities add to the problems in hazardous areas. The risk is further increased by the dramatic increase in infrastructural investments and development assets that get destroyed by disasters. There land-use has to be decided keeping in view the vulnerability to disasters. In other words, land-uselzoning has to be done so that different land zones can be earmarked for major activities in accordance with the risks that they are likely to withstand.

Land-use zoning for disaster prevention and mitigation may act as a spur to comprehensive land-use planning, more so is disaster prone regions. The major elements of land-use planning may be summarized as follow:

i) Land-use policies and plans setting out the social, economic and environmental goals of comprehensive land development and their stages of development;

ii) Land ownership and land tenure patterns identifying the legal, social and economic basis of ownership and tenure;

iii) Land values and prices, reflecting the forces of supply and demand for land; and

iv) Land-use controls which may be subdivided into three broad categories, i.e., legal, fiscal and directive.

12.2 GENERAL POLICY CONSIDERATIONS FOR DISASTER MANAGEMENT

Land-use policy is only one of the possible strategies to mitigate disaster, and all measures must be responsive to the economic and-social resource balance of the region. The major concerns of national or regional policy formulation deal mainly with economic and social goals but with environmental goals becoming increasingly important.

Regional policies emphasize local considerations and correspondingly appropriate physical planning and hence are particularly relevant for disaster management. Regional policies may include objectives such as a balance between various areas in the region by directing economic development into backward areas, or the encouragement of urban development to allow for social mobility and progress necessary for industrial activity.'

Major components of regional policies include the selection of areas designated for transport networks, industry, agriculture, and urban growth. The area aspects of regional planning are a vital link to national planning efforts and constitute a basic means of implementing disaster prevention policies.

Thus, guiding the location of activities within a region may not only serve social, economic and environmental goals but may also serve as a means of mitigating disasters leading to very significant benefits in the medium to long-term.

Local policies (including urban policies) are extremely important in the total planning process, for these guide the specific area distribution of human activities. It is here that investments are made and the development of human settlements take place. and it is here that specific hazard mitigation programmes are really required.

India being a developing country, most areas under developmental planning and land-use is decided/assigned accordingly. But the requirements of disaster mitigation tend to receive lower priority because of the overriding considerations of expediency. The apparent clash of interest between development and disaster management arises because of the following considerations:

i) The pressures for development are frequently so overwhelming that disaster risk is often overlooked in the hope of short-term gains, and little weight is likely to be given to disaster prevention in land-use policies.

ii) Traditional systems of land-use have over a long period adjusted to periodic disasters; but the pace of development over the last few decades has upset the natural socio-economic modes of adjustment. This pace is not likely to slow down, at least, in the foreseeable future.

iii) Traditional and intermediate indigenous economic systems are highly sensitive to regulation and the economic costs (measured by employment or employment growth losses) or uprooting, relocating, or inhibiting development can be very high in labour intensive employment sectors. This hampers land-use zoning to take care of disaster mitigation,.

iv) Growth of population and land shortages have tended to make tlie poor poorer and shift to marginal land, such as ravines, steep slopes, low flood plains or even riverbeds. This marginal land is prone to floods, landslides or other adverse natural phenomena.

12.3 ISSUES AT THE NATIONAL, REGIONAL AND LOCAL LEVELS

In tlie formulation of land use policies in a broad framework at national and regional levels, tlie following issues have been found to be important in the context of disaster management. Tlie discussion here is with reference to floods, which are tlic most frequent natural disaster.

i) The conflict between irrigation and flooding provides a basic dilemma for planners. Some of' the gains of extra agricultural produce through irrigation can be legitimately claimed to be preferable to tlie less tangible benefits of extra flood management and niitigation measures since reservoirs for irrigation water obviously need to be kept full, whereas for flood prevention tlie need is for empty reservoirs to absorb floods when they come. In our country, most of the big reservoirs are for irrigation and not lor flood control. Only tlie reservoirs of the Damodar Valley Corporation cater to flood control in addition to irrigation.

ii) Floods provide silt for increasing soil fertility, while both floocl prevention and irrigation can either eliminate tlie silting or limit it to well-defined areas. Large numbers of small farmers can lose tlieir livelihood or have their income reduced if their interests are not taken into account in the new plans.

iii) The relation between floodplain management and watershed area management has still not been sufficiently clarified; however, it is generally agreed that uncontrolled deforestation and shifting agricultural cultivation can cause soil erosion, lower water holding capacity of tlic land and increased risk of flooding through silting of riverbeds.

iv) Rapid urbanisation has produced large concentrations of urban squatters who have by and large settled on unoccupied land (both public and private) in unattractive or undesirable locations, including marshes and other low-lying land exposed to periodic or seasonal flooding, but where they are close to employment opportunities and services. One of the most serious and difficult challenges to land-use policies is tlic need to provide safe and suitable urban land for all segments of the population, including the lowest income groups who can least afford tlie disruption brought about by having to live in areas constantly subject to disasters.

Tlie relocation of squatter settlements from low lying flood-prone areas is often hampered by the high cost of suitable alternative locations, and the extremely high per capita costs of new infrastructure and services, for which subsidies directed at the lowest income groups are rare because of unbalanced housing policies and the low capacity of loan repayment among this segment of the population. Furthermore, as mentioned above the lowest income groups tend to congregate as near as possible to tlieir sources of employment, whatever the risk. In sum, nothing short of comprehensive policies and programmes can effectively cope with problems of disaster prevention in urban development.

The comprehensiveness of a policy framework is apparent where land-use policies are supported by corresponding social and economic policies. Thus, the reservation of new urban land for housing, especially where low income

families are concerned, should be linked to transport and employment facilities, education and other social services. The modes of investment in, and development of, new urban lands are complex. The most feasible approach is one that undertakes the development of infrastructure services and housing in progressive phases, employing wherever possible popular participation techniques to reduce capital costs by investing the labour and savings of the interested population itself. One may cite core-housing. sites and services, and the creation of small savings and loan societies or co-operative as components of the total land development process;

v) With increasing urban and industrial development resulting in drainage congestion, the risk of flooding increases. On the other hand alternative urban development strategies aimed at decentralisation and the creation of secondary urban centres are frequently beyond the available resources.

vi) In vulnerable towns and villages, the land-use planning process is confronted with many of the same social and economic dilemmas that can be found in land-use planning for floods and other hazards. The most vulnerable areas are the portions with the oldest housing. The poor generally live in the older and most crowded sectors. The economic and social cost of uprooting, disturbing and resettling this population may inhibit employment and income growth and also disturb the delicately balanced traditional social system especially in the villages. Thus, the rezoning of land in the older poorly built or high-risk pol-lions of towns can have unfavourable income distribution effects. Nonetheless, preventive measures are required, but should be closely harmonised with both land use and housing policies designed to respond to the problem of social and economic development.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

) Why are land-use policy considerations relevant for disaster management in the context of development?

2) What issues at the national and regional level play an important role in land-use zoning for disaster management?

12.4 ZONING CONTROLS

Zoning and sub-division controls are two means by which government can regulate and control both land use pattern and development in both rural and urban areas. Legal controls are increasingly used to regulate the activities of the private sector by placing location restrictions and minimum standards on specific types of land uses and activities. These controls can take tlie following forms:

12.4.1 Land Use Macro Zoning

Macro zoning is the establishment of land use planning zones at regional levels. Such zones generally establish agricultural, urban, industrial and recreational uses incorporating existing and future patterns. Specitic uses are allowed in designated areas, although macro-zoning plans are revised at appropriate intervals to take into account changes and growth. Such zoning is an efficient tool to control the over-all location of various human activities. Macro zoning has a broad function in the seduction of risk since hazardous areas can be zoned permanently for agricultural or recreational uses, minimizing as far as possible urban or semi-urban concentrations of population or industry.

Natural hazard macro-zoning is a technique of somewhat longer standing and more general application, but has been of limited use for detailed land-use planning, since it applies natural hazard mapping to the national and regional scales only. However, the demarcation of a country or 'regions into broad areas of natural hazard is useful for outlining general national policies in disaster prevention and mitigation.

As an example, land use planning with respect to flood plains can 'have two objectives:

i) To bring about the most effective beneficial use of tlie flood plain with least possible risks, consistent with over-all community development; and

ii) To promote the health and safety of the present occupants of land prone to flooding.

During the formulation of the land use plan, certain parts of the flood plains can be studied in the following format.

i) If residential and other public interest uses are to be permitted in tlie floodway fringe area, it should be only after adequate safeguards in the form of construction design criteria, which should be enforced to render structures safe from floods.

ii) Unless economic and location factors greatly over-balance the risk of potential flood damage, industrial development in flood hazard areas should be limited to a certain type of industry to areas beyond the limits of the floodway (e.g., pulp and textile mills, chemical and metal processing plants which require large quantities of water and discharge great amount of effluent).

iii) Site needs for wholesale and distribution uses, which require the stocking of large quantities of goods particularly susceptible to water, are flexible enough that locations free from flooding can usually be found.

iv) Flood plain land can be left as natural parks or developed as golf courses, picnic spots and stadium areas.

An evaluation of land use must include an analysis of public works and improvements and their relation to the local flood problem. The planning of public improvements, such as water and sewage treatment plants, transportation facilities and public buildings require the same type of consideration that is accorded tc private development with respect to flooding.

12.4.2 Land Use Micro Zoning

Micro zoning is the detailed preparation of land use maps by local bodies and public authorities, particularly in urban settlements, fixing speciric land - uses for each site (such as residential, educational, commercial, etc.). Micro zoning also details the density of land uses at particular sites. Furthermore, micro zoning establishes a detailed land use pattern within the natural hazard macro-zoning framework. From the point of disaster prevention, micro zoning is a basic tool which relates natural hazard assessment to land-use planning.

Detailed risk analysis for given locations assists in determining both land-use and building criteria. It can be said as a general rule, that whereas natural hazard macro-zoning maps are based on the broad geological and geographical configuration of a given region coupled to records of past hazard frequency and magnitude, natural hazard micro-zoning is essentially a detailed study of the probability of natural hazards in a given site as determined principally by the detailed stucly of sub-soil conditions. Naturally, hazard zoning identifies not only probable intensities but also probable return periods or frequency. Micro-natural hazard mapping allows tlie land-usc planner to employ quantitative as well as qualitative criteria for establishing land use zoning guidelines. Similarly, it enables tlie civil engineer to formulate more precisely, than would otherwise be possible, building codes for public worlts, housing, industry, education and health facilities and transport networks.

12.4.3 Sub-division Regulations

Sub-division regulations, like zoning, provide public control over the development of land. The sub-division regulation is a widely used tool that seeks to ensure tlie proper development of unused land. This is accomplished through approval of plans by the designated government authority where the criteria for approval establish restriction governing the exact way land is subdivided and the provision made for public facilities and infrastructure. The developer is prohibited from commencing development until tlie authorized government agency approves a niap of the proposed design of the sub-division.

12.4.4 Building or Location Permits

Building and location permits provide planners and government officials with an opportunity to exercise micro-controls over development. A building permit can be used not only to regulate tlie type of land use activity and the structure it occupies but also enables the authorities to control employment opportunities thereby influencing patterns of development.

The point here is that land use controls should not be limited to those areas tliat experience flooding, but should be expanded to include areas that may in fact contribute the hazard potential e.g. by blocking drainage.

12.4.5 Open space Controls

Land use policies that regulate the location of agriculture or green area have a direct impact on the provision of open spaces in the total planning area and vice-versa. Agricultural lands, parks and other types of open spaces can play an important role in improving the environment and also mitigating the effect of natural disasters.

Not only do open space help reduce capital losses, but equally important, they serve to limit the loss of life because of their tendency to generate minimum human activity. However, it should be noted that open space does not imply the total non-use of land. Clearly, such areas may be used to satisfy a wide variety of social and economic needs. Thus, open spaces may serve to prevent or mitigate disasters while providing some economic returns as well.

12.4.6 *Building Codes*

Any discussion of disaster prevention and mitigation must consider not only "where" but "how" a particular building is built, and this leads to the regulatory instrument of building codes. Building codes or building by-laws in the present context establish minimum standards of design, construction and materials in order to avoid structural collapse under conditions of severe physical stress caused by extreme natural phenomena to which that land might be vulnerable.

Although building codes are extremely important for mitigating the effects of natural disasters, they should not be considered as separate from land use controls, especially zoning. The co-ordination of land use controls and building codes is one of tlie most effective local level devices for disaster prevention and mitigation.

Since building codes are not retroactive, tlie use of performance standards for the repair or rehabilitation of older structures could serve as a supplementary means of improving tlie safety of existing structures.

12.5 LOCATION OF ACTIVITIES AND LAND USE

As a basic principle, major functional land uses sliould be segregated and not mixed as far as possible. Mixing of land uses, especially between residential and Iiigli-risk industrial, sliould be avoided. All such industrial plants and storage areas of explosive and combustible material and substances should be separated from residential development by a system of green belt.

In order to diminish the risk of total paralysis of productive or administrative activities in disaster prone areas, tlie industrial and business zone sliould be decentralised and located in more than one centre in tlie city.

All important installations like centres of communication, ltey supply facilities, and even historical monuments and cultural landmarks require special attention in case of a catastrophe. These elements sliould be located in such way that they are well accessible and well protected.

Density of developnient in a disaster-prone area should be Itept as low as possible. In case of a conflict due to economic criteria (cost of land and infrastructure) or with functional demand (accessibility or proximity) the compromise, if unavoidable, should be a function of tlie level of risk in the area, building technology and material, and height of buildings and cost of infrastructure.

12.5.1 Implications in *Town* Planning

Urban planning is a state responsibility and as such tlie plans are prepared under tlie respective Town and Country Planning Acts. Such acts should be amended to include disaster mitigation as an integral component of a master plan. Similarly, techniques of plan preparation should include risk mapping and vulnerability analysis to identify the extent and nature of vulnerability.

A modification of steps in master plan preparation would also be required. Instead of a detailed zonal plan being prepared after tlie overall land use plan, a broad zonal structural plan based upon risk zones identified should be prepared before the overall land use plan. This will reduce tlie time lag between master plan and zonal plan preparation. Existing development in each zone can be accommodated and modified to suit the risk factor of any zone.

As a further follow-up, building codes need not be uniform in each zone. High-risk zones, which are consequently more vulnerable, should have lower Floor Area Ratio (FAR), wider set baclcs, more open spaces, and restriction on high rise development. Use of building materials that increases structural safety should be mandatory in high-risk areas. The rear set back, in case of industrial plots, should be kept larger than the front set baclc to prevent factories from being built baclc to back which reduces availability of open spaces for rescue operations.

12.6 APPLICATION OF REMOTE SENSING AND GIS

The data supplied by earth observation satellites can often provide information such as maps and images which are useful at scales 1:500,000 or better. Maps of watersheds, river and stream patterns and coastal plains can be produced and geographical maps completed. They can also be used to show inhabited settlements which are of the order of 1 km or larger in dimension.

Satellite observations of the earth can be used to map flood plains and delineate areas of potential floocl impact. Observations by the satellite (e.g., Indian Remote Sensing Satellite IRS-1C with a spatial revolution of 5.8m arid revisit capability of 5 days) can provide information on surface cover changes, which when processed using Geographic Information Systems (GIS) can help in producing a judicious land use map and also help in assessing the impact of various alternative land use plans. Satellite data can also provide maps of destruction caused by a disaster (flood, earthquake, drought, even pests and cliseases). As GIS is a computerized system, the maps in GIS can be easily and quickly manipulated and studied.

Check Your Progress 2

Note: i) Use the pace given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) Explain the various components of zoning control as a tool for disaster management.

2) Write the steps you would follow in preparing a town plan keeping disaster management as a top priority.

12.7 LET US SUM UP

In this unit we have learnt how important land use planning and zoning regulations are in the context of disasters. Careful land-use zoning can prevent disasters, and also reduces the extent of damage both to lives and property. We also saw that with varying sub-division regulations, relief operations can also be made smooth and quick.

12.8 KEYWORDS

Land Use — The observed (or planned) dominant activity that occurs at a particular location at the scale of a region or a city.

Sub-division Regulations — Locally adopted laws governing the process of converting unused land into building sites. Together with zoning, these regulations approve or disapprove permissions to make improvements or to divide and sell a developer's land based upon development standards set forth in the sub-division regulations.

Zoning — Zoning provides for the division of an area into zones by categories of allowed and/or prohibited land uses, such as industrial zone, residential zone or greenbelt zone. Zoning is also done according to the perceived risk of disasters on the basis of vulnerability.

12.9 REFERENCES AND FURTHER READINGS

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12.10 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include following points:
   - a more pressure on urban land;
   - a pace of change of land use is faster than the society can handle;
   - o socio-economic cost of relocating people is very high;
   - o economic pressures are pushing the poor into marginal lands prone to disasters; and
   - overall economic resource crunch.

2) Your answer sliould include following points:
   - o conflict between conservation storage such as for irrigation and dedicated flood storage reserve in large reservoirs;
   - relation between floodplain management and watershed management;
   - a rapid urbanization process and pressure on urban land; increasing change of land use from agricultural to non-agricultural land uses: and general resistance to shifting of population.

Check Your Progress 2

1) Your answer should include the following points:
   - Macro zoning, micro zoning, sub-division regulation, building permits, open space controls, building codes, arid development controls.

2) Your answer should include following points:
   - broad zonal plan based on risk zones;
   - building codes;
   - building material supporting structural safety; and
   - monitoring through techniques of Remote Sensing and GIS.

UNIT 13 PREPARING COMMUNITY THROUGH IEC

Structure

13.0 OBJECTIVES

Information, Education and Communication (IEC) is one of the most effective means for disaster preparedness, as it deals with pre-disaster action for capacity building of tlie community through knowledge upgradation. After reading the unit, you will be able to:

- explain tlie meaning and significance of IEC;
- describe the ways to increase tlie disaster preparedness of a community through IEC;
- discuss the Participatory Rapid Appraisal (PRA) method and tlie three most commonly used tools to accomplish PRA; and
- highlight tlie essential means for creating an awareness campaigns.

3.1 INTRODUCTION

Disasters can be defined as events that are beyond tlie capacity of normal local resources to cope. Tlie definition provides a helpful starting point when considering disaster response. The definition of disaster as an unmanageable extreme event suggests that response can be organized at one of tlie two levels – either within local capacity (by strengthening local preparedness and response mechanisms) and/or from outside the local context. Tlie former provides the best option in terms of providing long term sustainable disaster preparedness; the latter, if relied upon too much, creates a dependency, and is costly, time-consuming and reduces tlie local initiative and responsibility within the community.

In the light tlie strengthening of local preparedness of the community should always be the primary objective. Experience shows that disasters are mitigated best by those affected (communities/groups) being well prepared. Tlie development of sustainable mitigation and preparedness measures comes from developing self-reliance. Hence tlie belief that the management of disaster is primarily the responsibility of those affected by it should bc reinforced whenever possible. As such, tlie local preparedness capacity is tlie prime resource for disaster management, and this is the target area for Information, Education, and Communication inputs. In other words, we need to build up the disaster preparedness capacity of tlie community through the processes of IEC.

13.2 MEANING AND SIGNIFICANCE OF IEC

Each of the three components of IEC, i.e. information, education and communication, has its own distinct significance, origin, perspective and focus area. These aspects are discussed below:

Information

Preparing tlie community for disaster management through information means tlie transfer of basic knowledge by means of facts, figures and processes to the community so as to increase tlieir awareness. The key issue here is- tlie availability of data to the people, based on which they may form more realistic perspectives, and be better prepared to anticipate and face the disaster. It is useful for the administration and other agencies for planning purposes, and useful to tlie community for development of internal coping mechanisms.

Adequate information provides correct answers to tlic questions of What, *When, Where,* How *and How Much* with respect to the expected disaster. It also addresses tlie issue of probability of the occurrence of the disaster, more easily understandable in terms of extent of risk; risk being the cumulative effect of hazards and vulnerabilities. So information in this context tells the community about the hazards, sucli as floods and tlieir causative mechanisms such as release of waters from the upstream reservoirs and tlie time lag between such release of water and actual floods in tlie community locality. The downstream vulnerabilities such as deficiencies in the housing structures, insanitary conditions, lack of knowledge of epidemics and tlieir causes and treatment also need to be known as also the details of probable adverse effects that could occur clue to the combined effect of tlic hazards and vulnerabilities. Information, in this manner creates a picture of tlie reality for tlie community, lielps them realize tlie risks and motivates tliem to take preparedness action.

Education

Education goes a step beyond information and aims at an awakening of tlie people rather than just awareness. It sensitizes the people in the community and besides making them aware of the risks, it enlightens them about their individual and collective stake, the actions needed to be taken and their roles, and it also motivates them to act.

Education conveys to the people an idea of the mechanism of the occurrence of disasters. It tells them what to do and what not to do for preventing or mitigating clisasters. It tells them how to manage situations, and provides them with the possibility of alternatives. Many a times people are seen to be having a fatalistic attitude towards disasters. They treat disasters as unavoidable acts of nature and express total helplessness to do anything against them, thereby surrendering to them. Education eradicates this kind of attitude by informing communities of best available alternatives and means of achieving them, makes them more motivated to take counter-disaster measures.

Mocle and means of education are dependent on the target groups. As such, the design and packaging of the educational material has to be based on local considerations, and should be acceptable, understandable, interesting and motivating for tlie community that is being addressed. While educating communities, their traditional practices, existing knowledge and traditional wisdom in coping with such situations must also be kept in mind, and accommodated in the educational process. However, if there are any superstitious and illogical ideas or customs prevalent in the community in respect of hazardous or disastrous events, these should be slowly and carefully eradicated. Only then, the education process will be considered complete.

Communication

Communication is the process of information exchange between two or more groups/individuals. It could be applied to both, education as well as emergency management. In terms of education and preparedness, communication is a process of knowledge transfer to the community regarding disaster risks and mitigation measures to be taken. In this process, the system is of flow of information from a Itnowledgeable source to the mass group, i.e. the community. Another manifestation of the same process is in times of anticipated disasters when the communication relates to hazard forecasts. At such times warnings have to be issued to the community regarding the impending disaster in a clear understandable mariner. This is a very critical and final stage of pre disaster communication that gives the community a chance to take evasive action, or move away from the scene to a safer place in order to avoid or lessen the disaster impact.

Once the disaster has struck, communication becomes an essential support system for search and rescue (SAR) operations. Field teams have to be in contact with tlie base station or control room. This is required to coordinate the efforts of the field teams for better and wider coverage in an efficient manner. Through an effective communication system the field tennis get to know what kind of help is required in which areas. This is also useful for reaching out to the affected community with relief materials like food, medicines and clothing. The field teams can also send back information to the control room regarding extent and nature of additional assistance required, and tlie deficient areas. They should also inform about tlie areas covered, so that other teams may be notified not to visit the same areas again, thereby avoiding overlap. Special medical help or evacuation teams may be required in critical situations, and valuable time could be saved in getting these if there is an on-line communication system, which would eliminate the need for physically going and conveying the messages. In such situations the communication takes the form of Emergency Management Information System (EMIS).

While dealing with communications for disaster management, modern tools such as radio or satellite communication become very useful. Amateur (HAM) can also be utilized ifavailable.

Besides the areas discussed above, communication is also very useful in the process of monitoring and evaluation, In order to know whether the rescue, relief and rehabilitation work is in progress in the desired manner, flow of information from the field upwards is required for setting up an effective monitoring and evaluation system. This applies also to the preparedness and awareness stages, where monitoring is required for periodic check on the progress of the efforts, and required modifications in the programme, if necessary. Thus the significance and importance of fail-safe communication system is self-evident. That is why more than one type of communication channels is set up to deal with disasters so that some means of communication are available even if other channels fail under the impact of a disaster.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) Briefly describe the meaning of IEC.

2) How are Information, Education and Communication linked with each other?

13.3 WAYS TO PREPARE COMMUNITY THROUGH IEC

Traditionally, awareness campaigns have been treated as tlie main method Tor preparing communities through IEC. The basic methodology has been relined and made more effective through participatory tools such as Participatory Rapid Appraisal (PRA) and Action Planning, which take care of the disaster management planning process, and at the same time increase the awareness, knowledge and capacity of tlie community regarding disaster processes and management efforts required. These are discussed below:

Participatory Rapid Appraisal (PRA)

Participatory Rapid Appraisal for risk assessment is carried out in collaboration with community representatives, and there are numerous tools to do this. The three most commonly used PRA tools are discussed below:

1) **Mapping**

Participatory mapping is interacting with the community members on matters such as:

a) Drawing maps showing physical/geographical features, households, and available community resources.

b) Speaking to community members and learning more about the community. Ask them to identify a suitable area (e.g. a large flat ground suitable for drawing outlines in the sand) for conducting tlie mapping exercise.

c) Explain to everyone present the purpose of the exercise.

d) Ensuring that the map is copied as a permanent record (on paper) for future reference.

e) Listing the names of the main participants who facilitated and managed the process.

2) Seasonal *Diagramming*

This is a calendar showing the work performed during the course of a year by different members of a community. This is achieved through the following steps:

a) Decide what kind of a diagram should be drawn (e.g. rainfall, labour demand, diseases, crops harvested or firewood gathered).

b) Speak to the community members who have knowledge of the issue being investigated, and who would like to share their knowledge..Women should have a major say in most of these exercises.

c) Explain what the purpose of the exercise is, and what you would like them to do, i.e. show how certain requirements change with season.

d) Draw up a 12-18 months calendar, but let participants choose at which season in the year they want to start.

3) *Children's Drawings*

Children do not need much instruction in order to begin drawing – they enjoy the process and they will spontaneously produce what is important to them. Children usually assemble near adult's gatherings. This may be a good time to initiate drawings among children. Speak to them say you would like to learn more about their lives. The following can be the possible steps:

a) Identify a suitable place, preferably a large sheet of paper because children love to draw lines in colour.

b) Provide sheets of flipchart and thick marking pens or crayons.

c) Stand back, relax, and do not interfere.

d) If there are numerous occasions when children draw, you may want to encourage equal participation by girls, and different age groups – this will lead to a greater variety in perspective.

e) Review the drawings with the children, ask for explanations if necessary.

Action *Planning*

Action planning is a step further to the PRA exercises, and addresses the remedial actions to be taken up to reduce the risks analysed in the PRA processes. Action Planning should again be a participatory process, and should be ideally carried out through a workshop or series of workshops with the community group. The workshops would also include representatives from the local government, emergency services and NGOs to make it a comprehensively participatory effort that would have a sustainable long-term impact on the community as well as the various agencies involved in disaster management and mitigation.

Action Planning would lead to the narrowing down the exercise to a few selected actions to be taken up in order to reduce risks of disaster. These actions would include actions to be taken up by the community as well as those by the governmental and non-governmental agencies. However, emphasis would be on those activities that can be carried out by the community itself with minimal help from outside agencied, in order to build on the internal capacities and coping mechanisms of the community.

Awareness Campaigns

Awareness remains one of the major tools for preparing communities for risk reduction, and is most effective when used in combination with other tools that ensure effectiveness in awareness and also translation of awareness into action. Awareness needs could also emerge from the PRA exercises or as a recommendation of the Action Planning process.

Awareness campaigns could bc carried out in a number of ways. The traditional means have been through lectures, printed pamphlets, posters and exhibitions. Where resources allow, audiovisual tools such as films are very useful. Street plays and interactions liave also been found to have a great impact. This kind of means can be further modified and made interesting through integration and PRA and Action Planning process. Printed material, which includes visuals from the community itself, is round to attract the people's attention more easily. In this way, they are able to relate to themselves, their community as well as the various agencies involved in disaster management and mitigation.

Calendars carrying visuals of the seasonal hazard diagrams could prove very effective as they would constantly keep reminding the people of the likely disasters for the current and next month. Video films with footage of the community and its area, along with animated guidelines on do's and don'ts could be aired through local television or cable network for short duration slots. This is more easily applicable in urban areas but can also be used in rural areas now that the reach of television and local cable TV has extended to semi-urban and even rural areas. Action planning workshops could be given a high profile by arranging 7'-shirts for participants which could graphically depict some key map of the arca with hazards and also telephone numbers of emergency services. These usually attract a lot of attention.

Awareness and emergency management communication can be achieved through voluntary innovations even in difficult and inaccessible areas during disaster situations. For example, a long pole can-be used to serve as a flag mast erected in a flood and cyclone prone area where there arc no radio or television to serve as a means of warning dissemination. One red flag fluttering on tlie mast may mean that the disaster may occur, stay or alert. Two flags on the same mast may mean that the disaster is going to occur, prepare to evacuate. And three flags on the same mast meant that the disaster is almost there, so leave everything and run. This mechanism can prove very effective in remote vulnerable areas, and can become the central focus of attention of the local community. This can be an ideal tool for creating awareness and also setting up a volunteer warning system at the same time.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) How does Participatory Rapid Appraisal (PRA) help in preparing the community for meeting disasters?

2) What are tlie essential means of creating an awareness campaign?

13.4 LET US SUM UP

Information, Education and Communication (IEC) are basic means for enabling a community to prepare them for disaster risk reduction. These can be effectively applied through a number of tools such as integration of these with ongoing developmental programmes of the community. One of tlie major advantages of IEC and its tools is that risk assessments are carried out and action plans are prepared at the same time as the awareness arid education processes are going on. These become long term assets for the communities as well as the planning agencies, which can use these locally perceived appraisals and plans for future planning, and activities. Above all, the participation of the community at every stage ensures their involvement from disaster. preparedness to disaster management.

13.5 KEY WORDS

'Capacity Building	Increasing the capability
Integrity	Honesty
Knowledge Upgradation	Increasing the knowledge
Sensitise	Make the people aware of the importance of tlie subject
Stake	Deep involvement

13.6 REFERENCES AND FURTHER READINGS

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13.7 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- IEC stands for Information, Education and Communication
- These three terms are inter-related closely and are very important tools for disaster management.

2) Your answer should include the following points:

- Adequate Information is necessary to learn about what, where, when, how and how much about an anticipated disaster.
- Education enables the people and the community to understand the available information and to learn to face a disaster.
- Communication provides the methods for exchange of information and dissemination of education regarding disaster preparedness.
- All three viz. Information, Education and Communication are essential to deal with every stage of disaster management, i.e. pre, during and post disaster states.

Check Your Progress 2

1) Your answer should include the following points:

PRA helps in preparing a community to deal with disasters through the following tools:

- Mapping
- Seasonal diagramming, and
- Children's drawings.

2) Your answer should include the following points:

- Printed pamphlets, posters and calendars
- Media- audio, videos; and local cable TV
- Exhibitions, street plays and interaction among local groups.

UNIT 14 DISASTER MITIGATION

Structure

14.0 OBJECTIVES

After studying this Unit, you should be able to:

- know the definition of disaster mitigation;
- understand the importance and aims of mitigation in disaster management,
- describe various types of approaches to disaster mitigation,
- understand mitigation strategies suitable in typical natural disasters.

14.1 INTRODUCTION

Natural disasters cause loss of life and property every year in India and other parts of the world. Each disaster disrupts the normal life pattern and essential services. In India, floods, droughts, cyclones, earthquake and landslides are Frequently occurring natural disasters, responsible for devastating economic losses, human miseries and hardships.

Disaster Mitigation involves measures to reduce the effects of disaster-causing events. Disaster Mitigation is defined as "All actions to reduce the impact of a disaster that can be taken prior to its occurrence, including preparedness and long term risk reduction measures". It also includes the planning and implementation of measures to reduce the risks of man-made hazards, and the process of planning for effective response to disasters; which do occur.

Disaster mitigation includes scientific analysis of risk assessment; realistic assessment of social. economic, legal and technical processes involved in the development of mitigation measures; taking appropriate administrative and political actions for the application of these measures.

14.2 IMPORTANCE AND AIMS OF DISASTER MITIGATION

The most important 'part of implementing disaster mitigation is the full understanding of the nature of threat. In India, different states are vulnerable to different types of hazards. Some states are prone to floods and droughts, others to floods and cyclones. Some states are prone to earthquake, falling in highly active seismic zone (zone 5 or 4). Most states are prone to combination of various hazards.

The effects these hazards are likely to have and the damage they are likely to cause depends mainly on the following:

i) Population in that region,

ii) Type of houses,

iii) Sources of their livelihood (Agriculture, others),

iv) Infrastructure

To understand hazards of a specific region/state and to develop mitigation strategy, one should have knowledge of:

i) Causes of hazards and how they arise,

ii) Disaster History of the area

   a Occurrence of hazards,

   b Frequency,

   c Magnitude (severity),

iii) Physical mechanism of destruction caused,

iv) Elements at risk (most vulnerable to their effects),

v) Economic and social consequences after damage.

Importance of Disaster Mitigation

The worst effects of any natural disaster are loss of human life, injuries and health problems of the affected people apart from loss of property and livelihood. Understanding the way that people are killed and injured in a particular disaster is a prerequisite for reducing casualties.

In an Earthquake, 90% of the casualties are caused by house collapse. Hence, saving the lives in earthquakes means focusing on prevention of building collapse. Similarly, in floods, most of the deaths are because of drowning in fast flowing or turbulent waters. Reducing loss of life by floods is possible by preventing or minimising the extent of water flow or keeping people out of the track of potential waterflow.

Mitigation is planned after studying the elements at risk. Saving human life is of the highest priority in mitigation plans, followed by those of animals. Next comes safety of crops, infrastructure, and other elements at risk. Identitication of elements most at risk indicates priorities for mitigation.

Mitigation also entails the protection of the economy from disasters.

Aims of Disaster Mitigation

The specific aims of disaster mitigation are as follows:

i) Creating awareness of risk at community level,

ii) To promote local actions through community participation to reduce such risks,

iii) Induction of mitigation measures in the national and regional development plans, land use planning proposals and in project design and appraisal in disaster prone areas.

iv) To assist decision makers (politicians and administrators) to understand the nature and extent of various risks faced by the communities in their area of responsibility, and to assess tlie economic effects of natural disasters on agriculture, commerce and industry.

v) To demonstrate ways and means to reduce those risks within the limits of national, regional or socio-economic conditions through proper decision making and planning.

vi) To introduce effective measures to implement disaster mitigation plans at the different levels of public administration based on risk assessment and vulnerability analysis.

In brief, mitigation is involvement of community, administration, politicians and decision makers in reduction of risks through local actions and taking mitigation measures in tlie local, regional and development plans.

Check Your Progress 1

Note: i) Use tlie space given below for your answers.
ii) Check your answers with those given at tlie end,of the unit.

1) Define Disaster Mitigation?

2) What are the aims of Mitigation?

14.3 APPROACHES TO DISASTER MITIGATION

Disaster mitigation focuses mainly on minimizing the destruction and disruption by a hazard and offers long-term, cost-effective method of dealing with or managing natural disasters. There are two approaches to disaster mitigation,

i) Structural Approach

ii) Non-Structural Approach

In fact, non-structural measures cornpleniented by structural measures is the best way of disaster mitigation. However, it is essential to understand these two approaches,

14.3.1 Structural Approach

structural approach for disaster mitigation may refer to:

- Engineered Structures, and
- Non-Engineered Structures.

Engineered structures are those supervised by qualified architects and engineers during the planning, designing and construction of structures, including buildings, dams, embankments, roads, and bridges. Usually, there are legally binding building codes for engineered construction. These codes provide guidelines for appropriate design and construction in disaster prone areas. Adhering to the building codes might add only about 5% of the cost of building but will make the building safe.

Sucli structures can be designed after collecting data for hazard vulnerability and related meteorological parameters (wind velocity, direction, rainfall, its duration etc.).

After the Uttarkashi earthquake (1991), University of Roorkee provided training even to field masons for constructing earthquake resistant houses in the area.

Non-engineered structures are generally constructed by people with the help of local artisans like, masons and carpenters, with the locally available material. These structures can be made safer, if people are trained and given improved designs. These structures are normally of low-cost but having less strength/resistance for a disaster. There can be strengthening of such buildings by retrofitting as suggested in a number of villages of Maharashtra after the Latur earthquake (1993).

14.3.2 Non-Structural Approach

Whether structures in an area are engineered or non-engineered, there could be many ways of enhancing the safety of lives and property by judiciously adopting non-structural safety measures. Such approach to disaster mitigation consists of positive actions through legislation, incentives, educating people, creating community awareness, forecasting and warning. Some of the non-structural mitigation measures are given below:

i) Legal Framework

In some of the disasters like flood, cyclone, earthquake etc. more casualties occur because people are living in houses built without following appropriate building codes. Similarly, there are other legal provisions regarding activities permissible in flood plains or near hazardous areas such as large petrol depots or oil refineries. It is necessary to adhere to these legal bindings.

ii) Incentives

By suitable incentives people could be included to adopt safe measures. For example, in highly seismic zones, if some incentive can be provided to construct earthquake resistant buildings in the form of grant or subsidy, people will adopt such mitigation measures. The incentive can also be in terms of tax exemption or providing material required in earthquake proof construction.

iii) **Insurance**

Insurance of crops, buildings and other infrastructure in disaster prone area are non-structural measures that are yet to gain public patronage. Insurance companies may provide soft loans for disaster resistant structures and buildings. Alternately, the insurance premium for houses in unsafe or less safe areas may be subsidized for poorer sections of the society.

iv) Training, Education and **Public Awareness**

Training of the public officials at different levels in an essential part of disaster management. Separate training for technical people, and NGOs is also required for specific disaster mitigation.

The general public should be made aware and kept informed about the nature of hazards to which they are exposed, their vulnerability and protection measures available. Awareness campaigns should be mounted in the vulnerable communities and schools and colleges. For such campaigns in rural areas, assistance of NGOs and local Panchayats will be very useful.

v) Forecasting and Warning

Reliable and timely forecasting and warning of an impending disaster can save a lot of human lives.' In recent years, death toll in -cyclones is minimized considerably because of effective forecasting and warning system and people's quick response.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit;

1) Name the two approaches to disaster mitigation?

2) **Identify** a few of the **non-structural** measures for disaster mitigation.

14.4 MITIGATION STRATEGIES FOR SPECIFIC DISASTERS

(A) Floods

i) Causes

Normally floods are caused by high rainfall or more snow melt on the higher altitude of mountains. This raises the level of rivers than its normal level leading to floods. Deforestation of the catchment areas and sedimentation in the riverbeds due to soil erosion can increase the severity of adverse effects.

ii) **Flood Severity**

Severity can be evaluated from following parameters.

(a) Depth of water (flooding),

(b) Area inundated (flooded),

(c) Speed of water flow,

(d) Duration of inundation,

(e) Amount of sedimentation or mud deposition in agricultural field.

iii) Hazard Assessment and Mapping

In case of flood, historical records can provide a rough idea of hazard vulnerability. In case of river floods, topographic mapping and contouring near and around river systems can also be prepared.

iv) **Elements of Risk**

(a) Everything in the flood plains,

(b) Buildings, particularly "kucha" or earth buildings or masonry with mud or water soluble material,

(c) Building with weak and shallow foundations,

(d) Basements and underground buildings,

(e) Underground electrical and telephone lines,

(f) Water supply (underground pipes),

(g) Sewerage,

(h) Crops, fisheries and hatcheries,

(i) Food stock and other essential supplies,

(j) People and livestock,

(k) Fishermen's boats and nets etc.

v) Mitigation

(a) Land use planning and control to avoid use of flood plains for residential or commercial purposes,

(b) Structural measures like engineering of structures to withstand flood forces and design for elevated floor levels and construction' over stilts. Construction of reservoirs, dams, dykes, retaining walls, embankments, constructing alternate drainage courses are structural methods for flood disaster mitigation,

(c) Non-Structural Measures, such as, people's participation through education and creating awareness, sedimentation clearance from rivers, afforestation, effective warning systems, flood resistant houses (with strong foundation and by use of water resistant material), changing farming practices, storage and sleeping area to be much above the ground, flood evacuation preparedness, arrangement of boats and rescue equipment, adoption of afforestation and checking deforestation in the area.

(B) Earthquake

i) Causes

Earthquakes are caused by vibrational energy released by geological adjustments deep in the earth. These may also result from tectonic drift or local geomorphology shifts or volcanic activity.

The vibrations of earthquake cause damage and collapse of structures, which in turn may kill and injure people living in the area. Earthquakes have multiple effects. It can cause landslides, rock-falls and dam failure leading to floods and can cause enormous loss to the settlements in tlie vicinity. There could also be flooding and fires in urban areas clue to broken water mains, gas leak or electric short-circuiting.

ii) Severity

The earthquake severity is reckoned by tlie magnitude on tlie Richter Scale, which indicates tlie amount of energy released at tlie focus. Higher the magnitude, more is tlie damage and larger is tlie area affected.

iii) Hazard Assessment and Mapping

A hazard assessment map of the country/state can be prepared after identification of seismic fault systems and seismic source regions. India has been divided into five seismic zones from the point of vulnerability for earthquakes.

iv) Elements at Risk

In high seismic zones following elements are at risk:

(a) Weak foundation buildings,

(b) Multi-storied buildings,

(c) Buildings constructed by earth (mud), rubble, stone and unreinforced masonry,

(d) Old structures,

(e) Building weakened by subsequent modifications,

(f) Tall building on alluvial soil or slopes,

(g) Underground pipes, power lines, sewerage lines, water supply pipes, telephone wires, etc., and

(h) Industries, chemical, nuclear plants.

v) Mitigation

(a) To follow building codes,

(b) Enforcement of compliance with building codes requirements and encouragement of higlier standards of construction quality,

(c) More emphasis should be given to engineering of structures to withstand vibration forces. High standard of engineering design of all public buildings (hotels, schools and hospitals).

(d) Reduce urban densities in high seismic zones,

(e) strengthening of existing buildings, monuments strengthening in the vulnerable areas,

(f) Encouraging insurance,

(g) Community participation in constructing safe houses; creating awareness of what to do and what not to do at the time of earthquake. Community action groups in fire fighting first aid and rescue operation. Regular earthquake drills in the area.

(C) Drought

A major difference between drought and other type of disasters is that droughts do not have a sudden onset such as in case of floods or earthquakes,

i) Causes

Scarcity of rainfall in the area, over exploitation of underground water can aggravate or even cause drought.

ii) Severity

Drought severity depends on:

(a) Rainfall deficiency

(b) Duration of drought

(c) Extent of soil moisture loss and ultimately loss of soil cover

(d) Area affected

iii) Hazard Assessment and Mapping

The meteorological department prepares rainfall map of each state/region. This indicates the normal rainfall pattern of the region. Less than normal rainfall for prolonged period causes drought conditions. Topographic maps can be prepared of the area having more frequent droughts.

iv) Elements at Risk

(a) All types of vegetation and crops,

(b) Human and animal health,

(c) Entire human settlement (in prolonged drought and famine),

(d) All industries, business and other economic activities depending on water, and

(e) Soil system.

v) Mitigation

Both structural and non-structural mitigation strategies are necessary.

(a) Construction of dams and check dams,

(b) Provision of irrigation facilities,

(c) Watershed management,

(d) Food, fodder and water management including rationing, if necessary,

(e) Herd-management,

(f) Proper selection of crop for drought affected areas,

(g) Leveling, and soil conservation techniques,

(h) Reducing cleforestation and fire wood cutting in the affected areas,

(i) Checking of migration and providing alternate employment for people,

(j) Education and training to the people,

(k) Community participation in construction of check dams, reservoirs, wells, tanks, afforestation, introducing water conservation arid efficient water management through community programme, (pani-panchyat in Maharashtra) changing livestock management practices, encouraging self-employment by cottage or village (non-agricultural) industries.

(l) Public Health Management,

Some of the community based programmes like "Sukhomajri" experiment in Haryana or "Ralegaon Sidhi" in district Ahmednagar of Maharashtra should be replicated. These are good examples of water conservation in these areas with the help of local people.

(D) Cyclones

i) Causes

Cyclones generate over sea areas in certain parts of tropics such as the Bay of Bengal and the Arabian Sea and move towards coasts. Intense atmospheric processes cause these in the months of April-May and October/November. These are hundreds of kilometers in diameter and are accompanied by torrential rain and very strong winds.

ii) Severity

Cyclone severity depends upon wind speed and rainfall.

iii) Hazard Assessment and Mapping

Climate charts are available from the India Meteorological Department indicating all the past occurrences of cyclonic storm during the past 150 years. The Department also provides forecasts and warnings for cyclones through a state-of-the-art system.

iv) Elements of Risk

All vulnerable coastal areas:

(a) Weak houses and light-weight structures,

(b) Timber houses.

(c) Loose and poorly attached building elements (Sheets, Boards, etc.),

(d) Telegraph and electrical poles,

(e) Sign boarcls, fences, trees, etc.,

(f) Fishing boats,

(g) Maritime industries.

v) Mitigation

(a) Engineering structures to withstand cyclonic wind forces,

(b) Suitable building codes for the area having wind load requirement,

(c) Better architectural design of buildings, taking winds speed and wind direction into account,

(d) Planting wind breaker trees in upwind of towns and on coasts,

(e) Cyclone shelters for the community,

(f) Community participation in construction of wind-resistant or easily rebuilt houses. Proper fixing of elements (like metal sheets, rods, angle iron, etc.) that could blow away and cause damage elsewhere. Construction of strong wind resistant shelters for community. Protection to animals, arid protection to fishing boats. Cyclone rehearsals (drills) in the vulnerable areas. Selection of means of communication at tlie time of cyclone (e.g., I-lam Radio).

Check Your Progress **3**

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

I) What could be tlie mitigation strategy for flood disaster?

2) What could be the mitigation strategy for earthquake disaster?

14.5 LET US SUM UP

Disaster mitigation includes all possible actions to reduce the impact of a disaster that can be taken prior to its occurrence, including preparedness and long term risk reduction measures. For effective mitigation measures, knowledge of tlie disaster, history of the place, its vulnerability to types of hazards and elements, which are at risk, is important. Disaster mitigation is important because basically it is to prevent or minimise loss of life, property and infrastructure from disasters. The main aim of disaster mitigation is to create awareness of risk among the community and to reduce such risk through their participation. It is to involve administrators and politicians (decision-makers) in induction of mitigation measures in the national and regional development plans.

Tliere are two approaches to Mitigation:

i) Structural Approach

This applies to:

(a) Engineered structures (designed and constructed by qualified architects and engineers)

(b) Non-Engineered structures (designed and constructed by local artisans with local skill and material)

ii) Non-Structnral Approach

This includes (i) Legislation, (ii) Incentives, (iii) Insurance, (iv) Training, Education and Awareness, (v) Institution Building, (vi) Forecasting and Warning.

14.6 KEY WORDS

Contouring	indicating slopes or high areas or low areas on a map.
Disaster	is an event, natural or man-made, sudden or progressive, which impacts with such severity that the affected community has to respond by exceptional measures and it often needs outside help to cope with the situation.
Disaster Prevention :	is mostly applicable to man-made disaster, where preventive measures can possibly be taken to stop disaster possibilities. Prevention is a term, which can be used when the disaster possibilities can be totally eliminated. For natural disasters, mitigation is the more accepted term.
Disaster Mitigation :	involves all measures to reduce the impact of a disaster.
Risk	is the probability of a disaster in a region/place.
Risk Assessment	is assessment or quantification of risk by hazard assessment and vulnerability analysis:
Disaster Preparedness :	is all actions taken to reduce the risk of a hazard before the disaster as well as to provide effective relief after the disaster.
Topographic	Indicative of local physical features on a map.

14.7 REFERENCES AND FURTHER READINGS

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14.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your **Progress** 1

1) Your answer should include the definition given in the second paragraph of section 14.1 (Introduction)

2) Your answer should include the following points:

- Creating awareness in the community.
- Community Participation.
- Mitigation measures in the national and regional plans.

Check Your Progress 2

1) Your answer should include the following points:

- Structural Approach
- Non-Structural Approach

2) Your answer should include the following points:

- Legal Framework
- Incentives
- Insurance
- Training, Education and Public Awareness
- Forecasting and Warning

Check Your Progress 3

1) Your answer should include the following points:

- Land use planning and control
- Structural measures such as reservoirs, dams, embankments, alternate drainage systems
- Non-structural measures such as awareness, flood plain laws, forecasting and warning, evacuation, boats and rescue equipment, relief camps,

2) Your answer,should include the following points:

- Awareness of seismic zones and corresponding risks
- Construction of earthquake resistant houses and buildings
- Retrofitting old and weak buildings and monuments
- Avoiding construction over alluvial soil
- Earthquake mitigation drills and keeping special beam cutting equipment ready
- Providing special equipment to locate persons buried under debris.

UNIT 15 SEARCH, RESCUE AND EVACUATION

Structure

15.0 OBJECTIVES

After studying this unit, you should be able to:

- define the Search and Rescue (SAR) and evacuation processes;
- discuss the importance and significance of SAR and evacuation; and
- briefly describe the traditional as well as the modern, scientific and professional methods and techniques of SAR and evacuation.

15.1 INTRODUCTION

Relief measures are the immediate need in the post-disaster scenario, Especially when infinite victims are affected and their locations are not clearly known. In such type of circumstances, search, rescue and evacuation processes are carried out immediately after the disaster has struck a certain area or zone, These are the most important operations, which are usually performed by the local volunteers, voluntary organizations and the district and state agencies. If the condition worsens and these groups are not able to control the situation, then the defence services are also called in to help. In this unit, we will discuss the! Significance Search and Rescue as well as the evacuation processes. The unit will also give us an idea about traditional and new methods i.e. scientific and professional methods of SAR and evacuation

15.2 IMPORTANCE AND SIGNIFICANCE

Search and Rescue (SAR)

Search and Rescue, often known by the acronym SAR, is the process of identifying the location of disaster victims who may be trapped or isolated, and bringing them to safety and providing them with medical attention. The basic aim of search, rescue and evacuation is to ensure the survival of the maximum possible number of victims. A plan is worked out with the help of local people through aerial surveys and then appropriate steps are Gken by the various teams involved, to carry out the operations. These teams use local volunteers who are well-versed with the local area and can be instrumental in searching, SAR teams also depend on sniffer dogs and heavy machines such as cranes and earthmovers etc., to search out and extricate the victims from difficult situations such as collapsed buildings especially after earthquakes. Besides bringing about physical and material relief, the aim is also to control panic and confusion and to provide moral support.

The operation not only includes the evacuation of the people and temporary relocation in safer areas, but also the measures by which they could survive in the affected place, by providing necessary aid to them, till such time that they can be rescued. Post-evacuation relief through emergency supplies and services is also a part of the relief operations.'

In case of floods and cyclones, boats, rafts and helicopters are used to carry out the search and rescue operations by forming different teams and carrying out SAR operations in the entire area systematically, each team covering its assigned sectors. In such cases, SAR usually includes locating stranded flood victims, who may be threatened by rising water, and as per their need either bringing them to safety or providing them with safe drinking water, food and first aid until they can be evacuated or returned to their homes. A number of the disasters such as floods, cyclones and storms can now be predicted and forecast with the aid of the skills, tools and scientific techniques developed over the past years. On the basis of these forecasts, warnings need to be issued to the people in advance, so that those in the disaster risk areas may brace themselves and take adequate action to mitigate the impact of the coming disaster. At the same time, rescue and relief agencies also may gear up and be placed in a standby position to get into action as soon as required.

During the season that floods and cyclones are expected to occur, boats, vehicles and even helicopters for evacuation of people to safer areas should be kept ready so that they could be made available at a short notice. The possible camp-sites for the evacuees should be identified in advance, In the vulnerable areas, drinking water, dry ration packets, ultra-pasteurized milk, food, clothing and medical supplies should be stockpiled, or arranged for ready delivery when required. Trained rescuers should be in a position to assist the victims, and local volunteers should be identified and imparted basic training in rescue and first aid operations.

It has been observed that sometimes due to delay in rescuing people stranded due to floods or cyclones, survivors die of shock exhaustion and injuries or snake bite and also suffer due to mental stress. This has to be avoided to the extent possible. The public intervention strategy should, therefore, give priority to such preparedness and the Government should make this known. Only then will the behavioural response of the community be orderly, systematic and amenable to persuasive control.

In dealing with earthquakes, the situation is different because no advance warnings whatsoever can be given. In the aftermath of earthquakes, SAR usually focuses on locating people who are trapped inside damaged buildings or are. buried under debris but are still alive. This is a highly skilled work and needs special equipment. Trained teams and equipment need to be maintained at a number of centers in zones 4 and 5 so that these can be quickly rushed to the site of earthquake disaster.

Evacuation

Evacuation involves the removal of a population from pones at risk of an imminent disaster to a safer temporary location. Evacuation is most commonly associated with cyclonic storms but is also a frequent requirement with technological or industrial disasters, For evacuation to be effective, there must be a timely and accurate warning system, clear identification of escape routes, provision of transport, an established policy that requires everyone to evacuate when an order is given; and a public education programme to make the community aware of the plan.

Check Your Progress I

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this unit.

1) What do you understand by Search, Rescue and Evacuation?

2) Briefly describe the term 'Evacuation'.

3) Highlight the actions taken by SAR teams in the event of floods and cyclones.

15.3 ESSENTIAL REQUIREMENTS FOR SEARCH, RESCUE AND EVACUATION

For the search, rescue and evacuation process to be effective and useful, there are quite a few essential requirements that have to be available simultaneously, if not in advance. Prime ones amongst these are:

i) Shelter

To provide temporary shelter for victims whose houses have been destroyed or rendered unusable. This may involve:

- Making urgent repairs to some buildings
- Providing tents or tarpaulin as temporary shelter
- Accommodating groups of homeless people in community buildings such as schools

ii) Food and Drinking Water

- To organize and distribute food and drinking water to disaster victims and also emergency workers
- To estimate damage to crops and food stocks
- To estimate food reserves available (including unharvested crops) and organize their distribution along with requisitioning additional stocks required.

iii) **Communication**

To establish essential radio, telephone, telex or facsimile links with central bases, control rooms, and head offices of agencies responsible for coordination and provision of manpower, service and material backups. Amateur Radio Operators (HAMs) are often quite helpful.

iv) **Clearance** and **Access**

To clear the key roads, airfields and ports in order to allow access for vehicles, aircraft and shipping; and to identify and prepare helicopter landing sites in the immediate vicinity of the disaster struck area.

v) Water and Power Supplies

To re-establish water and power supplies, or to make temporary arrangements for them, the provision of potable water is often difficult, particularly in the early post-impact stages. Water purifying equipment might therefore have to be obtained and/or water purifying tablets distributed.

vi) Temporary Subsistence Supplies

To provide supplies such as clothing, medical kits, cooking utensils and plastic sheeting, so as to enable victims to subsist temporarily in their own area, thus helping to reduce the pressure on evacuation.

vii) Health and Sanitation

To take measures to safeguard the health of people in the disaster stricken area and to maintain reasonable sanitation facilities, including provision of temporary toilets, safe water, garbage disposal service and vector control measures.

viii) Public Information

To keep the stricken community informed on what they should do, especially in terms of self-help. And on what action is in hand to assist them. To prevent wild speculation and rumours concerning the future situation that may lead to unnecessary fear and mental stress to the people.

ix) Security

To maintain law and order, especially to prevent thef? and other crimes, which could add to the miseries of the victims.

x) Construction Requirements

To estimate high priority building repairs and replacement requirements. Unsafe buildings and buildings beyond repair should be identified and declared out of bounds till they are demolished and rebuilt.

xi) Disaster Welfare Inquiry

To make arrangements to handle national and international inquiries concerning the safety and welfare of citizens and residents, including tracing of missing persons, preparation and maintenance of records and inventories of the dead, and injured as well as the survivors along with information on their locations.

15.4 METHODS AND TECHNIQUES

Traditionally, due to lack of technology and scientific approach, it was difficult to carry out the search, rescue and evacuation operations. The only possible way out for the teams was to work with the help of local people who volunteered themselves during such operations. The teams used to move around in vehicles/boats/helicopters to search out people and rescue them.

In the present context, due to scientific advances, it has become easier to carry out these operations efficiently. Advancements in science and technology have made it possible to forecast the disaster occurrences with specific locations, which helps in the initial stages of search and rescue operations. Besides, there are techniques available, like remote sensing, satellite imagery and computer based Geographical Information Systems(GIS), which help in identifying areas which are disaster prone, zoning them according to risk magnitudes, inventorying populations and assets at risk in the respective zones, and simulating damage scenarios. These tools are useful even while managing disasters as they can provide instant access to information required for management decisions. Modern communication systems have also proved very useful in disaster situations particularly in search and rescue operations. They not only help in providing warnings before the disaster, but also help in creating awareness, which helps in reducing panic, confusion and mental stress. A communication network system helps in establishing contacts between relief teams, which with better central coordination could work more efficiently and be more effective. It is for this reason that various control rooms are establislied to manage the disasters. And in the cases such as floods and cyclones, which can be predicted in advance, such control rooms are also set up in advance.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this unit.

1) Briefly discuss five major requirements that are needed along with or in advance of Search, Rescue and Evacuation.

2) Highlight the difference between the traditional and modern methods and techniques regarding relief measures.

3) Briefly describe the important steps in providing food to the victims.

15.5 LET US SUM UP

This unit has dealt with the search, rescue and evacuation operations. The role of local volunteers and voluntary organizations that' lays focus on essential requirements to make Search, Rescue and Evacuation effective has been discussed. The unit has also described the traditional and modern methods and techniques regarding search, rescue and evacuation.

15.6 KEY WORDS

Communication Network for disaster management includes the human and technical network for transmitting information to the public. This information can be transmitted between the disaster site and the emergency operations centre via telephone, radio, telegram, television and newspaper.

Evacuate means to remove someone from a place of danger to a safer place.

Evacuation Planning is a structured procedure whereby persons could be moved from a threatened or impacted area.

Search and Rescue is the process of identifying the location of disaster victims who may be trapped or isolated and of bringing them to safety and medical attention.

15.7 REFERENCES AND FURTHER READINGS

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15.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress **1**

1) Your answer should include the following points:

- Search and Rescue, often known by the acronym SAR, is the process of locating of the clisaster victims who may be trapped or isolated and bringing them to safety and providing them with medical attention.
- SAR becomes a necessity in the aftermath of floods, cyclones and earthquakes particularly.

2) Your answer should include the following points:

- Evacuation involves the relocation of a population from zones at risk of an imminent disaster to a safer temporary location.
- It is most commonly associated with tropical storms and floods and also industrial and technological disasters.

3) Your answer should include the following points:

- In cases of floods and cyclones, SAR teams search their assigned sectors for search and rescue work. They use boats, rafts and helicopters to carry out the SAR operations.
- SAR usually includes locating stranded flood victims, who may be threatened by rising water, and as per their need either bring them to safety or provide them food and first-aid until they can be evacuated or return to their homes. In case of an earthquake, SAR involves locating and rescuing the persons buried under debris. This needs trained rescuers and specialized equipment.

Check Your Progress 2

1) Your answer should include the following points:

- Shelter
- Food and drinking water
- Communication facilities
- Health and sanitation
- Security

2) Your answer should include the following points:

- Traditional methods involve local people to work with the teams to search out people and rescue them. The teams are used to move around in vehicles, boats or helicopters,
- Modern methods involve a scientific approach. Advancements in science and technology have made it possible to forecast the disaster occurrences with specific locations, which helps in the initial stages of search and rescue operations. Besides, modern communication systems have also proved very useful in disaster situations, particularly in search and rescue.

3) Your answer should include the following points:

- To organize and distribute food to the disaster victims.

  To estimate damage to food stocks and crops.

- To estimate available food resources locally and organize their distribution along with requisitioning additional stocks as required.

UNIT 16 SWELTER FOR VICTIMS

Structure

16.0 OBJECTIVES

After studying this unit, you should be able to:

- discuss tlie importance of shelter provision;
- highlight shelter provision differential in lieu of peculiarities of location, climatic condition and availability of resources; and
- describe the shelter provision for different types of disasters.

16.1 INTRODUCTION

In this unit, an attempt is made to discuss tlie importance of shelter provision as part of emergency relief operation as well as long-term rehabilitation plans. Shelter provision differential in lieu of peculiarities of location, climate conditions and availability of resources will be highlighted. In addition, shelter provisions for different types of disasters will be briefly described. The need of security for property will also be discussed.

16.2 CONCEPT AND SIGNIFICANCE

To understand the mechanism of shelter provision and restoration in disaster management cycle, various cliaracteristics have to be taken into consideration.

i) Need for Different Shelter Strategies

Various types of disasters need different shelter strategies and this reflects on the level of intervention, the design options and the requirement of resources, Another important factor is the likelihood of recurrence of disasters in tlie same area. This could be almost immediately after a disaster or after a long interval. Such areas have to be dealt with separately and with long-term plan intervention.

ii) Geographical Factors

The location of the place where the disaster has occurred, the physiographic terrain and the subsoil conditions contribute significantly in the choice of various shelter options. Location also becomes important from tlie strategic point of view. Sometimes tlie areas may not be readily accessible. Such peculiarities severely limit tlie choices available for intervention.

iii) Shelter Strategies

Varying shelter strategies may be adopted as given below:

Large Shelter Space	:	To accommodate large number of people in one place; sometimes existing community buildings such as schools etc. may be used for this purpose
Temporary Relief Camps	:	Camping sites may be set up in proximity to the affected settlements. Tents may be used if buildings are not available.
Rehabilitation Settlements	:	These may be rebuilt scttletnents in new sites on permanent basis using construction technology, which could provide for proofing against future disasters. This strategy is adopted when a community is to be relocated permanently.
Repair and Restoration	:	These could be carried out in the existing areas if the extent of damage is not very high.
Retrofitting and Strengthening	:	Retrofitting is done as a measure to reduce the vulnerability of the existing weak structure to future disasters.

iv) Knowledge Sharing and Awareness

In view of the daunting task of large-scale shelter relief in the shortest possible proofing methods, especially materials and methods of construction sharing of knowledge could be a boon. In certain cases, there are possibilities of usefully adapting traditional knowledge in existing structures as well as new ones with a view to mitigate (or possibly prevent) the effects of disasters.

Check Your Progress 1

Note : i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) Discuss the main factors which contribute to the choice of various shelter options.

2) Highlight any three types of shelter strategies.

3) Write a note on rehabilitation settlements.

16.3 SHELTER FOR HUMANS

The physical conditions of the existing housing stock of India, particularly in rural areas, have substantially deteriorated over the years. Most of the houses in small towns and rural areas stand in dilapidated condition and warrant upgradation or replacement. The bulk of the housing in the country is constructed by the people themselves or semi-skilled houses with varying standards and specifications without recourse to support from governmental agencies or financial institutions. In spite of quantitative and qualitative increase in housing stock during the successive five year plans, it is estimated that every year nearly 1,75,000 houses get adversely damaged or destroyed by different types of disasters.

House forms and building system have been traditionally adapted not only to local climatic conditions but to the availability and experienced structural performance of basic building materials. The major limitations of traditional materials in local applications are in their low resistance to extreme natural forces (e.g. earthquakes, cyclones, floods etc.) and lower durability. As a result, the level and frequency of maintenance and the resulting lower service life of houses built with these materials have emerged as major constraints to their performance and durability and render most of these buildings vulnerable under the forces of natural disasters,

In the event of a disaster, these vulnerable structures give way, killing the occupants or injuring them. One of the immediate relief tasks is of providing alternate shelters to the survivors.

Shelter Relief

Part of the relief material distributed to the disaster victims may include building materials like roofing items, camping kit etc. This strategy is adopted very often. However, it may have a limited effect as the community may not be aware of how to use them. Besides, these may not provide protection against recurring disasters.

When the settlement is completely destroyed or submerged, the population may have to be moved to a new location where temporary Relief Camps may be established. The Relief Camps may provide for essential services like food, water supply and health services in addition to meeting the shelter requirements.

In areas which are prone to disasters, sometimes large structures may be erected in preparation for disaster. These large structures could be used to house the affected population. (It is important to note that such structures should be designed scientifically to withstand the anticipated disasters, otherwise they would offer no refuge when required).

In case of cyclones, designing and constructing of special multi-purpose anti-cyclone community relief shelters provide safe and secure accommodation to vulnerable population. This is done through construction in a phased manner of chain or network of such cyclone relief shelters all along the vulnerable coastline. It is erected so as to be within trekkable distances from the threatened settlements.

The cyclone relief shelters can generally take care of a population ranging from 50 to 300 people .(men, women and children). These are provided as multi-purpose community facility with spaces to be used for adult education, primary health centres, primary schools, vocational training,, and community centre needs. This will be at elevated areas, to be protected from floods and also with a provision for community kitchen, ensuring water supply, sanitation, battery operated electric supply and in some cases with helipad landing facility. The flat roofs serve as places for air dropping of food, water and other packets.

These are of various shapes which are able to withstand extreme cyclonic storms and offer least resistance to wind force. The siting, orientation, shapes, structural strengthening features do contribute to the performance of the structures. In addition, other school buildings, community centres in the vicinity are also used as shelters in case the cyclone relief shelters are not available or are not sufficient to meet the needs.

In case of earthquakes; large community shelters if situated in mountains have to offer protection against the uncertain and strong weather including snow fall as also stand the effects of recurrent mild tremors. They have to be not only seismically resistant'but also capable of being built in a short time and provide protection from the dicey weather as also security from wild animals like mountain wolves and tigers, which usually start prowling after the substantial death of a Iarge number of people and cattle.

Removal of the damaged elements of the structures including debris and recovering people who are either injured or deceased also is a very major task that is required after disasters such as earthquakes and cyclones.

Shelter Rehabilitation

Shelter rehabilitation may be introduced as a long-term strategy in areas completely devastated due to disasters. Rehabilitation is usually required in case of earthquakes in which virtually all existing structures suffer damage and may be unfit for living. However, rehabilitation strategies have their limitations as they are resource-intensive and may take a long time to implement.

Shelter relocation on a new site and fresh construction of dwelling units may be adopted in areas where large scale devastation may have taken place. Such activities were carried out on a large scale in the state. of Maharashtra following the major earthquake in Latur in 1993 and. recently in Gujarat after the

destructive earthquake of January 26,2001. However, in many cases, relocation may not be adopted if the community preferences are for their original places of residence. Also, in certain cases relocation as a strategy might entail higher costs making it infeasible. In such cases, as part of the rehabilitation, the existing structures may be restored by repairs and retrofitting. Retrofitting means essentially the introduction of elements in the existing structures to provide reinforcements against possible collapse. Such retrofitting would also serve as a strategy to reduce the vulnerability of the structure against future disasters.

If appropriate earthquake resistant construction features are introduced, this would go a long way in reducing the damages during the occurrence of an earthquake. This is for normal housing and for structures, which are constructed by local people and are generally called 'non-engineered' buildings. Therefore, the level of technology inputs have to be left at a locally manageable level by giving the earthquake resistant construction features for walling, roofing, foundation, door and window fixing etc. using materials like mud, stone, steel, cement, concrete, roofing material etc.

16.4 SHELTER FOR ANIMALS

During disasters, the casualty among cattle is particularly high because at the time of disaster, they are left tied to their stakes with no means of voluntary escape. Furthermore, there is nobody to take care of them during and after the disaster. Considering the fact, that livestock is also a source of livelihood to a substantial number of households, it becomes vitally important to save their lives and provide relief in the form of fodder and shelter in the post-disaster phase.

In the absence of any allocated shelter for animals, the community may like to keep their cattle close to'their own relief shelters, which in turn could lead to some unhygienic conditions and possible outbreak of epidemics. It would be desirable to set up separate shelters adjacent to the camp colonies as part of the relief package.

16.5 SECURITY TO PROPERTY

In disasters, the community gets dislodged from their homes leaving behind in a hurry their valuables, cash and other household items. They may not-be in a position to return immediately to retrieve their belongings. Also, immediately after a disaster, the community may be so traumatized that retrieving their belongings would not be their immediate priority. Often in such situations, there is the likelihood of their belongings being misplaced or stolen by unsocial elements.

Providing security to their property during such times gives a tremendous psychological relief to the affected community. This, in fact, acts as an incentive for their timely evacuation as too often people delay such evacuation measures for the sake of their valuables.

Check Your Progress 2

Note : i) Use the space given below for your answers.

ii) Check your answers with those given at the end of the unit.

1) Why have the physical conditions of the existing housing stock in India especially in rural areas deteriorated substantially over the years?

2) Briefly describe the limitations of the rehabilitation strategies.

3) Highlight the basic needs of livestock during and after the disaster.

16.6 LET US SUM UP

This unit has highlighted the importance of shelter provision as a part of emergency operations as well as a long-term rehabilitation plan. Various shelter strategies have been described briefly. The unit also dealt with the shelter provision for humans and the livestock. Lastly, certain significant issues have been emphasised such as shelter provision differential in lieu of peculiarities of location, climatic conditions, availability of resources; and security of property.

16.7 KEY WORDS

Rehabilitation work rev* around operations and decisions taken after a disaster with a view to restoring a disaster-stricken community to its former living conditions, while encouraging and facilitating the necessary adjustments to the changes created by the disaster.

Relief means meeting immediate needs, of food, water, clothing, shelter arid medical care for disaster victims; assistance given to save lives and alleviation of suffering in the days and weeks following a disaster.

Relocation is permanent location of temporary settlement of displaced persons at a place separate from their last place of residence.

Shelter is temporary housing to meet the immediate needs during or after the disaster.

86.8 REFERENCES AND FURTHER READINGS

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16.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:
   - Location of the place
   - Physiographic terrain
   - Subsoil conditions

2) Your answer should include the following points:
   - Temporary relief camps
   - Rehabilitation settlement
   - Large shelter space

3) Your answer should include the following points:
   - These may be rebuilt settlements in new sites on perinanent basis using construction technology which could provide for proofing against future disasters.
   - This strategy is adopted when a community is to be relocated permanently.

Check Your **Progress** 2

1) Your answer should include the following points:
   - Due to financial constraints, most of these buildings are not properly maintained.
   - The bulk of the houses are constructed by the people with limited resources and knowledge.
   - The major limitations of traditional materials in local applications are in their low resistance to extreme natural forces (e.g. earthquakes)

2) Your answer should include the following points:

   Major limitations of the rehabilitation strategies are that;
   - They are resources-intensive; and
   - These may take a long time to implement.

Relief Measures

3) Your answer should include the following points:

- Food and fodder

  Shelter

UNIT 17 LIVESTOCK AND RELIEF MEASURES

Structure

17.0 OBJECTIVES

After reading this unit, you should be able to:

- Discuss the effect of disasters on livestock population and health;
- Comment upon the problems of livestock in disaster situation;
- Indicate relief measures for livestock; and
- Explain the overall livestock relief management process

17.1 INTRODUCTION

In this unit, we will discuss the importance of livestock in India in terms of its economic importance and also the effect of disasters on the livestock population and health. In addition, livestock problems in disaster situations and relief measures will be briefly described.

17.2 IMPORTANCE OF LIVESTOCK IN INDIAN SITUATION

Livestock has been an integral part of human civilisation and culture right from the time that humans started domestication of animals. In early times, livestock possession was a symbol of progress and prosperity. Even in these times, the most significant positive point in favour of animal husbandry is its employment potential for rural poor. As it does not demand more skill, it suits the farmers and landless rural agricultural labourers well. It is not only an alternate source to provide livelihood but also a proposition favoured by weaker sections of the society, most significantly, the women. Dairy farming by landless and poor farmers provides employment potential to their family members and substantially contribute to their family income. One study of National Dairy Research Institute, Karnal shows that a number of dairy animals kept by landless poor farmers per household is less but more productive compared to that of big landlords/cultivators.

The National Commission on Agriculture in India observed that next to crops, animal husbandry has the largest employment potential in rural areas. This sector can, make significant potential in direct and indirect employment in several ancillary activities (such as livestock feed, dairy and poultry equipment, leather and wool industry etc.) for the weaker sections of the society.

The importance of livestock is depicted pictorially in Fig. 1

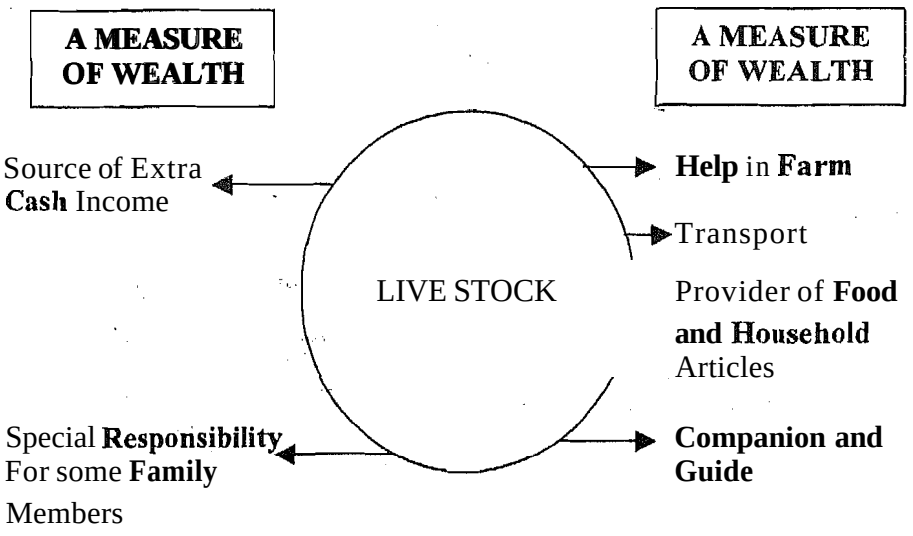

Figure 1

17.3 NEED FOR PROTECTING LIVESTOCK DURING' DISASTERS

There is a mutual give and take relationship between livestock and rural community. The major livestock products or outputs can be divided into 10 categories as depicted in Figure 2, which also shows the seven categories of inputs. Income from livestock includes not only cash from sale of animals, but also provision of services such as ploughing and transport. Land and agricultural improvement requires animal traction for ploughing, animal power for pumping water and post-harvest processing. The use of dung for manure and fuel and the making of fertiliser fram dung, bone, feather or horn are obvious livestock outputs. Livestock products which are used as clothing include wool, skins , hides, leather and feathers. In urban areas, livestock are not only companions for blind, elderly or lonely people but also provide security. The positive hygiene and health aspects of livestock output include soap making from animal products, transportation of water and the garbage- scavenging activities of pigs.

Seeing the multiple uses of the livestock population in India and particularly in the rural society, it is important to protect livestock in disaster situations like floods, droughts and cyclones. During these natural calamities, animals may be lost due to drowning, running away out of fright, death due to snakebites etc. More common and severe damage to livestock are incurable injuries, starvation of animals due to being stranded and death due to various diseases after the disaster.

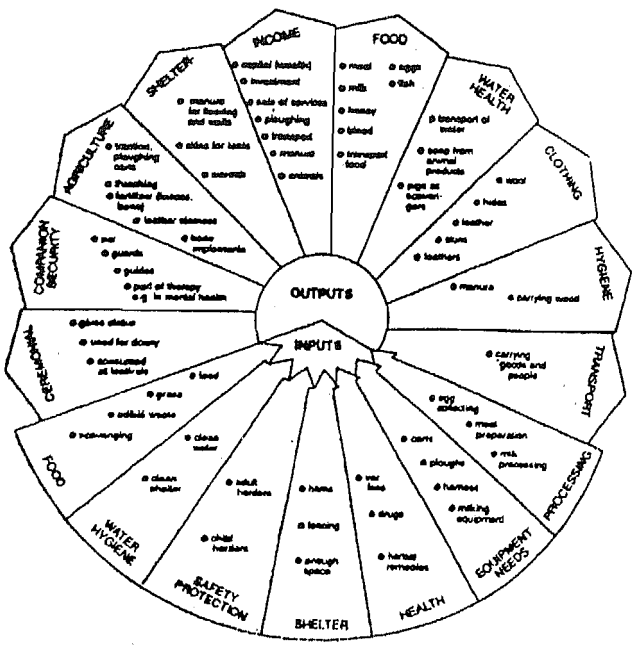

Figure 2: Community Inputs and Livestock Outputs

Whenever, there is any natural and human-made disaster. attention of the Government, NGOs and others are focused on human population. Most of the relief and rehabilitation works are for affected human community. The next focus is normally on livestock and other damages. According to the Government of India policy, first priority in disaster situation is to save human lives and provide them relief followed by livestock relief and then only come other aspects (viz. repair of roads, bridges, other infrastructure, houses etc.) Hence, disaster manager has to perform an important function to organise disaster relief to livestock next only to taking care of humans.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this unit.

1) Briefly discuss the priority systems in a disaster situation.

2) Highlight the importance of livestock in Indian situation.

3) Why should we protect livestock in a disaster situation?

17.4 LIVESTOCK PROBLEMS IN A DISASTER SITUATION

It has been stated above that during any natural calamity, prime concern of authorities, NGOs and related organisations is to save human lives and provide relief to the affected community. Livestock and infrastructure are always a second or third priority. The animal population is also affected equally in any disaster but their relief is normally neglected. It is also clear from the introduction of this unit that livestock is one of the major sources of our national wealth. As a significant part of sectoral growth and employment generatioh depends on livestock economy, its importance cannot be minimised in the development process of Indian economy. Loss of any form of livestock will affect the economic recovery of the people and will have a delayed and long lasting ill-effect on agriculture and people's lives, especially the rural poor. Some of the effects of various types of disasters on livestock are given below:

Whenever a disaster occurs, livestock is affected equally like humans. Even though a disaster usually lasts for a small period of time only, the loss of lives could be heavy.

UTTARKASHI EARTHQUAKE 1991

In villages near the epicentre of the earthquake, more animals died than human beings. In village 'Jamak' in which maximum loss of life and damage took place, 72 people died and 200 animals perished -----.

In drought situations, livestock is equally affected as human population. According to information available for 1987 drought, in India, which is still the latest widespread drought of the country, more than 50% of the total bovine population was affected (out of total population of 21.4 million, 12.0 million were affected by drought in affected states and UTs). In some states, the percentage affected was much higher than the national average.

Drought situation also causes malnutrition and leads to starvation deaths of animals. There is short-term as well as long-term impact of the disaster i.e. mortality and morbidity respectively.

In disasters caused by floods and cyclones, the impact on livestock is generally of short-term duration but severe in nature. Non-availability of feed for the duration of floods and epidemic diseases after the floods subside are very common. Incapacitation, disease or even death of livestock may have long-lasting effects on tillage and availability of animal products in the affected parts of the country.

Direct Effects of Natural Disasters on Livestock

i) People want to save their own lives and of their family members during disasters but tend to neglect the safety of their animals. Sometimes animals run away in panic.

ii) Death of animals due to collapse of cattle sheds during earthquakes and landslides. Even if there are no casualities, injuries are often caused.

iii) It is reported that during the earthquake or during the cyclone, animals try to free themselves of the neck ropes or metal chains. Sometimes, death takes place in this struggle by way of 'asphyxiation'.

iv) Drowning and washing away of animals in floods is most commonly reported.

v) Animals and birds are reported as being blown away during cyclones and high winds.

vi) Animals get stranded on isolated elevated places in case of floods or storm surges.

vii) Many a time, deaths of animals are caused by attacks through poisonous insects, snakes, rodents and leaches. Long-term starvation deaths are also common.

Indirect Effects of Natural Disasters on Livestock

There are many indirect effects of natural disasters on animal population. These can be summed up as follows:

i) Wet cohditions, after floods or cyclones, enhance the chances of infection by internal parasites like round worms, tape worms, liver flukes as well as of many epidemic diseases, like Haemorrhagic Septicaemia (HS), Black Quarter (BQ) or Anthrax.

ii) There can be non-specific water borne infections causing diarrhoea and other enteric diseases.

iii) Water and moisture may lead to wet hair coats, sticking of blood sucking leaches, skin disorders and ectoparasites. Standing in wet surfaces or in water can cause 'hoof-rot' and result in lameness.

iv) Moisture leads to many respiratory disorders in the animals and birds.

v) Loss of weight in the animals is possible.

vi) Loss of production of milk is most often reported.

vii) Similarly, loss of production of eggs in the poultry is reported.

viii) Losses to the agriculture sector in shortage of ploughing animals are likely.

The extent of damage to the livestock can be understood by following two cases:

FLOODS IN ASSAM (1988)

Assani is one of the most flood-prone states, suffers two or eight waves of floods every year. In 1988 (which was one of the worst year), almost all the districts and about 21742 villages were affected (four times more than average villages affected), A total of 99 lakhs of animals (70% of total population were affected) and about 3500 large animals (Valued at Rs. 3.8 crores) were drowned or washed away and lost. About 644 cattle camps had to be run and 4018 technical staff was deputed to carry out relief and rehabilitation work such as vaccination, treatment for injured animals, supply of food and feeding etc. It cost about Rs. 7.5 crores to the state government.

ANDHRA CYCLONE, 1977/1979/1984/1989

Andhra is one of the cyclone prone states. It has 1050 km. long coastiine. which is exposed to this type of disaster. The cyclone of 1977 is one of the most severe disasters, which struck the Andhra coast. As a result of which 5.74 lakh cattle perished in two worst affected districts. It caused a loss of Rs. 1.5 crores to the state government.

In the cyclone of May 1979, 3 lakh and in Nov. 1984 cyclone, one lakh livestock perished.

In the cyclone of 1989, in Kavali Tehsil alone (in which the cyclone crossed the coast) nearly 1600 cattle were perished (or lost) and 680 poultry farms, with more than one lakh birds, were blown away. The number of sheeps and goats that perished in the disaster was several thousand. It cost more than one crore rupee loss to the state.

17.5 PREPAREDNESS, RELIEF, REHABILITATION AND RECONSTRUCTION MEASURES

Preparedness

The important measures for disaster preparedness for animals are as follows:

There should be a separate plan for livestock population in the preparedness plan at state, district and even block levels. Similarly, there should be some initiatives by the central as well as state governments to take preventive measures to protect livestock such as-

- Construction of livestock shelters in disaster prone areas. In normal times, these structures can be used for animal feed stores, animal production, extension centre cum veterinary dispensary (on same lines as cyclone shelters are proposed to be used as community centres).
- Requisite stocks should be maintained for fodder, vaccines and medicines for animals in disaster prone areas.
- Animal shelters should be near the human shelters so that people can take their animals with them at the time of warning.
- Community should be trained to protect their animal population in the disaster situation.
- Separate action plan should be chalked out for veterinary staff who should receive the training dealing with to specific disaster situation.
- Contingency plans to remove the animals from affected areas. For poultry, special cages and transport arrangements can be made.
- In cyclone/ flood prone areas, regular mock exercises for livestock protection should be there.

Relief

The various relief measures for animals in the aftermath of disasters are briefly indicated as under:

- Stranded and affected livestock in the disaster should be rescued and taken to safer places such as cattle shelter and. provided with basic needs for life i.e. feed, fodder and drinking water.

- The community and trained staff should protect the animals against beasts of prey and poisonous insects, snakes and reptiles.
- The community should maintain hygiene and assist the veterinary staff in giving vaccine and medicines to the injured and affected animals.
- The veterinary and para-veterinary staff should be assisted in damage assessment and specific needs of the cattle.
- Removal of dead animals and disposal of dead bodies should be given high priority.
- Non- Governmental Organisations (NGOs) can play a major role in providing relief to the livestock during the disaster in the following ways-

  a) establishment and running of cattle camps.
  b) collection/ transport and distribution of feed and fodder.
  c) collection of forest grass, straws, etc. for feed.
  d) accurate reporting on the extent of loss of livestock belonging to individual farmers.
  e) disposal of animal carcasses
  f) providing training to the community for animal care during natural disasters.

Rehabilitation and Reconstruction Measures

- Arrangements could be made for purchase of livestock that the farmers want to sell- out of distress. The cattle can be rehabilitated in 'Goshalas'/ 'Gosadans'.
- Farmers of the disaster-affected area should be encouraged to go for insurance of their livestock so that they may be adequately compensated for the livestock lost, incapacitated or dead due to disasters.
- There is a system of distributed cash relief by the State Government for the loss of animals.
- Reconstruction of damaged veterinary hospitals and artificial insemination centres should be given priority.
- After the disaster, cattle breed of high quality and resistance should be introduced in the area so that better genetic stock could come up for the future.
- Setting up of permanent fodder bank in drought and flood affected areas will help the people in a disaster situation. This will provide permanent feed security system in the vulnerable areas.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this unit.

I) Throw light on the livestock problems in a disaster situation.

2) Discuss briefly the three major steps in relief measures for livestock.

3) Mention three important steps in livestock rehabilitation and reconstruction.

17.6 LET US SUM UP

This unit has highlighted the important role of livestock in Indian rural communities as it helps in the farm and provide extra income to poor people. In addition, need for protecting livestock in disaster situations has been discussed. The unit has briefly described the livestock problem in disaster situations, Preparedness, relief, rehabilitation and reconstruction measures have also been discussed.

17.7 KEY WORDS

Livestock Animals kept on a farm for use or profit

Preparedness : Actions designed to minimise loss of life and damage, and to organize and facilitate timely and effective rescue, relief and rehabilitation in the times of disaster. To be more specific, preparedness is concerned with understanding the threat, forecasting and warning; educating and training officials and the populations; establishing organizations for disaster management, including preparation of operational plans, training relief groups, stock piling supplies and earmarking necessary funds.

Relief Relief means meeting the immediate needs for food, clothing, shelter and medical care of disaster victims; assistance given to save lives and alleviate suffering in the days and weeks following a disaster. The relief period, for creeping disasters may be months or ever: years.

Resettlement : Resettlement is an important component of a rehabilitation programme following a disaster. Displaced population requires to be resettled as a part of the process of rehabilitation.

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17.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include tlie following points:

   According to the Government of India policy:

   - First priority in a disaster situation is to save human lives and provide them relief followed by livestock and other aspects like repair.

2) Your answer should include the following points:

   - Next to agriculture, animal husbandry has the largest employment potential in rural areas.
   - It is not only the alternate source to provide livelihood but a proposition favoured by weaker sections of the society like women.
   - Dairy farming by landless and poor farmers provide employment potential to their family members.

3) Your answer should include the following points:

   - Considering the multiple uses of the livestock population in India, it is important to protect livestock in a disaster situation.
   - Next to agriculture, animal husbandry provides the largest employment in rural areas.
   - It is tlie main livelihood for landless and poor farmers as well as for weaker sections.
   - Loss of livestoclc will not only affect the economy adversely but also will have a *long* lasting ill-effect on people's lives, especially tlie rural poor.

Check Your Progress 2

1) Your answer should include the following point.

   - Some of the major points to be kept in mind are tlie direct effects:
     i) Animals run away in panic;
     ii) Death of animals due to collapse of cattle sheds;
     iii) Drowning of animals in floods;
     iv) Starvation deaths; and
     v) Respiratory diseases in wet conditions.

- Some of the indirect effects are:
  - i) Wet conditions after floods or cyclones enhance the chances of infection by internal parasites; and
  - ii) Loss to agriculture sector due to shortage of ploughing animals.

2) Your answer should include the following points:
   - The animals should be provided basic requirements i.e. food, shelter, drinking water, and medicines.
   - The community and trained staff should protect the animals against beasts of prey, poisonous insects, snakes and reptiles.
   - Removal of dead animals and disposal of dead bodies should be given high priority.

3) Your answer should include the following points:
   - Arrangements be made for purchase of deemed stock that the farmers want to sell out of distress (sheep, goat etc.). Cattle should be rehabilitated in 'Goshalas' and Gosadans.
   - Farmers of the disaster affected area should be encouraged to go in for insurance of their livestock so that they may be compensated for the livestock lost, incapacitated or dead in the disasters.
   - Reconstruction of damaged veterinary hospitals and artificial insemination centres should be given priority.

UNIT 18 CLEARANCE OF DEBRIS AND DISPOSAL OF THE DEAD

Structure

18.0 OBJECTIVES

After studying this unit, you should be able to :

- discuss about tlie debris clearance;
- understand tlie process of disposal of dead human bodies; and
- describe the process of disposal of dead animals.

18.1 INTRODUCTION

In this unit,-we will discuss about the clearance of debris and disposal of tlie dead after the trail of deaths and destruction that disasters leave in their wake. This unit will highlight the necessity of immediate clearance of debris, including that from collapsed buildings and uprooted trees and will discuss tlie location and means of disposal. Tlie steps to be taken and precautions to be observed in the disposal of human dead bodies and dead animals will be described.

18.2 DEBRIS CLEARANCE

Debris from collapsed buildings, bridges and other structures, as well as uprooted trees, hoardings in the wake of a disaster, is the biggest hindrance to search, rescue and relief operations, as they lead to tlie disruption of communication services and transportation. As such debris clearance is the first step towards re-establishment of transport and communication networks, and setting up of a system to enable effective search, rescue and relief efforts.

Search operations for trapped survivors should be tlie first concern in tlie event of a disaster. These are most difficult where there have been building collapses and people are buried under tlie rubble. In such cases, debris removal has to be taken up in a very cautious and scientific manner. Any mistakes during debris removal can lead to further problems if the debris heaps move or settle, crushing any survivors trapped underneath. This is the reason wliy in such cases it is advisable to first cordon off the area and allow only technical personnel to carry out these operations. If the bystanders are allowed to take part in such operations, they may, though witli good intentions, land up on the site in large numbers, and start moving tlie debris in a haphazard manner, thereby endangering the lives of those trapped inside.

Technological and material support is also very critical for clcbris removal operations. Semi-automation, with the use of earth moving equipment, lifts and cranes, removal trucks, cutters and drills etc. is useful for dealing with high mass or high sensitivity areas. To locate trapped or buried.persons or animals, special sound sensing or heat sensing equipment is needed in addition to sniffer dogs. Once such a location is made, utmost care is required in handling ancl clearing debris at that site.

18.2.1 Damage to Buildings

Many a times, disasters such as earthquakes as such do not kill people, building collapses do. Buildings collapses are widespread in case of earthquakes and cyclones and even heavy rains or floods. These kill or injure many people. Even partially damaged buildings are a big potential threat, as they may collapse due to any further stress. Therefore, it is essential not only to remove the debris of collapsed buildings, but attention is needed on the partially damaged structures as well. In cases where they are recoverable and repairable, these should be carried out as soon as possible, and till that time the buildings or the structure should not be occupied or used. In cases of building damage beyond repair, they should be demolished lo avoid any further mishaps. A structural assessment is required immediately after the disaster in order lo identify the extent of damaged and partially damaged buildings and to decide the course of action.

18.2.2 Debris Clearance

Debris clearance in a post-disaster scenario is a complex task, not only due to high volumes and hampered accessibility, but because tlie nature o f debris is also highly varied. It may comprise rubble from damaged buildings, bridges and other structures, uprooted trees, poles nncl hoarding, damaged vehicles, goods and even accumulated solid waste, which may be of bio-degradable or non-bio-degradable nature. Debris could also include harmful or injurious material and will certainly include broken glass and plastics.

During debris clearance operations, care has to be taken so as not to cause further problems endangering lives or property. Care has to be taken to safeguard survivors trapped underneath the debris and attention is also needed not to tamper with any infrastructure nncl service networks in the process of debris clearance. As already mentioned above, survivors should be first located. Then these areas need lo be taken up first, and the trapped persons rescued before further debris clearance.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) Briefly mention the biggest hindrance to search, rescue and relief operations.

2) Why should only technical personnel be allowed to carry out search operations for trapped survivors?

3) Why is structural assessment required immediately after the disaster wherein damage to buildings is involved?

18.3 DISPOSAL OF DEAD HUMANS

Quick disposal of dead bodies is very important for avoiding the outbreak and spread of diseases due to their quick decay. Besides, decomposing human dend bodies on the site with fast spreading stench, present a very unpleasant environment for the rescue workers as well as surviving victims. This could have a telling effect on their mental health.

However, human dead bodies need to be handled with great care and due respect because sentimental values are attached to tlie dead and human dignity should be respected even in death. Therefore, the means, process and the manner of their disposal are of great importance. The first step in this regard has to be the identification of tlie dead bodies. This is also required for compliance with legal formalities. In case there is no person to identify or if the body is unidentifiable, tlie religious/ethnic identification should be attempted diligently. Once such background of the victims has been identified, they should be suitably disposed in accordance with their religious and cultural practices. Officially, it is tlie duty of the police to handle the dead bodies. Unless specifically waived, a post-mortem examination has to be also arranged by police.

Resources such as fuel need to be mobilised for cremation purposes. Those whose ethnic background prescribes burial have to buried: If tlie families of tlie dead are at hand and are willing to take charge of the bodies for individual disposal, this may be done. Otherwise, in case where there are no claimants, or where bodies cannot be recognised they should be collectively disposed through mass burial or cremation. All this has to be done by the police or under their supervision maintaining proper records for future reference and for issue of death certificates later.

The location of disposal site is of importance because this land is then always identified as tlie dead body disposal site by the local residents. Instances in the past, where mass cremations of human dead bodies have been carried out in the village open space, the local villagers have later refused to live in tlie village as it had acquire the reputation of being a cremation ground.

18.4 DISPOSAL OF DEAD ANIMALS

In most natural disasters, particularly in rural areas the number of animal deaths are very high, especially in residential areas, due to the fact that most domesticated animals are kept tied up, and in the event of a disaster while the people flee urgently, the animals left tied up have no chance of voluntary escape. As a result they often perish.

Disposal of dead animals is as important as that of humans because decaying dead bodies can be a potential health and environment threat. Still, this aspect is usually accorded lower priority, more so in case of stray animals. The rescuers are not willing to handle animal carcasses. Yet, this must be done expeditiously by local volunteers till the authorities take charge and get the carcasses disposed. Disposal is best done by burial, at some place outside the inhabited area. At such times, nobody should be allowed to hold on to the dead bodies for extraction of hides or bones or any other recoverable material, because the health threat is very high, and quickest disposal of the dead bodies is desirable. While burying the carcass, quick lime should be added as it will hasten the process and control the spread of any possible infection.

Check Your Progress *2*

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this unit.

1) Why is the disposal of dead bodies important?

2) Mention the major steps in disposal of the dead humans.

3) Highlight the best way of disposal of the dead animals as suggested in this unit.

18.5 LET US SUM UP

This unit described the clearance of debris as a prime requirement in post-disaster scenario so that trapped survivors may be rescued, and the way may be cleared for rescue and relief operations. Disposal of the dead needs to be done on an emergency basis to stop decomposition of bodies and spread of diseases. In the case of disposal of human bodies great care must be taken of the emotional sensitivity of the survivors and relatives of the dead. Disposal should be done in accordance with the religious and ethnic background of the dead and with due regard to dignity of the dead.

18.6 KEY WORDS

Debris Broken and fragmented pieces; rubble

Ethnic Relating to characteristics of different race, culture or society.

Epidemic Control : Control of rapid and widespread outbreak of disease within a given population and site.

Hide Animal's skin

18.7 REFERENCES AND FURTHER READINGS

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18.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress **1**

1) Your answer should include the following points:

- Debris from collapsed buildings, bridges and other structures as well as uprooted trees, hoardings etc. could be the biggest hindrance.

  Such debris disrupt or obstruct communication and transport.

2) Your answer should include the following points:

- In such cases, any mistakes during debris removal can lead to further problems if the debris .heaps move or settle, crushing any survivors trapped underneath.
- Non-technical volunteers, although well-meaning, could endanger the trapped persons by handling debris without expert knowledge.

3) Your answer should include the following points:

- To identify the extent of damage in wholly and partially damaged buildings.
- To determine if any person or animal could be trapped or buried in the debris.

Check Your Progress 2

1) Your answer should include the following points:

- For avoiding the outbreak and spread of diseases due to their quick decay.
- Decomposing human dead bodies on the site with fast spreading stench, present a very unpleasant environment and could have a letting effect on mental health of tlie rescue workers as well as the surviving victims.

2) Your answer should include tlie following points:

- Disposal of dead bodies needs to be done with great care and with due regard to the dignity of tlie dead.
- Identification of the dead bodies.
- Post-mortem examination, unless waived.
- Resources, such as fuel, need to be mobilised for cremation or burial purposes. Generally, this is done from government funds through police, who are officially responsible to take care of dead bodies.
- Identification of the location of disposal site (burial or cremation).

3) Your answer should include tho following points:

- Disposal is best done by burial, outside the inhabited area.
- At such time nobody sliould be allowed to hold on the dead bodies for extraction of hides or bones or any other recoverable material from the carcasses.
- During burial, quick lime sliould be added because it will accelerate the absorption of the remains inside tlie earth and also prevent spread of any infection.

UNIT 19 CONTROL OF FIRE

Structure

19.0 OBJECTIVES

After reading this unit, you will be able to:

- understand the fire hazard;
- know the types of fires;
- understand the causes of natural and man-made fires;
- evaluate the damage caused by different type of fires; and
- familiarise yourself with possible ways of fire prevention.

19.1 INTRODUCTION

Fire is a disaster that kills, maims or disfigures very cruelly. It can be due to natural causes also but is mostly man-made. Devastation is compounded if fires occur in the wake of disasters like earthquakes.

Fire is a major and frequent hazard particularly in urban industrial environment and results in colossal loss to property and threat to lives. In India, it is estimated that over average fire kills about 100,000 people and damages property worth Rs. 100 crore every year. In view of such huge disaster potential of fires, two units have already been devoted to this topic. A very important characteristic of fires lies in 'this fact that these spread very fast. Hence the emphasis has to be on control of fires. This unit is devoted to this aspect.

19.2 TYPES OF FIRE

Fire can be classified into two types.

1) Natural Fire - Wild Fire/Forest Fire
2) Man-made Fire

19.2.1 Natural Fire

Forest fires could be both natural and man-made. The forest environment is particularly susceptible to wild fires, that may be set off by erupting volcano, lightning or human carelessness. The risk of a naturally ignited fire turning into catastrophe is increasingly seen as a function of the degradation of the forest habitat. Crises caused by fires are compounded by such longstanding problems as rural poverty, technological constraints and inefficient cropping pattern and use

of forestland. Mounting pressure on scarce land and forest resources has led to rapid and massive deforestation.

Uncontrolled fires have contributed heavily to the depletion and exhaustion of natural forests. Like land clearing; they set in motion events that may result in permanent losses of bio-diversity, soil fertility and sustainable forest · based production. They usually produce large tracts of eroded and weed infested lands, altering ecosystems and increasing vulnerability to natural hazards. Wild fires destroy timber and forage, disrupt animal habitats, deplete soil nutrients and diminish an area's tourist value. Rapid run off from a burned over area can lead to local flooding and erosion of exposed soil. It can trigger landslides.

Fire Seasons

It is observed that during the summer season (April-June), the conditions become favourable for the fires to take place. This is mainly because the temperature during that period goes above 40"C, which makes everything so dry. Further the wind speed during this period is also very high, which helps the fires to intensify and also spread.

Type and Reasons of Wild Fire

a) Natural Wild Fire

1) Sparks produced on account of friction of rolling stones or dry branches of trees.
2) Lightning during thunderstorms.
3) Fire caused by volcanic eruptions
4) Sparks produced by steam locomotives near the railway tracks.
5) Sparks produced by pellets in the firing ranges of Army.

b) Carelessness on the Part of Humans

I) Careless throwing of cigarette, bidi stubs, match sticks by travellers and graziers.
2) Careless burning of firewood by passer by.
3) Carelessness in extraction of honey and other forest produce, using lighted torches.
4) Negligence in camp fires and coolcing operation near camping grounds and fairs.

c) Deliberate Causes

I) Concealing the illicit felling of trees.
2) Clearing the forest paths by the villagers.
3) Shifting cultivation.
4) Obtaining green flush of grass for grazing the animals.
5) Burning the pine needles to clear the ground from carpet of needles.
6) Settling scores (by burning one another's area).

Since there is a ban on felling trees these days, only burnt and fallen trees can be allowed officially to be taken out of tlie forests, unsocial elements have a vested interest in tlie forest fires.

Factors Affecting Fire

1) **Fuel** - Surface area of a given volume of slash is responsible to determine tlie state of spread and resistance to control. Dense heavy fuels arc late in igniting and burn slowly but produce intense heat and light. Flashy fuels ignite easily, burn rapidly and produce less heat. Fuels with less than 10% moisture content ignite easily.

2) **Aspect** - Southern slopes, exposed to direct rays of sun are more vulnerable.

3) **Topography** - It affects indirectly and is related to wind beliaviour, Fire travels rapidly upslope and least rapidly downslope. Convection heating increases with increase in tlie angle of slope. Fire travels rapidly in narrow canyons and draws flames. It curls backwards into the fire at tlie top of slope.

4) Delay in onset of monsoon rains is also one of the causes of wild fire. Due to very low humidity and the dryness, forests are more susceptible to fires.

5) Wind dries fuel, supplies oxygen to fire, tilts the flame forward to increase radiation and convention and transports burning cinders and hot gases. The rate of drying and fire danger increases with increasing wind speed. Fire usually burns fiercely in tlie afternoon depending upon slope, relative humidity, wind and temperature.

Impact of Wildfire

Wildfire has a great impact on environment as compared to other natural disasters because it causes ecological destruction with a long recovery period (in some cases 40-80 yrs).

Indonesia Forest Fire – 1997

The fires that raged in Indonesia and blanketed South-East Asia with a choking haze were one of the worst forest fires of the decade. The smoke warted over parts of Indonesia, Malaysia, Singapore, Brunei, the Philippines and Thailand. About 10,000 fire fighters were deployed and worked around tlie clock. More than 50,000 people got treatment in Indonesia and Malaysia only. Children suffered greatly by tlie smoke and found it difficult to breathe. Even the monsoon rains couldn't stop the fires.

An Indonesian airplane crashed on 25th September 1997 in which 234 people were reported killed. This was also attributed to the thick haze and poor visibility in the area.

There was another accident on September 27, 1997 two days later. Due to the thick smoke enveloping the region, two cargo ships collided and one sank in the strait of Malacca in which 29 Indians died among others.

The amount of carbon dioxide emission and environmental impact on the whole region was indeed immense.

Wild Fire Risk Management

All effective fire Management Programme includes –

1) Prevention
2) Planning and Management
3) Incident Management Technique

Prevention

Prevention focuses on the factors that cause disasters and seeks to eliminate its effects.

In the context of India, tlie following factors should be taken into consideration for the sake of prevention of wild fires.

a) Agricultural traditions: Shifting cultivation in which a part of land is cleared by fire in order to use it for agricultural purposes (slash and burn or ZHUM)
b) The education level of tlie people
c) Attitude of the people towards environment, especially those people who either live in these forests or the forests form the means of livelihood for them.

Planning and Management

It focuses on developing plans to respond to a disaster once it threatens or lias occurred.

With proper planning and management, tlie impact of wild fires could be reduced to a great extent. This could be done by:

1) Zoning and Mapping of Vulnerable Areas: The areas prone to wild fire disaster should be identified.
2) Assessment of Fire Hazard : A complete assessment should be made with the help of volunteer force and available technology.

Fire Fighting

Fire can be fought principally by three methods of attack.

i) Direct Method: Where the effort is put directly on or immediately adjacent to the edge of fire. It is used for small and slow spreading fire where labour is able to work close to tlie edge of fire.
ii) Indirect Method: Where the control line is located along favourable topographic breaks or natural breaks and tlie area between tlie fire-edge and control line is burned off. It is useful where natural breaks (streams, ridges, rockslides or changes in cover type) occur. Less manpower is needed for this method and knowledge of terrain helps in location of control line and burnt area is limited by control line.
iii) Method combining the above two in various ways is also used.

Fireline Procedure

When working at the fire-edge:

i) fire should be attacked where it meets fresh fuel.

ii) Work should be facilitated by stamping out on burning debris which should be thrown into the fire, and non-burning one outside the fire.

iii) Fire guard (a trench) should be dug down to mineral soil.

iv) Logs or roots extending across the line should be cut and pulled into the burnt area to prevent fire escaping through them.

v) As a bare minimum, all snags, within about 70 meter of burnt area should be felled. Fire spreads overhead from snags to snags and then it becomes difficult to control. Snags should be chopped away from fire.

vi) Nonburning snags, in dangerous zone should be made fireproof by removing all debris around from them.

vii) Fires in snags should be suppressed by water (if available) or by mud.

viii) Any fire that has descended into the roots should be grubbed out.

ix) All surface fires within 80' metres of the fire line should be extinguished.

Education and Training

An education and training programme should be carried out. It can act as an effective tool for pre - and post-disaster planning and management. The community is to be divided into the following three groups for the education and training at the group level:

i) General Public

The general public should be made aware of and sensitised to the nature and causes of fires so that they could defend themselves by knowing the simple techniques of fire fighting in the event of large fires.

ii) Volunteers/Social Workers

Fire fighting needs trained volunteers and social workers in fairly large numbers. In fact, fires cannot be controlled without the assistance of volunteers from the community.

iii) Experts

Professionally qualified person, or group could be pre-selected for this purpose. This person or group should be trained and made conversant with the latest technology. Apart from that, the expert should be able to detect, evaluate and assess the damage caused by the fire and should also be able to manage relief operations.

Training Centres

Training centres should be established to provide practical training for the efficient application of the equipment, planning and implementation of wild fire control, and mobilisation of fire fighters.

Rapid Detection and Messages

Wild fire disaster mitigation can be achieved through rapid detection of incident and prompt passage of messages to control the centre of fire without any loss of time in dealing with the incidents.

Fire Brigade

It should be stationed near the hazard prone area. Fire brigades should be well equipped with modern equipment and the fire personnel trained in fire suppression methods.

Strengthening of Forest Staff

The pressure on the forests is mounting up due to increase in population along with the developmental activities. Hence, there is a need to strengthen the forest conservation staff to have effective patrol. During the fire season, additional staff need to be engaged to form "special squads" to deal with fire at the incipient stage to avoid any major incident.

Communication and Transport

An effective communication and transport system should be worked out and put in place so as to help reduce the effect of wild fires.

Incident Management Techniques

1) Nodal Agency

A nodal agency consisting of District Commissioner/District Magistrate should be formed to coordinate the activities of the various departments in case of a wild fire disaster. As soon as any information is received by the District Magistrate, the same shall be passed on to the District Fire Officer/Divisional Forest Officer as well as District Police Officer.

2) High Power Committee at the State Level

A High Power Committee should be constituted at the state level of the concerned departments under the chairmanship of the chief secretary to review the situation and make policy decisions.

3) Coordination Action Committee at the District Level

An Action Committee should be formed at the district level to take immediate actions in the disaster struck areas. This Committee should also be formed under the ,chairmanship of the District Commissioner/District Magistrate.

4) Stages of Action

Action Committee normally functions at three stages.

1.Alert 2. Preparatory 3. Operational

During the fire operations, first two stages would be declared simultaneously while the 3rd stage is declared as soon as the information is verified and the types of contingency are identified.

Types of Contingency

Three types of contingency can be verified by the District Commissioner/District Magistrate. These can be visualized as minor, medium and major.

1) Warning System

A proper warning system should operate to give warning and information to public. This would help in avoiding panic and ensuring that the public is

aware of the situation and take tlie necessary safety actions. Apart from that, authentic press notes to newspapers, All India Radio and TV should be given along with informing the people about the relief camps.

2) Setting up of Control Rooms

For better co-ordination and control of the situation following control rooms shall be set up.

a. District Control Room

b. Police Control Room and Fire Control Room

c. Departmental Control Room

3) **Depot Service**

All the service squads should be placed at the depots, which should be located close to hazard prone areas but in a safer zone.

Check Your Progress 1

Note: i) Use the space given below your answers
ii) Check your answers with those given at the end of this unit.

I) What are the types of fire?

2) Explain the causes of Wild fire.

3) What are the main methods of fire fighting?

19.2.2 Man-made Fire

The trend of rapid urbanization has led to increase in population in cities. As a result the pressure on land has increased, which has resulted in the overcrowding and unplanned growth in the cities along with serious fire-risks. This risk has further been increased with the expansion of industries and construction of high-risk buildings. The fast pace of city life coupled with problems of stress in distress situations can lead to violent/destructive or careless situations. As a result, the risk of violence and higher damage during fire situation is real.

Every year, due to these fire incidents there is a tragic loss of life and property. It is observed that most of these incidents generally occur during the summer season as the temperature is high and the conditions become favourable for fires and other such accidents to take place.

Types of Fires

Basically Man-made fires can be divided into two types.

1) Intentional
2) Unintentional

1) Intentional - It is a deliberate attempt to harm a community or an individual.
   a) Riots- Differences between people could result in arson and riots. Rioters often become uncontrollable and set fire to property. Fire in riots is thus responsible for a great loss of life and property.
   b) Terrorism - Terrorists terrorise people by exploding bombs in public places due to which fires are caused with widespread damages. The recent horrific event of September 11, 2001 in New York was, an extreme example of terrorist attack of unprecedented fury.
   c) Suicides by burning and thereby causing fires.

2) Unintentional - This is not a deliberate attempt but often it happens due to:
   a) Carelessness of Humans
   b) Accidents
   c) Violation of the Safety Norms

a) Carelessness of Humans

A large number of incidents take place because of the carelessness on the part of concerned people. Even elementary precautionary measures to avoid fires are neglected or not taken in time due to .carelessness. As a result a large number of people have to suffer for it. For example in ordinary households the following types of carelessness are noticed:

i) Carelessness on the part of housewives while cooking on stoves etc.
ii) Use of open flame lamps for lighting
iii) Storing of explosives/inflammable material in a house e.g.-crackers, kerosene, gas cylinders
iv) Smoking cigarettes in bed or throwing lighted ends carelessly
v) Not keeping children away from fire goods
vi) Burning of crackers during festivals and celebrations

vii) Unsafe electrical wiring/short circuit

viii) Generators working on diesel, wliich can catch fire and explode if these become very hot.

b) Accidents

Sometimes accidents are also responsible for occurrences of fire. Accidents are caused either due to the careless attitude of people involved or technical/mechanical faults.

i) During transportation of inflammable materials

ii) Air crashes/Oil tank spillover

iii) General vehicles accidents, which can also catcli fire.

iv) Explosions in industrial or chemical units.

v) Gas leaks which can cause fires

c) Violation of Safety Norms

Absolute safety from fires is not attainable in practice but it can be avoided through certain norms or standards, which if not violated can reduce the danger to a great extent. An attempt at the national level is made under section IV of the National Building Code, which deals specifically with fire protection.

The Code in its different parts deals with safety from explosions and fires. 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, tlie structural components and other restrictions and requirements necessary to minimize danger to life from fires, smoke, fumes and panic before tlie people in the building can be evacuated. The Code recognizes that safety of life is very important and accordingly deals with various matters, which are considered essential to the safety of lives.

Classification of Buildings and Non-buildings Based on Occupancy

a) Buildings

General Classification - All buildings shall be classified according to the use or character of occupancy in the following groups:

Group A		Residential
Group B		Educational
Group C		Institutional
Group D		Assembly
Group E		Business
Group F	-	Mercantile
Group G		Industrial
Group H		Storage
Group I	-	Hazardous

b) Non-buildings

Others - In non-buildings come the 'others', where tlie use might be the same as in the above mentioned groups but the building is not there e.g.- slums, temporary structures, camps etc.

Road Vehicles - Accidents occur which can cause vehicles to catch fire.

Dry Grass - Dry grass which can cause fire due to the carelessness of a passer by or a deliberate attempt to clear the place.

Railway Yard - The fire incidents might occur in Railway yards, where repair works are carried out.

Airports, Oil Depots Fire can occur where large quantities of highly inflammable fuel are stored.

Causes of Building Fire

1) Electric Short Circuits: Most of the fire incidents that occur are caused due to electric short circuits. This is mainly due to bad wiring or high voltage fluctuations in an area, or due to electric overloading by the users.

2) Naked Flame: Fire caused during cooking on a gas stove, cooking gas or traditional methods of burning wood. In all these cases, fires take place due to naked flame. The valves of the cooking gas cylinders are usually not shut off at night and gas leak can cause serious fire if a stray rodent cuts tlie rubber tube.

3) Spark/Heat: Sparks during high heat/temperature can cause fires.

4) Fire Works: Fire works during festival times can cause fires. Often fire accidents take place in fire work factories during the packing, transportation and selling period.

5) Intentional: Deliberate attempt by terrorists can cause fires in the buildings.

19.3 FIRE PROTECTION

1) All or maximum number of safety norms, given by National Building Code and the local bye-laws should be strictly followed.

2) The design, structure and material of the building should incorporate the adequate fire protection measures right from the beginning. It would also be necessary for this purpose to associate qualified and trained fire protection engineers.

3) Public must be made aware of the general fire prevention techniques and all the prescribed guidelines should be strictly followed. The Loss Prevention Association of India has issued very useful guidelines.

4) Carelessness and deliberate attempts made by human beings must be stopped by making strict rules arid implementing them so that the number of such incidents can be minimised.

5) Adequate manpower, equipment and facilities should be provided to fire stations,

6) New techniques for prevention, detection and fire fighting should be adopted.

7) Drills should be conducted at the required places to familiarize the people with actual situations that exist during tlie fire incidents so that tlie people can take appropriate action during the time of any fire occurrence.

8) Evacuation plan should be displayed, listed or placed at locations, where everyone can see it e.g. lifts, staircases etc., and can understand it easily once they enter tlie building.

9) The exit routes and exit gates should be clearly marked and should be easily approachable.

19.4 INSTRUCTIONS IN CASE OF BUILDING FIRES

If you discover a fire:

a) Break tlie glass of the nearest push button fire alarm and push tlie button.

b) Attack the fire with fire extinguisher provided on your floor.

c) Telephone the fire station.

If you hear the fire alarm:

a) Leave the building immediately.

b) Report to your fire warden at your pre-determined assembly point outside the building.

c) Do not use lifts if your are on a higher storey of the building but take the staircase to go out.

d) Do not go to the cloak room or bath room

e) Do not stop to collect personal belongings

f) Keep the lift, lobby and staircase door shut.

19.5 UPHAAR TRAGEDY - A CASE STUDY

It was the first time in the history of Indian cinema that a disaster of immense magnitude took place in Delhi at tlie Uphaar Cinema, which claimed the lives of 57 people and caused grave injuries. It led to the everlasting images of death, desperation and suffering in public memory. Innocent people who had gone to watch a popular film were trapped in a virtual gas chamber due to a fire. It was considered that this was clearly a case of tlie violation of fire safety norms along with carelessness on the part of various authorities and tlie staff/owners of the cinema house. But the well-educated victims also failed to take elementary action which could have saved many lives. For example, many ladies were carrying mineral water bottles as this was a hot June afternoon. Only if they had used wet handkerchiefs on their noses instead of getting panicky and wasting time on cell phones, many would have escaped asphyxiation deaths. This highlights the need for awareness.

Not only in Delhi where a daily audience of over two lakh people comes to watch movies in *66* cinema halls, but the people who flock the Cinema Hall in other cities everyday (estimated to be around 23 million). They are exposed to fire hazards (in 13,000 theatres across the nation).

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at tlie end of this unit.

1) Explain the types of man-made fire.

2) What are the causes of Man-made fires?

3) What are the instructions in case of building fires.

19.6 LET US SUMUP

Fire is a major and frequent hazard specially in urban industrial environment. It results in extensive loss to property and threat to lives. In this unit, we have tried to understand the various types of fire i.e. natural fire and man-made fire in detail and also the various causes of the same. Effective fire management techniques like prevention, planning and management and fire incident management techniques have been highlighted. We have also discussed some case studies which have thrown light on major fires.

19.7 KEY WORDS

Air Convection Current — Air, when it gets hot, rises up and cooler air from different sides takes its place. Thus convention currents develop in case of forest fire.

Combustible — Capable of burning easily

Fire Sensors — Small electronic devices that get activated and sound an alarm as soon as they perceive heat.

Inflammable	Capable of catching fire quickly and burning intensely.
Self-ignition	Catching fire by itself due to self-generated heat.
Smoke detecters	Small electronic devices that get activated and sound an alarm as soon as they perceive smoke particles.
Snags	Tree stomps

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19.9 ANSWER TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

   Natural Fire – wild fire and forest fire

   Man-made fires

2) Your answer should include the following points:

   Natural wild fire

   - Carelessness on the part of human beings
   - Deliberate causes

3) Your answer should include the following points:

   - Direct Method

   Indirect Method

Check **Your Progress** 2

1) Your answer should include the following points:
   - Intentional
   - Unintentional

2) Your answer should include the following points:
   - Electric short circuit
   - Naked flame
   - Spark/Heat
   - Fire works
   - Intentional

3) Your answer should include the following points:

In case of building tires you should know the:

- Telephone No. of Fire Station
- Operation of fire extinguishes
- Use of Fire alarms
- Nearest entrance and exit route
- Assembly point on the ground floor

UNIT 20 DAMAGE ASSESSMENT

Structure

20.0 OBJECTIVES

After studying the unit, you should be able to:

- define damage assessment and understand its objectives;
- describe the rapid damage assessment techniques; and
- highlight the detailed damage assessment methodology.

20.11 INTRODUCTION

Damage assessment is the process of determining the impact of a disaster. Damage assessment process includes the preparation of specific qualified estimates of physical damage resulting from a disaster. It may include recommendations concerning the repair/reconstruction of structures, replacement of equipment, and restoration of economic activities.

'20.2 RAPID DAMAGE ASSESSMENT TECHNIQUES

Damage assessment is a prerequisite for all disaster management practices, Assessing the level of damage is required at two basic levels of intervention. Firstly, for emergency relief measures, for which purpose a quick assessment of damage would become the basis for the amount of medical relief and food stocks to reach the disaster area quickly. At the second level, would be a detailed technical analysis of the damage for long-term restoration and rehabilitation works. From a long-term perspective, realistic damage assessment examines the mechanisms of failure that take place during the disaster. These studies are very useful for all future prevention and mitigation efforts regarding disasters.

The basic objectives of damage assessment are;

- to make rapid assessment of areas affected and the extent of impact, for the purpose of immediate rescue and relief operations,
- to prepare estimates for the amount and type of relief to be provided and mode of relief, in terms of food, clothing, medicines, shelter and other essential items,
- to make detailed assessment for long-term relief and rehabilitation planning, and .
- to identify focus areas for purpose of replication in similar situations.

- Identification of information needs and sources of reliable data;
- Collection of data;
- Analysis and interpretation of data;

Report writing;

Conclusion; and

Recommendations for planners and decision makers.

The official agency for reporting estimates of disaster damages is the Revenue Department of the State Government, as they arc also the authority for granting and distributing relief to the affected persons. As usual, there is a hierarchy of officials who report from the lowest level of villages/panchayats through blocks/revenue circles, tehsils/talukas, sub-divisions and finally to the districts. The basic items usually covered in the assessment report, as per the rapid assessment norms are:

- Name of sub-division
- Area in square kilometres
- Total number of villages
- Number of villages affected
- Total population
- Population affected
- Total number of panchayats
- Number of panchayats fully affected
- Number of panchayats partially affected
- In case of floods, areas still under water

Check Your Progress 1

Note: i) Use the space given below-for your answers
ii)Check your answers with those given at the end of this unit.

1) Define damage assessment and briefly discuss its importance.

2) What are the basic objectives of damage assessment? Discuss any two;

3) Highlight the rapid damage assessment technique.

20.3 DETAILED DAMAGE ASSESSMENT

Detailed damage assessment goes further than the rapid assessment, and it includes the following aspects of disaster damage.

i) Verified number of human lives lost

ii) Cattle last
   a) Number
   b) Estimated Value

iii) Details of damage to crops (in hectares) and estimated loss of produce (in rupees)
   a) Area completely damaged (Ha)
   b) Area partially damaged (Ha)
   c) Area likely to be replanted or resown(Ha)
   d) Extent of affected area in percentage
   e) Crops lost (quintals)
   f) Estimated value of crops lost (in rupees)

iv) Houses damaged or destroyed
   a) Number
   b) Estimated value

v) Loss to infrastructure, public works and utilities including property of local bodies
   a) Name of the work and utility
   b) Nature of damage
   c) Estimated value of damage
   d) Estimated cost of restoration work

vi) Rough estimate of the total financial loss in rupees
(Total of ii(b), iii(f), iv(b) and v(c))

20.3.1 Damage to Buildings

The damage caused to buildings by the various disasters may be categorized as losses under the following heads:

- The loss of the main building
- The loss due to failure of other components whose damage is attributed to the main building damage.
- Area covered by the collapsed structure
- Death or injury to life due to building collapse
- Loss incurred in terms of debris removal and restoration
- Loss of revenue during the idle non-work period

In addition to these, there would be socio-economic costs arising as a consequence of the disaster, which would add to the loss under the heads listed above.

Building damages, on the wider scale, usually are most relevant in terms of damage to houses, than other types of buildings. Damage to house property is estimated in terms of number of households, percentage of reported damage, and repair cost per household. This estimation is needed to be carried out for all houses, even under classified categories of 'Kutcha' Houses, 'Pucca' Houses, and "Semi-pucca" Houses. This is required in order to carry out a value based assessment.

Besides the house structure damage itself, there is also an aspect of household asset damage assessment, which has to be taken into account. Damage to house structure can cause resultant damage to household goods, artisan assets and other productive assets stored in the house. These need to be accounted for in terms of average value of damage per household (in rupees)

20.3.2 Damage to Land

Damage to land due to disaster could be short-term damage, as in land rendered useless temporarily due to coverage by debris of sand and loss of standing crops, or else it could be long term damage as in perennial flood, lava or ash deposit, or loss of productivity of land. The most important in the immediate post-disaster scenario is the aspect of agricultural loss through land destabilization.

Crop damage is assessed in terms of percentage of households reporting damage under the following heads:

i) Area damaged per household (ha)
ii) Production loss per hectare (quintals)
iii) Production loss per household (quintals)
iv) Value of production loss per hectare (Rs.)
v) Value of production loss per household (Rs.)

Besides the damage to direct land attributes such as crops, there is also a long-term impact on the productivity of the land itself, which is felt even after tlie disaster, mainly in case when the floods have receded. The long-term impact on crop production could either be favourable or unfavourable. Tlie favourable effect would be in the form of deposit of fertilising silt on land resulting in rise in soil fertility, which would manifest in crop yields or a better crop after the monsoon season due to water availability. Tlie unfavourable effects would be in tlie form of sand castings rendering the land unfit for cultivation. This generally affects tlie production of Rabi crops and winter crops after tlie floods. This effect can be assessed in terms of variation in production of crops after floods, as follows:

- Yield per hectare (quintals)
- Normal yield per hectare (quintals)
- Percentage variation in yield

20.3.3 Damage to Human Lives

The most disastrous and immediate impact on human lives is in terms of loss of lives by deaths that may occur due to the direct impact of the disaster, or through indirect impact as in case of building collapses, fires etc. Injuries are tlie second level of impact of disasters on human lives, and result from the same sources as deaths. The impact on lives in terms of deaths and injuries has to be estimated not only in numbers, but also in terms of the expenses incurred due to tlie death or injury, as also the loss of productivity of the persons affected.

In a longer term perspective, the impact of the disaster is also manifested in morbidity. Usually after a gestation period, which may be about two weeks after the disaster, diseases start to set in due to the insanitary living conditions and contamination of drinking water and food. The affected persons, who may be housed in makeshift relief camps, have no access to proper civic services, and as a result vector-borne diseases affect them, which may even take the form of an epidemic if it goes unchecked. Once again, the impact of the sickness due to disaster is felt in terms of expenditure on treatment and loss of employment during the sickness period. This may be assessed under the following Izeads:

i) Total number of sample households

ii) Percentage of households reporting sickness

iii) Average number of persons reporting sickness per household

iv) Average duration of sickness (Days)

v) Average expenditure on treatment per household (Rupees)

vi) Average employment lost per household (Days)

vii) Average loss of income per household (Rupees)

Besides the physical impact of death, injury and morbidity, and their resultant financial implications, there is also a purely economic impact on human lives, which is in terms of loss of employment due to dislocation and disruption ,of routine activities due to the disaster. For assessment of this impact, it is necessary to first collect information on the total number'of households, number of households reporting wage employment, and average number of wage earners

per household in the affected area. An inventory has to be prepared to enumerate the following factors.

- Average employment days per household
- Average monthly earnings per household (Rupees)
- Average monthly earnings per earner (Rupees)

These factors have to bc accounted for in the disaster scenario context, as factual figures in the post-disaster scenario, as well as in a situation of no disaster. The comparison of these two scenarios would give a gross loss in employment due to the disaster.

The loss of employment can be further classified according to the nature of skill or employment in a typical regional setting, the classifications adopted could be:

- Agriculture
- Dairying

  Fisheries
- Non-agricultural Labour
- Artisans

  Business/Trade

  Service
- Others

20.3.4 Damage to Livestock

The damage to livestock, namely cattle, other animals and poultry, which is a very important asset in rural households, is generally assessed in terms of the number of households reporting loss, and the per household value of livestock lost (Rupees). It is generally observed that loss of livestock takes place because they are not moved out at the time of disaster threat, or else because people flee the area, leaving their livestock tied up or enclosed, with no means of escape. In this light it has been observed that in case of floods, the loss of livestock is usually low in the areas with high flood zones, because the people expect a disaster, and move out their livestock in time. Losses are high in low flood zones where severe floods are not so frequent, and when they come, they take the people by surprise, and they are not able to move out their livestock in time. The loss in fishery is also often the result of floods and cyclones.

Check Your Progress 2

Note: i) Use the space given below for your answers
ii) Check your answers with those given at the end of this unit.

1) Briefly describe the essential elements of detailed damage assessment.

2) "Besides the house structure damage itself, there is also an aspect which has to be taken into account while assessing damage to house property". Discuss.

3) How is crop damage assessed? Mention any three heads under which crop damage is assessed.

20.4 LET US SUM UP

This unit has dealt with damage assessment as an important tool for knowing the extent of a disaster's impact, and the basis for immediate rescue and relief operations, as well as long-term rehabilitation and retrofitting programmes. However, in order that this could be really effective, damage assessment has to be realistic. Rapid damage assessment techniques have been identified and briefly described. Detailed damage assessment for long-term relief and rehabilitation planning has also been discussed.

20.5 KEY WORDS

Assessment is a survey of a disaster area to make estimates of damages and recommendations for necessary relief actions.

Damage Assessment is a post-disaster estimate of physical, human and economic damage.

Ha: Hectares

Replication: Reproducing the same at another place or time.

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20.7 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- Damage assessment is the process of determining the impact of a disaster on specific society.
- Damage Assessment is an important tool to assimilate and document the extent of impact of a disaster.
- It forms the basis for disaster management actions.

2) Your answer should include the following points :-

- The basic objectives of damage assessment are:
  - i) to make rapid assessment of areas affected and the extent of impact, for the purpose of immediate rescue and relief operations.
  - ii) to prepare estimates for account of immediate relief to be provided and the mode of relief in terms of food, clothing, medicine, shelter etc.
  - iii) to make detailed assessment for long-term relief and rehabilitation plans, and
  - iv) to identify focus areas for replication in similar situations.

3) Your answer should include the following points :

- The official agency for reporting estimates of disaster damage is the Revenue Department of the State Government,
- Dalnage assessment process includes:
  - i) Identification of information needed for data sources
  - ii) Collection of Data
  - iii) Analysis and interpretation of data
  - iv) Report writing
  - v) Conclusion
  - vi) Recommendation
- The Report should include:
  - i) Name of Sub-division
  - ii) Area in square kms.
  - iii) Area affected in sqs. kms.
  - iv) Total number of villages
  - v) Total number of villages affected
  - vi) Total population
  - vii) Population affected

viii) Total number of panchayats

ix) Number of panchayats fully affected

x) Number of panchayats partially affected

xi) In case of floods, areas still under water

Check Your Progress 2

1) Your answer should include the following points :

- The essential elements of detailed damage assessment include the 'following:
  - i) Verified number of human lives and cattle lost.
  - ii) Details of damage to crops and estimated loss of production.
  - iii) Houses damaged or destroyed.
  - iv) Loss to infrastructure, public works and utilities including property, local bodies, and
  - v) Rough estimate of total loss in rupees in all the above items.

2) Your answer should include the following points :

- Besides the house structure damage itself, there is also an aspect of household asset damage whicli has to be taken into account.
- Damage to house structure can cause resultant damage to household goods, artisan assets and other productive assets stored in the house.
- Above mentioned damages need to be accounted for in terms of average value of damage per household.

3) Your answer should include the following points :

- Crop damage is assessed in terms of the following heads:
  - i) Area damaged per household.
  - ii) Production loss per household, and
  - iii) Value of production loss per household.

UNIT 21 COMMUNITY HEALTH DURING DISASTERS

Structure

21.0 OBJECTIVES

After studying this unit, you should be able to:

- explain how disasters affect the health of communities at risk;
- describe the direct and indirect health problems that arise as a consequence of disaster situations;
- highlight the types of health hazards and injuries that may occur during or due to disasters of varying kinds;
- describe the types of essential medical equipment and stores necessary to mitigate the aftermath of disaster; and
- define a set of guidelines to draw a long-term plan for mitigation of effects on health from disasters.

21.1 INTRODUCTION

Disasters often occur all of a sudden and are mostly unplanned, unintended and unexpected. Lack of adequate preparedness or severity of disaster may lead to a huge loss of human and animal lives, injuries to people and cattle and damage to or loss of property.

Whatever be the type of natural disaster, the communities at risk have to bear the brunt of it and strive to limit the consequent damage with courage and fortitude within its local resources in the first few hours or days till outside help arrives.

Disasters. often cause high incidence of mortality due to injuries, drowning, electrocution etc.. and morbidity due to total or partial loss of basic sanitation facilities viz., water supply, sewage disposal system, food shortages, failure of electricity, telecommunications and even road and rail traffic. Damage to civil property and personal lives could sometimes be enormous. Dead cattle, pets and wild animals add to the problems. It is, imperative that these burgeoning problems must be clearly understood fully, addressed and prevented to the extent possible.

21.2 HEALTH IMPLICATIONS OF DISASTERS

The post disaster deaths and injuries are a direct consequence whereas morbidity due to variety of factors is an indirect impact on the health of the community affected. Hence the effects of disaster can be classified as :

i) Direct **Health** Consequences : Injuries and deaths to people or animals

ii) Indirect Health Consequences: Eruption and Transmission of communicable diseases due to contamination of water and food supplies, disrupted sewage disposal system, over crowding and poor environmental sanitation.

21.2.1 Direct Wealth Consequences

Deaths and injuries are a common consequence during tlie sudden onset of natural disasters like earthquakes and flash floods. Tlie mortality can be as high as 10% of the population at risk, and much more in some cases as was witnessed after tlie Orissa super cyclone (1999) and Bhuj earthquake (2001).

Disasters cause damage to life, which depends upon many factors such as (a) type of construction of houses, (b) tlie time of occurrence and (c) tlie population density. Yet it has been found that certain sections and age groups are more vulnerable than others. The highest incidence of direct health consequence falls upon these vulnerable sections. It is found that children below 5 years of age (17% to 20%), pregnant and lactating mothers (3% to 5%), old age group (8-10%) are more vulnerable and account for 28% to 35% of the vulnerable population.

The most common injuries sustained by tlie affected population are fractures, hemorrhages, shock, lacerated wounds and burns. Injuries to bone viz. Tibia, Fibula, Radius, Ulna and skull occur most commonly. Spinal injuries and fractures of pelvis alone constitute about a twelfth of all injuries.

During earthquake hospitals are cramped with patients who normally remain there for a week (1-7 days). The maximum number of casualties is received in hospitals within tlie first 2 days (24 to 48 hours) of occurrence of a disaster. During floods and storm surges many deaths occur due to drowning but the incidence of injuries are relatively less.

21.2.2 Indirect Health Consequences

Disasters of many kind cause diseases, disabilities and morbidity in their wake. The potential for transmission of communicable diseases increases manifold. It has been observed that transmission of water and food borne diseases occurs within two weeks of the disaster. Tliis is often due to faecal contamination of food and water. Other contributory factors are endemic level of disease, population density, population displacement and disruption of ongoing public health programmes.

The potential for transmission of vector borne diseases like malaria also goes up very much. Vector borne diseases generally occur by tlie third or fourth week of occurrence of a disaster. This is due to disruption of vector control methods, washing away from buildings of residential insecticide, increase in vector breeding sites, and increased vector-human contact.

Other diseases, which rate very high during droughts and floods, are on account of malnutrition and secondary infections that arise due to loss of body resistance to disease. These conditions are aggravated due to poor environmental sanitation around temporary shelters and campsites. Garbage disposal, drainage system and

public latrines are almost always absent or very poorly managed leading to increased fly breeding and further aggravation of food and water borne disease transmission.

Psychiatric and social maladies have been abundantly reported soon after disaster. Sudden mental sliock due to death and destruction all around can create serious mental depression. Incidences of sexually transmitted diseases (STD) and AIDS have been reported among victims of Latur earthquake.

Check Your Progress 1

Note: i) Use tlie space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) List the direct health consequences of disasters on the community.

2) What are the indirect health consequences of disasters?

21.3 COMMON HEALTH PROBLEMS AND INJURIES DURING DISASTERS

The most common health problems and injuries that occur during disasters such as tlood, cyclone and drought are water borne diseases like diarrhea, dysentery, typhoid, viral hepatitis; malnutrition, respiratory diseases such as pneumonia, whooping cough and other diseases such as, chicken pox, measles, gastroenteritis, cholera, conjunctivitis, fever, etc.

The commonly occurring injuries during earthquake and fire are head injuries, injuries to face and neck, abdoniinal injuries, hemorrhages, fractures, shock, and burns.

21.4 ESSENTIAL MEDICAL EQUIPMENT AND STORES REQUIRED

Even as the disaster strikes, there is an immediate need for medical equipment required to treat the disaster victims. Medical equipment such as syringes, needles, scissors, thermometer, stethoscopes, sphygmomanometer, oxygen masks, oxygen cylinders, first aid boxes, gloves, bandage, cotton, towels, disinfectant, sterilizing equipment etc. are immediately required.

21.5 PLAN FOR MITIGATION OF DISASTER HEALTH PROBLEMS

While drawing up a mitigation plan for disaster related health problems, it should be ensured that the community for which the planning is being carried out becomes equal partner right from the inception stage. Failing the involvement of the population at risk, the plan, howsoever efficient would not succeed. The plan should be as composite as possible. All related sectors must be involved, represented and participated. The plan should be necessarily a long-term plan. Some suggested guidelines for a long-term plan are given below:

21.5.1 *Guidelines* for *a Composite, Long-term Disaster Wealth Plan*

A composite plan for mitigation of medical and health related problems arising out of any natural disaster should cover the following broad headings:

Community profile;

Plan of action;

Resource planning;

Training plan;

Allied planning;

Periodical practice

Post practice evaluation of plan and consequent modification thereof; and

Collaboration and coordination with allied agencies and neighborhood areas.

The information to be included under each of the above mentioned headings of the long-term plan for a community are listed below:

Community Profile

Community Database which should include the total population and the vulnerable population in view. Likewise the age distribution, sex distribution, the socio-economical, educational and. cultural distribution in the population/community is to be considered. The cattle and pet population also should be documented.

Disaster Scenario describing the incidence, periodicity, magnitude, epicenters and vulnerable areas.

Population at Risk highlighting the age distribution of the population at risk, the incidence and mortality rate of the vulnerable population.

Disease Profile giving the endemic and other likely diseases, past history of disease breakout or aggravation in the wake of disasters.

Plan of Action

Prevention of Risk by the provision and monitoring of basic immunization, prevention of epidemics by specific immunization, water and food sanitation, prevention of the break of communicable diseases, prevention of mosquito and fly infestation.

Promotion of Health by way of nutritional intervention, environmental hygienic, maternal care, infant and childcare, and geriatric care.

Specific treatment which includes the early diagnosis and treatment of the primary cases, chronic and acute cases.

Medical Rehabilitation including the medical, psychological and social set up of the affected population and vulnerable groups.

Disposal of the dead. This is a sensitive task. Due care needs to be taken to protect the dignity of the dead and the sentiments of the community.

Resource Planning

Health manpower resource planning such as the availability of doctors, nurses, para-medical staff and above all, able bodies volunteers.

Medical stores & equipment such as drugs, medical and surgical appliances, diagnostic aids, sterilization equipments, etc.

Logistical requirements such as fuel and oil, lighting equipments, tents, beds or floor covering linen, pillows and mattresses, materials for cleaning and sanitation, storage equipment like ration, water, buckets, mugs.

Ambulances

Medical facilities such as primary health centre, hospitals, nursing homes, mobile centres etc.

Food and water including cooking and heating arrangements.

Training Plan

Traning of the manpower such as doctors, nurses, paramedicos, and attendants.

Administrators and other related sectors including block development officers, police, fire and civil defence personnel, village pramukhs, administrators at all levels.

Health education to the population at risk, schoolteachers, women folk, and local volunteers.

Allied Planning

Available local administrative support (municipal, pancliayat);

Involvement of NGO's and voluntary groups;

Commitment and allocation of funds;

Involvement of educational institutions, industrial establishments, banks locally and nearby;

Formation of area level functional bodies and earmarking of their specific tasks and responsibilities;

Establishment of communication channels;

Establishment of alternate sources of energy;

Cooperation of media for publicity and promotion of public awareness;

Plan for rehabilitation;

Periodical practice of the long-term plan. Periodical practice drills should be an essential feature of the plan;

Post practice evaluation of plan and consequent modifications thereof. This will ensure that the plan is always ready for implementation at short notice.

Collaboration and coordination with allied agencies, and neighborhood areas. This is essential in case where the impact of disaster is severe enough to disable the local arrangements and immediate assistance from neighborhood areas in required.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) Briefly state the common health problems and injuries during disasters.

2) Mention the components of the long-term plan for the mitigation of health problems emanating from the occurrence of disasters.

21.6 LET US SUM UP

Disasters often occur suddenly and without warnings. A high incidence of mortality and morbidity is caused by such events. The quantum of loss of life, injuries and loss or damage to property will be directly proportional to the type and quality of houses, population density, time of occurrence and severity of disaster. All disasters result in serious health problems for the community.

The health related effects of disaster can be the direct consequence of the disaster leading to injuries or deaths or indirect ones where high mortality will be due to transmission of communicable and vector borne diseases. Lack of proper environmental sanitation and immediate medical aid aggravates the problems.

It is important to draw up a long-term composite multi-sectoral disaster-health plan where the population at risk has full representation and expression in planning and its execution.

21.7 KEY WORDS

Hemorrhage	Excessive bleeding
Morbidity	Unhealthy state, condition when disease is prevalent.
Mortality	Loss of life; deaths
Communicable Diseases	Diseases that are directly or indirectly transmissible from one individual to tlie other
Lacerated	Badly cut or torn
Orthopedic	A branch of surgery dealing with all matters pertaining to the bones.
Tibia, Fibula, Radios, Ulna :	Name of different bones

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21.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:
   - Death of persons and cattle
   - Injuries

2) Your answer should include the following points:
   - Increase in the communicable diseases
   - Spread of vector borne diseases
   - Mental depression due to shock and trauma
   - Incidence or increase in diseases like STD and AIDS in the post-disaster period

Check Your Progress 2

1) Your answer should include tlie following points:
   - Common health problems during disasters are diarrhea, dysentery, typhoid, cough, pneumonia, cholera, and conjunctivitis.
   - Common injuries during disasters are: Head injuries, fractures, hemorrhages, shocks, burns.

2) Your answer should include the following points:

- Community Profile
- Plan of action;
- Resource planning
- Training plan
- Allied planning
- Periodical practice
- Post practice evaluation of plan and
- Collaboration and coordination with allied agencies and neighborhood areas

UNIT 22 EMERGENCY HEALTH OPERATIONS

Structure

22.0 OBJECTIVES

After studying this unit, you should be able to:

- describe the nature and scope of disaster medicine;
- highlight the approach of save a 'life or limb' during rescue and resuscitation of victims;
- explain how to allot priorities for emergency treatment vis-a-vis victims, seriousness of health state and chances of survival; and
- highlight the need to train local, population to render correct first-aid for life threatening situations during and outside a disaster situation.

22.1 INTRODUCTION

Whatever tlie type of disaster, it leaves in its wake depending upon its severity, a state of fear, panic, death, disability and disease among the population at risk. The ensuing mortality and morbidity are directly proportional to tlie extent and magnitude of tlie disaster event, its proximity to tlie effected community, population density, time of occurrence and the state of preparedness in the community.

The types ,and severity of injuries, disabilities, diseases, and numbers of death are largely specific to the types of disaster. As such there is a need to enhance the preparedness of tlie community by imparting knowledge of preventing casualties and damages arising as a consequence of any disaster, and to facilitate treatment through first aid and emergency health operations.

22.2 DISASTER MEDICINE

Disaster medicine relates to the task of preserving health and preventing deaths, disabilities and diseases that occur as a consequence of natural or man made disasters and minimising them to the utmost. Promoting health, prolonging life and medical rehabilitation of victims of disaster along with organised community support brings about a rapid return to normal in tlie aftermath of a disaster event and also helps mitigate the long-term adverse impact of any disaster. Environmental sanitation, control of epidemics of communicable diseases, ensuring safety of drinking water and food supplies and immediate medical attention are important aspects of disaster medicine. .

Early availability of efficient medical, para-medical and nursing services helps to ensure quick diagnosis and rapid and prompt treatment during disaster situation. Creating an able bodied and motivated volunteer force from the Iocal communities and educating and training these volunteers in health and hygiene matters as well as rendering correct first-aid will greatly assist in limitation of diseases, disabilities and deaths during disaster situations.

22.3 MANDATORY COMPONENTS

(a) Rescue

The principle of 'SAVE A LIFE OR LIMB' should be efficiently employed during rescue, resuscitation, first-aid and emergency medicare. The first life saving procedure is 'Rescue' of victims of disaster without aggravating the existing damage to their health and safety. Rescue operations often become haphazard and hazardous due to fear and panic that grips nearly every unprepared individual during a sudden disaster event. Hence through prior training, education and mock exercises among the local population and by encouraging large-scale community participation in disaster limitation planning, more lives could be saved and disabilities limited. Rescue may be necessary when the individuals are:

- trapped under the ruins of collapsed buildings;
- buried under mud or landslide;
- cut off due to floods or damage to communication routes.

The rescue parties must observe the following rules:

- do not trample over ruins;
- do not remove rubble unless one is sure of not causing further collapse of building or structure;
- use manual method of removing the rubble;
- use of the spades and pickaxes should be very careful of persons trapped underneath, gas and water pipes and high voltage electric cables.

(b) First-Aid

As soon as a victim who is buried under the debris is noticed:

- ensure free supply of natural air; avoid using fans or exhaust for this purpose.
- if victim can be reached, clear his throat using your fingers. Remove dentures if present.
- loosen collar, shirt buttons, and belt; remove shoes and socks.
- use blankets to keep the victim warm.

Once rescued, the victims of disaster may be found injured, bleeding, in a state of shock or unconscious. A quick physical examination can largely indicate the exact cause of infirmity. The victim may need resuscitation, stopping of haemorrhage, prevention of impending shock and its management, location and immobilisation of fractures using body support, splints or improvised artifacts. The collective aim of all such resuscitatory measures is to enable transport of a victim to the nearest medical facility in as stable a state of health as achievable, and without any further injury. .

(c) Emergency Medicare

'Cardio-pulmonary Resuscitation' (CPR) of victims of heart and respiratory failure is another important component. These procedures are simple and easily understandable by an average literate person, housewives, and school children. Some training and practice are of course necessary.. Deaths due to heart attacks, electrocution, drowning, accidental ingress of foreign body in tlie windpipe, can be averted by timely rendering of CPR through trained hands.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) What do you understand by disaster medicine?.

2) Explain briefly the mandatory components of Disaster Medicine to be followed during disasters.

22.4 TRIAGE AND EMERGENCY TREATMENT

'Triage' in its simplest form means SORTING of patients. The purpose of triage is to assess the severity of infirmity along with chances of survival, accord an appropriate category and ensure correct attention quickly thereafter.

When a large number of injured people are brought at the samc time to the health establishments, triage becomes necessary. Experts among the local health personnel make a quick but careful assessment of all cases and categorisation is done in the following manner:

A) Those who must be sent urgently to the nearest hospital on account of acute cardio-pulmonary insufficiency, severe hemorrhage, internal bleeding, severe burns, shock, skull injuries, rupture of liver, spleen and other serious conditions.

But before being sent to a hospital, many victims in life threatening situations, arising as a consequence of disaster situation, may necessitate minor surgical interventions or immediate medical attention on tlie spot. Deep and profusely bleeding wounds may require exploration of wound and lighting tlie bleeding vessel. Multiple fractures of long bones may entail careful immobilisation.

Head injuries will need specialised management and handling of the victim. Electrocution, drowning, foreign body impaction in the windpipe (trachea) and a hoard of other emergencies may occur and must be handled with extreme care and skill. It is therefore imperative that the local medical personnel must be given detailed training and some experience at the causality department of large hospitals in handling emergencies like haemorrhage, shock, respiratory distress, cardio-vascular failure, skull injuries, multiple fractures, dislocations, burns, electrocution, drowning, accidental hypothermia.

B) Those cases who are very serious but have apparently less or no chance of survival. These cases are given immediate medical attention on the spot.

It is important that the local healthcare personnel as well as members of the community have a good knowledge of location and functions of definitive treatment centres. Referring of victims to correct hospitals will ensure proper treatment without wastage of time in cross referrals. The local healthcare personnel must also be prepared for the possibility of disruption of roads and all other means of communication for upto 72 hours. During this period they must rely solely on their own skill and resources.

C) Those with minor injuries are treated on the spot (but separately from those in the category B above) by First-Aid personnel and sent home or to the relief camps.

22.5 PROTOCOL OF FIRST-AID

Disasters bring about injuries and other serious health maladies in large numbers of individuals. The first-aid team must make a reconnaissance of the area in order to assess :

- the likely number of causalities;

  the nature of injuries;

  the presence of local hazards e.g. fire, floods, live electric wires, escape gases.

General Principles of First-Aid

The general principles of first aid are:

- Rescue and removal of the casualty in the shortest possible time without aggravating existing health situation.

  First aid should be confined to essentials only.
- Immediate arrest of hemorrhage.
- Restoration of respiration and circulation.
- Prevention of impending shock and treatment of shock if the victim is already in such a state.
- Immobilization of simple and compound fractures and dislocations.
- Alleviation of pain by simple procedures and medication.
- Assurance of getting well quickly to the victim and morale boosting.

Cheek Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) How is triage important for emergency treatment?

2) Briefly explain the principles of first aid during disasters.

22.6 LET US SUM UP

Prevention of deaths, disabilities and diseases, as a consequence of any disaster is of paramount importance. Timely and correct first aid and emergency treatment help achieve this aim.

Promotion of health, prolonging of life and rehabilitation of victims of disaster is an important health management factor. Effective rescue of victims, resuscitation, first aid and efficient treatment are valuable tools to achieve these objectives. Training of local health personnel and volunteers from the community at risk, in rendering first-aid and emergency treatment during disaster situations, till some outside help becomes available is a mandatory requirement.

Adequate attention to environmental sanitation, safety and safeguard of water and food sanitation and precautions against the spread of communicable diseases must be organized with full support and participation of the local community.

22.7 KEY WORDS

Denture		Artificial teeth
Resuscitation		(To revive) to restore life, one who is apparently dead, collapsed, shocked or unconscious; artificial respiration.
Communicable Diseases	:	Diseases that are directly or indirectly transmissible from one individual to another.
Hemorrhage escape		Bleeding from a blood vessel as a consequence of an injury or operation.
Immobilization		Limiting or arresting the movements of any joint of tlie body, especially limbs by using body support or splints.

Cardio-Pulmonary	Any event where heart and lungs are involved. The primary disease focus may be in the heart and involvement of lungs may be secondary phenomenon.
Hypothermia	A state of abnormally low body temperature. This state is produced artificially in surgery of brain or heart. It can accidentally occur by drowning in cold water or occur in extremely cold conditions.

22.8 REFERENCES AND FURTHER READINGS

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PAHO, Emergency Health Management After *Natural* Disasters, Washington DC.

22.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- Disaster Medicine relates to tlie task of preserving health and preventing deaths and injuries due to disasters
- Disaster Medicine medical preparedness in the pre-disaster phase and medical attention during disaster and in the post-disaster phase.

2) Your answer should include the following points:

- Rescue
- First-aid
- Emergency Medicare

Check Your Progress 2

1) Your answer should include the following points:

- Triage helps in sorting of patients according to the severity of their injuries received due to the occurrence of disasters.
- The sorting of patients helps in prioritizing medical attention by first rendering medical treatment for those injuries which are of emergent nature such as hemorrhage, shock, respiratory distress, cardio-vascular failure, skull injuries and likewise.

2) Your answer should include the following points:

- Immediate rescue and removal of the casualty
- Restoration of respiration and blood circulation
- Immediate treatment of hemorrhage, pain, and dislocations
- Immobilization of fractures with splints
- Prevention and treatment of shock
- Assuring the victim and boosting his or her morale.

UNIT 23 DRINKING WATER

Structure

23.0 OBJECTIVES

After studying this unit, you will be able to:

- describe the sources of water supply and the requirements of drinking water; highlight the water borne diseases;
- explain the methods of purifying water; and
- pinpoint the water supply requirements in emergency situation.

23.1 INTRODUCTION

Water is essential to maintain life. It is the basic necessity of life for human beings, animals and plants. Thus the availability of water, adequate in quantity and of desired quality is essential for survival. It is very important that the water required for the human consumption must be free from unwanted impurities and harmful chemical compounds of bacteria. In order to ensure the availability of sufficient and good quality water to the community, it becomes utmost necessary to plan and design the water supply system carefully to ensure potable water. The water supply systems must be designed to withstand adverse effects of the emergencies created by the various types of disasters.

In the aftermath of any disaster, the immediate need of the situation is to provide sufficient potable water to the affected population. By providing potable water various problems like spread of epidemics can be avoided. In the present unit, we will study the water supply requirements and various water-borne diseases in the context of disaster situations.

23.2 WATER SUPPLY SOURCES AND WATER RESOURCES

The basic source of all fresh water is from precipitation, which may be in various forms such as rain, snow, hail, and dew. This from the atmosphere may either remain on surface or go underground. Our requirements of water are met from these origins, The surface and sub-surface sources of water is categorized as follows:

1) Surface Sources

a) Ponds and lakes

b) Streams and rivers

c) Storage reservoirs

2) Sub-Surface/Underground Sources

a) Wells and tube wells

b) Springs

In the surface sources of water supply, the water drawn from lakes and reservoirs is considered most safe, due to settlement of suspended materials usually present in the water. However, still water standing for long periods in lakes encourages the growth of algae, weeds and other vegetation in the water. These usually contribute to the development of bad smell, taste and colour to the water. Similarly the quality of water obtained directly from rivers is usually not useful for direct human consumption due to the presence of silt, sand and other suspended solids. Harmful bacteria and unwanted chemicals could also be present in such waters. The practice of discharging untreated sewage into the river increases such impurities in the water. Thus the water from majority of surface sources could be contaminated and cannot be used without treatment or purification.

Rivers and streams are the most important sources for public water supply schemes. The importance of water from quantity viewpoint had been recognised for a long time now. That's why most of the present urban centres grew up on the banks of major rivers which enacted continuous and regular wate'r supply to the inhabitants. In most of the rivers the quantity of water flow is not constant round the year but is based upon various factors including seasons. Thus to overcome this problem and to ensure a regular supply of water, a barrier in the form of a dam is constructed across the river to store the excess water that flows during the monsoon season. The pool so created upstream of a dam constitutes the storage reservoir. Smaller reservoir may also be termed as artificial lake.

The sub-surface sources of water are based on rainwater that percolates down to be stored inside the earth. The water, which is so stored inside the earth in the form of ground water reservoirs, constitutes the major source of sub-surface water supply. Underground water is generally pure because of natural filtration during the percolation process. This type of water is expected to be free from the presence of harmful bacteria but may have higher quantities of dissolved inorganic/organic compounds depending upon the geological formations of the region. The underground water may be brought unto the surface by some natural phenomenon like springs etc. or through some artificial means such as by constructing wells and tube wells.

Table 1: Describes the possible pollution of water sources and the remedial measures.

Pollution in water sources and the remedial measures

Water Source	Possible Pollution	Suggested remedial Measures.
Dug wells	Contamination by nearby water discharges; surface water pollution through lining, cover slab, or manhole	Sanitary conservation of nearby arqa, sealing of leaks, chlorination of supply
Tube wells	Entry of pol luted drainage due to improper sealing at top, liquid water discharges in the vicinity	Sanitary conservation of the area, sealing of the top and at ground level with a concrete apron, emergency chlorination.

Infiltration wells and galleries in river beds	Raw water access through leaky lining and cover slabs, short circuiting through deep underground water channel	Closing holes and filling up leaks, and chlorination of the water supply
Natural streams and springs	Access near point of intake for human and animals; pollutional discharges upstream; irrigation works or cultivation nearby	Sanitary conservation of the area, emergency chlorination at the intake point.
Lake or reservoir	Drift of pollution by wind; access to intake point for people and animals; fishing, boating, swimming, and wading activities; picnics on marginal land and shores; habitations, manure pits, and agricultural operations in the nearby catchment areas; inadequate policing.	Restrictions and treatment to be decided by the bacterial purity of the water at the point of intake; sanitary conservation of the nearby watershed area; routine post-chlorination treatment. Regulatory measures for picnic uses.
River flows	Liquid waste discharge upstream of the intake point and chemicals in the return flow from irrigation, sewage farms, dumping grounds, the growing of crops in the river bed above the intake point during periods of reduced flow; fairs and festivals near the river margin; laundry, washing, and ferry activities just above the intake point.	Corrective steps to avoid, to mitigate, or to minimize the pollutional load at the point 'of intake depending on discharges into the river and the "extent of contamination" in the nearby watershed; pre-chlorination during emergencies; routine post-clilorination treatment. Enforcement of pollution control regulations strictly.
Raw water transmission	Route and mode of conveyance should be chosen to avoid additional pollution during transmission	Open canals should be protected in accessible reaches against contamination; cross drainages, if any, should be diverted
Treatment plant	No part of the plant should be affected by contamination from any sewage or sludge near the area	All quality assurance measures .should be followed strictly

Source: Based on 'Guide to simple measures for the control of enterie diseases'. WHO, Geneva. 1974.

Check Your Progress 1

Note: i) Use the space given below for your answers.

ii) Check your answers with those given at the end of this Unit.

1) Describe the water supply sources'?

2) Explain the remedial measures for removing pollution in water sources.

23.3 DRINKING WATER PURIFICATION

Proper selection and protection of water sources are of prime importance for safe drinking water supply. It is always wise and economical to protect water sources from contamination than to treat the water after it gets contaminated. Prior to tlie selection of water supply sources it is very important to ensure the satisfactory quality and quantity of water. The water sources must be protected from human activities, which may contaminate tlie water. Activities like mining, quarrying, hazardous waste dumping, agricultural use of fertilizers and pesticides and recreational activities must not be allowed around the water source. In practice, it is very difficult to protect sources like rivers but all efforts should be made to keep away the various sources and activities which may contaminate the river waters.

It is very important to purify/treat tlie water before distribution to community. The extent of treatment required to be given to the water, however, depends upon tlie qualities of available raw water and the quality requirements prescribed for the intended use.

The basic purpose of water treatment is lo protect the consumer/user from pathogens and impurities in water that may be offensive or injurious to human health. The water treatment systems for urban water supply schemes mainly involve following stages:

1) Pre-Treatment
2) Sedimentation aided with coagulation
3) Filtration and
4) Disinfection

1) Pre Treatment of Water

The pre treatment of water consists of storage or disinfection of river waters. Most of the suspended impurities have to settle down under gravity during the storage process. The microbiological quality of water also improves during the

impoundment of water in lakes or reservoirs, especially when combined with the exposure to ultraviolet radiation of sunlight. Pre-disinfection is usually done when water is abstracted and treated without storage. This process destroys or reduces harmful faecal bacteria and pathogens. Another important objective of pre-treatment or pre-disinfection is to reduce the amount of ammonia in the water.

2) Sedimentation aided with coagulation

The very fine suspended mud particles and colloidal matter present in water cannot settle down during the pre-treatment impoundment of water in the sedimentation tanks. These particles can easily be removed by increasing their size by changing them into flocculated particles. For this purpose certain chemical compounds like aluminum sulphate, ferric or ferrous sulphate and ferric chloride are used. These compounds commonly known as coagulants on thorough mixing, form a gelatinous precipitate called floc, which absorbs and entraps the very fine mud particles, colloidal matter, and mineral particles present in the water, This can bring about a major reduction in turbidity and in the numbers of pathogens. This process of adding and mixing of chemicals is called coagulation. The coagulated water is then made to pass through sedimentation tanks to remove the flocculated particles after proper settlement.

3) Filtration

Even after the pre-treatment and sedimentation aided with coagulation processes, water may contain some very fine suspended particles and pathogens. To remove or to reduce the remaining impurities still further and to enhance quality, the water is filtered through beds of fine granular materials such as sand. This process of passing the water through beds of such material (called filters) is known as filtration. The filtration process helps in removal of colour, odour, turbidity and pathogens from the water.

4) Disinfection

Disinfection is the process in which microbiological organisms are destroyed by physical or chemical action, and is commonly used as the final process in the water treatment. A small amount of the active disinfectant should normally remain in the distributed water, to destroy subsequent contamination during distribution. Chlorine is the most common and most effective disinfectant used world over as it is cheap, reliable and easy to handle. The term chlorination is used very commonly to indicate that the water has been treated with a sterilizing agent. Other acceptable methods of disinfection are:

- Boiling of water
- Treatment with lime
- Treatment with ozone gas
- Treatment with iodine and bromine
- Treatment with ultraviolet rays
- Treatment with potassium permanganate

Disinfection by Chlorination

The application of chlorine during disinfection process require certain precautions due to harmful effects of chlorine compounds and thus the careful dosing of chlorine is essential. The quantity of chlorine required for disinfecting the water depends upon the water quality, quantity and contact period, i.e. the

period for which chlorine remain in contact with water before serving to consumer. However, the excess amount of chlorine gives bitter and bad taste to water.

The dose of chlorine is generally determined by experimenting various combinations in a water sample and to check the residual left after 20-minute contact period. The dose, which gives a residue of 0.1 – 0.2-mg/l milligram per litre is considered ideal.

Chlorine used for disinfection can be applied in any of the following forms:

i) in the form of liquid clilorine or chlorine gas.

ii) in the form of bleaching powder.

iii) in the form of chloroamines and

iv) in the form of clilorine dioxide.

23.4 WATER SUPPLY IN DISASTER SITUATIONS

An adequate supply of clean, safe drinking water is very important for the proper health and well being of the community. When water and sanitation facilities break down, the public health is at risk. The chances of break down of water supply during the cmergency situation can not be ruled out. In the aftermath of an earthquake, flood, or cyclone, there could be a serious water crisis. It, therefore, becomes very necessary to develop contingency action plans for meeting any emergency arising due to any of the natural or man made disasters. These contingency action plans should include:

- Coordinating measures to be taken up to ensure safe water supply
- A communication plan to alert and inform users of the supply
- Detailed plans to provide and distribute emergency supplies of water

Alternative safe water supply means have to be developed in the case of water supply system becoming inoperational due to any disaster. Various practical and social considerations must be taken into account prior to assessing the emergency needs of the affected community, such as:

- number of people to be served;
- quantity of water can be calculated by taking atleast 15-20 litres per person per day for needs like drinking, cooking, personal hygiene etc.;
- quality of available water and level of contamination;
- availability of water in the nearest source.

a) **Urban Water Supply Scheme:** If the disaster has affected an urban centre and a disruption to water supply scheme has taken place, the first priority should be to put tlie system back into operation. Damaged portions must be replaced or repaired and tlie supply must be quickly restored. In the aftermath of the disaster, the water pressure and the chlorine concentration must be increased to avoid any contamination from polluted water. In case any of the portions of treatment plant gets affected by the disaster, it should be repaired and proper disinfection must be done prior to putting it back into operation.

b) **Underground Source:** Underground sources are usually free from disaster related contamination and may not require any treatment. When springs are being used as a source after a disaster certain changes in the water quality may take place after earthquake or floods. Hence proper testing for water quality is required before restoration of supplies. As far as wells as the potential water sources are concerned, the location of these should be atleast 30 metres away from the potential source of contamination like latrines and sliould be at a higher elevation. Tlie wells must be properly covered. For additional precaution, the drinking water from these sources must be boiled or disinfected prior to use.

c) **Surface Water:** The usage of surface water as a water supply source should be the last option. Muddy, coloured, polluted water should not be consumed. Tlie water from the surface sources should be treated to remove turbidity, colour and other impurities and sliould be disinfected. For this purpose mobile water treatment plants as an adhoc measure could be pressed into service. Mobile plants are available mounted on a truck along with all accessories which include a centrifugal pump run by an engine, a rapid sand filter unit, chemical solution tanks, chlorine solution tank and other necessary accessories.

23.4.1 Water Storage in Emergency Situation

Emergency storage of water can be done in canvas, rubber coated nylons and plastic containers. Polyethylene containers erected in pits dug to size can also be used as storage. The total storage capacity for water distribution should be equal to tlie amount required for 24 hrs. Elevatecl water tanks must be erected using drums. iron sheeting and wooden poles. For long term emergency camps, all the storage tanks must be covered to protect from dust, and other contaminations. Special attention must be paid to proper sanitation near these tanks.

23.4.2 Distribution of Water

In emergency situations water is usually distributed through tankers. The individual families and local groups must be provided with water containers to store water. Special care has to be taken in checking the quality of water prior to transporting the water for distribution.

In long term camps, distribution pipes with community taps must be installed for water supply.

Check Your Progress 1

Note: i) Use tlie space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) What are the different methods of water purification?

2) What are the different methods of disinfection for water?

23.5 LET US SUM UP

In the aftermath of any disaster, there is an immediate need to restore drinking water supply and also to ensure its purity. To ensure its purity, there is need to have pretreatment of water, sedimentation aided with coagulation, filtration and disinfection, especially chlorination. The disrupted water supply has to be restored and till that time alternative safe water supply means have to be arranged.

23.6 KEY WORDS

Colloidal	Suspended in liquid
Coagulate	Curdle, turn from liquid to somewhat solid like curd.
Pathogen	Any organism that causes disease.
Potable	Fit for drinking
Percolation	Filter down
Faecal	Belonging to human excrement
Flocculated	Turned into small wooly lumps
Turbidity	Muddy, translucent

23.7 REFERENCES AND FURTHER READINGS

***Guide** to simple measures for the control of enterie disasters,* World Health Organization (WHO), Geneva, 1974

23.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answers should include the following points:

- Surface Sources: ponds, lakes, streams, rivers and reservoirs

  Sub-Surface or Underground Sources: wells, tube wells, springs

2) Your, answers should include the following points:

- Remedial measures for removing pollution from water sources vary for different water sources

- However, sanitary conservation of the area, covering the water storage if possible, emergency chlorination at intake point and regulatory measures are some of the common methods.

Check Your Progress 2

1) Your answer should include the following points:
   - Pre-treatment or pre-disinfection
   - Sedimentation with coagulation
   - Filtration
   - Disinfection

2) Your answer should include the following points:

   Chlorination
   - Boiling
   - Treatment with lime
   - Treatment with ozone gas
   - Treatment with ultra violated rays
   - Treatment with potassium permanganate

UNIT 24 FOOD AND NUTRITION

Structure

24.0 OBJECTIVES

After studying this unit, you will be able to:

- explain the various components of balanced food;
- highlight tlie importance of nutritious food;
- describe the methods of collection and storage of food;
- explain tlie methods for food distribution and
- highlight the sanitary equipments during mass feeding in the wake of disasters.

24.1 INTRODUCTION

Food is the necessity of life. It provides nutrition, sustenance and growth to human body. Foods can be classified into cereals, pulses, nuts and oilseeds, vegetables, fruits, milk and milk products arid flesh food. Food comprises proteins, fats, carbohydrates, vitamins, minerals salts and water. Most of tlie food items contain all these in varying proportioris. Oils and ghee are exclusively fats while sugarcane and starch contain high amount of carbohydrates. Accordingly food items are termed as protein rich, vitamin rich, fat rich food etc.

Proteins, fats and carbohydrates are usually termed as 'proximate principles'. Along with water., which is an important food element, proximate principles form the main bulk food. These are burnt or oxidised in the body to provide energy for the different activities of life. Consequently, different age groups need different food mix.

Vitamins and mineral salts do not supply energy but they play a very crucial role in regularisation of various body functions. Some of tlie minerals are important components of the body structure like bones and teeth.

When we talk about food in the contest of disasters, what becomes important is the availability of nutritious food in the wake of disasters. In such situations, the food served to the children in arms, pregnant women and nursing mothers and tlie aged needs special attention.

24.2 FOOD COLLECTION

Specialists are required to assist and advise in surveying the availability of local food and related supplies and in supervising their collection, storage, transportation and distribution. This would involve collecting food from donors, government controlled stocks or trade sources, moving it to the locations wliere required, using various agencies for its carriage and other related activities.

One agency whose contribution to disaster relief is often ignored is tlie effort put in by tlie community itself in taking care of the needs of the less fortunate among them. The village elders representing the community often organise their own relief and rescue operations till outside help can reach them. In' this foodstuff is their major contribution where they pool in the available food and distribute it. The formal and informal linkages that bind the community together are of great help in such situations. However, over a period of time the role of community participation has come down in organising food collection and increased dependence is visible on organised activity from government and NGO sources. These organisations may send food as an emergency aid or they can pre-locate the food for use when disaster occurs.

Government **Food** Stocks

Large amount of food stocks including some buffer stock is maintained by government agencies like the Food Corporation of India. These are the primary source from where tlie bulk of the food is collected, on instructions of the government, by the local administration for use amongst the affected population. It may be financed by either central or state government, or partly by both. This may be brought to the open market for sate to check against price rise and shortages in retail outlets. Also, certain quantities may be distributed as outright relief to the needy people or offered under "food for work" programmes.

The government administration monitors tlie overall food situation in its disaster management strategy. All food brought or intended to be brought for tlie disaster relief is co-ordinated by the local administration. Other agencies assist the local authorities in procuring suitable transportation, handling and storage requirements.

'Food Security

Food security is an important issue in disaster management for ensuring a balanced and nutritional food. This implies that people have access to sufficient quantities of food, when they need it and at a price they can afford. Principal conditions to be satisfied for achieving food security are:

a The supply of foodstuffs should be adequate to meet the demand.

- Fluctuations in seasonal food supply should be minimised, and reflected in relatively stable seasonal food prices.
- The population should have access to food supplies, either through adequate real income or, through targeted programmes such as food for work programmes.

The overall objectives of short term relief rneasures should be to provide to the people access to food by ensuring tlie availability of food in tlie affected area, and protecting the entitlements of groups within the affected population. Some of the principal measures for maintaining food security. include:

- Price stabilisation
- Food subsidies
- Employment generation programmes
- General food distribution
- Supplementary feeding programmes
- Special programmes for livestock and pastoral populations, e.g., fodder banks. "Gaushalaas"
- Complementary water programmes
- Complementary health programmes

Food security interventions in many areas are being implemented as part of their general developnient and welfare programmes and are potentially capable of expansion to serve as key components of a disaster relief strategy. How rapidly such an expansion can be implemented will in part reflect tlie amount of preparedness planning that has been carried out in advance.

Check Your Progress 1

Note: i) Use tlie space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) What is tlie system of food collection during disasters?

2) How call food security be ensured during disasters?

24.3 FOOD STORAGE AND DISTRIBUTION

In tlie emergencies created by disaster, storage and distribution of food is one of tlie essential and important aspects that need careful attention. Every effort should be made to minimise damagè of foodstuff already available in tlie affected areas. The proper storage and distribution of food in disaster situations require tlie following:

24.3.1 Warehousing

Proper selection, supervision and control of warehouses and storage facilities should be ensured. Wareliouses sliould be located centrally at key points in the area they intend to serve. Always maintain buffer stocks to meet needs when the system cannot keep up with tlie demand. Regional warehouses provide greater flexibility for field staff in timing the distribution to the beneficiaries and in receiving additional supplies. Tlie storage and delivery system is very important. Tlie logistics organisation responsible for receipt, storage and delivery of supplies must implement a system for recording, reporting and monitoring the flow of goods from receipt to final distribution. Significant losses can occur due to poor planning. Protecting the goods against inclement weathers, and theft is essential.

Warehouse Requirements

Tlie wareliouse sliould have sufficient capacity to meet forecast requirements for temporary or transit storage, reserve and buffer stocks. Following points should be considered when selecting warehouses or storage accommodation.

1. Wareliouses must provide proper storage in terms of their capacity and the preservation of tlie quantity and quality of the items stored. Cool and dry storage facilities are preferred. Warmth and dampness encourage infestation and growth of micro organisms. Every effort should be made to prevent foodstuff from being exposed to sun, rain, humidity or high temperature.
2. Open storage areas should be avoided. In case it is unavoidable, necessary precautions must be taken for covering tlie food items.
3. Tlie capacity of wareliouse to be selected depends upon tlie number of people to be served and the quantity to be stored. Provision for anticipated reserve and buffer stocks should be made, but ordering and holding contingency supplies for indeterminate future needs must be avoided. Consumption rates and shelf life liave to be considered. Supplies sliould be procured and stored in manageable quantities.
4. Warehouse buildings should be conveniently located with access from transportation system and provide protection from rain, flash floods, dampness, solar heating, rodents, insects and birds. A single large building is better than several small ones. Tlie warehouse must be provided with adequate fencing, lighting, fire protection and security system. Tlie area surrounding the warehouse sliould, have good drainage and easy access; with areas for parking and turning the vehicles.

Good Storage Practices

1. Each storage facility requires a storage plan, to allocate sufficient space for goods before the consignment arrives. Ideally, tlie floor of tlie wareliouse is laid out in a grid pattern, and stacks of items designated to different areas. A chart of the storage plan showing supplies location and available space should also be maintained.
2. Goods must not be stored against walls, pipes, pillars, roof trusses or partitions. One metre wide aisles sliould separate stacks. Foodstuff should be segregated from other supplies to avoid contamination.
3. Supplies and food commodities sliould be stacked neatly on pallets placed on the floor. Different consignments and items should preferably be stacked separately.

4. Easy accessibility to stacks placed earlier at tlie rear should be ensured.
5. Ventilation and good air circulation along with natural or electrical lighting must be ensured.
6. Limit stack height to prevent excessive floor loading causing structural damage to the warehouse or pressure damage to the packaging or the contents.
7. Individual stack dimensions at the floor should not exceed six metres so as to facilitate inspection and cleaning.
8. Stack packages in their upright position, especially those containing cans or bottles.
9. Stack damaged goods separately, repair or re-pack and issue them earliest.

The following details should be available for all tlie stored items:

- Type of supply. with expiry dates, if any
- Intended beneficiaries
- Quantities received with dates
- Source of supply
- Place where supply is received
- Mode of transport .
- All related costs
- Any losses and their reasons
- Issue details (date, quantity and to whom issued)

24.3.2 Family Food Stocks

Families may have some stocks of foodstuff, and these may be stored at home but have to be shifted to safer areas during evacuation at the time of a disaster where there may also be a shortage of fuel and cooking utensils for the families. A systeni has to be identified and devised where the entire community may have common storage of food and arrange for its security, as part of community effort.

24.3.3 Methods of Food Distribution

Food must be delivered to the beneficiaries who are often located in remote and inaccessible geographical areas. Local transportation and communication infrastructures may have to be reinforced and tlie process of control and information feedback introduced, lo ensure that the supplies from the source reach the beneficiaries at the destination, in tlie quantity and quality prescribed.

Distribution of food is an important activity in disaster management, especially during relief and recovery phase. Due to hostile weather and disruption of communications after a disaster, food cannot immediately reach tlie affected people. All possible means like helicopters and boats may be employed for this purpose.

Transportation may become a problem as certain areas may be cut off. This may require pre-positioning of supplies, air dropping, carriage by boats or other suitable means depending on tlie situation. To overcome disruption, alternate routes or transport methods should be explored. Groups may also be organised to repair bridges or roads so that supplies can come in from outside. Personnel are required to monitor this system by conducting checks and inspections,

manage and supervise operations at key control points. When food is procured locally, suppliers should deliver it to the control point nearest to the location where it will be needed. Distribution reports are necessary to confirm that supplies have been used for intended purpose.

Transportation of Food **Stuff**

Generally relief agencies may not have sufficient transport of their own and will have to hire available transport for moving bulky food supplies.

a) Road Transport. When moving supplies inland, trucks provide greater flexibility than other means in terms of capacity, scheduling and routing. If destinations can be reached by road, appropriate vehicle selection is determined by:

- The condition of terrain or weather, which will be, encountered en-route.
- The nature and quantity of goods to be transported.
- The time frame and frequency of each trip and tlie duration of the supply requirement at particular destinations.
- Tlie availability of fuel, spares and servicing facilities.

Tlie carrier should check their load carefully to ensure that the quantities and condition of the cargo coincide exactly with the information on the despatch challan, which should also be acknowledged by tlie receiver of the consignment.

b) Rail Transport.

If an adequate rail network exists and is functional between the place of' origin and near the disaster site, rail is usually the cheapest alternative, especially for transporting large, bulky consignments of food. As comparecl to the trucks, rail freight is usually fixed for a given period and is fairly stable. Railways, being a public service, usually reduce or waive freight charges on goods being transported for use in tlie disaster area.

c) River Transport

River transportation depends upon:

- Availability of navigable waterways
- Availability of ship, ferry or boat service on such waterways.
- Availability of cargo-carrying boats in good condition, with adequate capacity and in required number.
- Availability of personnel to handle boats.
- Docking facilities with personnel on both ends for handling, storing and transporting the cargo.
- Constraints and seasonal considerations.
- Costs and contractual options.

d) Air Transport

Aircraft are the fastest and most reliable means of transporting foodstuff, but it is expensive and should only be considered as a last resort, when supplies are urgently needed in an area where no other transport is feasible. In emergencies, airlifting may be an initial response to the situation, but Funds are better spent by moving supplies using other modes of transport.

At the receiving and transhipment points, supplies must be stored properly to maintain their quality, protection from pilferage or theft and keeping track of their location. Each location should have sufficient capacity with suitable facilities for handling and stocking.

24.3.4 Food Distribution to the People

Ultimately the food is to be distributed among the disaster affected population. The food distribution to the communities can be done in two ways i.e. dry rations and wet. rations or cooked food distribution.

a) Dry Ration Distribution

Dry food distribution method allows the families to prepare their food as they like and permits them to continue to eat together as a unit. This method is more acceptable culturally and socially in case of emergencies. The people must be provided, if thcy do not possess, the utensils, fuel and containers to protect and store food rations. Distribution may be done at 7 or 14 days intervals.

b) Wet Ration Distribution

In this method, the food has to be given in the ready-to-eat or cooked form, especially in the relief camps. This method requires centralised kitchens with adequate utensils, water etc. and trained healthy personnel for cooking, packing and distributing it in hygienic manner. At least two meals must be provided per day. The quality and quantity must be discussed regularly with the affected population and complaints must be taken care of. In this method, it is very important to check that food is being properly distributed and utilised at family level. If the food is providecl by the contractors, inspection and checks must be made.

Distribution of relief food must be done alter a survey of the affected population so that the meagre resources are best utilised. In this case, cards or coupons may be issued to those requiring food aid and can come to the distribution point. Care should bc taken to ensure that most vulnerable and poor segments like the women, aged, children and sick are not left out in preference to other stronger or more privileged people.

Immediately after a disaster, only cooked food would hc required, as the people even if they have not lost their cooking utensils, will bc in a state of psychological shock and require assistance. I-Iowever, they must be encouraged to commence cooking for themselves, as it will also help in restoring normalcy. Mobile distribution points will be required so that the people can collect food from reasonable distance from their locations. If there are large number of persons to be given rood, care will have to be taken to maintain law and order.

Food for Work

To ensure employment opportunities to the victims of a disaster rendered unemployed or without livelihood, particularly in drought prone areas, the local government implements food for work schemes. Here some development project is started where the wages are given in kind in the form of grains or food. This has the advantage of developing assets and ensuring gainful employment in the area preventing people to migrate to different areas. This also helps in maintaining the self-respect of the disaster-affected people as they have the satisfaction of earning their food and not depending on charity.

24.3.5 Sanitation Requirements during Mass Feeding Services

Unless proper sanitary measures are applied to the storage, preparation and distribution of food under emergency conditions, mass feeding programme will

be under constant danger to health. Various services connected with the food preparation and protection i.e. water supply and waste disposal require special attention. The various measures that can be applied in order to ensure good sanitation include.

- quality control of incoming food in order to check spoilage and contamination.
- quality control for food preparing centres.
- cooking staff and food handling persons to be free from infections and should observe proper hygiene.
- control of insects and rodents in stores, kitchens and feeding centres.
- proper storage of cooked food
- proper disposal of kitchen waste and food waste
- proper washing of utensils
- cleanliness of premises where food is prepared and served.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

I) What are the essentials of safe food storage system in disasters?

2) What are the methods of food distribution.

24.4 LET US SUM UP

Food and nutrition are essential to life but they assume an important role when an emergency situation is created by any disaster. While performing the exercise of food collection and distribution, the basic tenet of nutritious and balanced diet is to be kept in mind. Also, hygiene and sanitation measures have to be taken and duly maintained, which otherwise may worsen the already bad conditions in a disaster. Food security becomes important. Adequate stocks need to be maintained in properly managed warehouses. Food distribution has to be very

quick and this can be ensured by the most feasible and available mode of transport such as road, rail or air. Likewise a fair distribution practice has to be adopted for the vulnerable population and adequate sanitary measures have to be adopted during mass feeding programmes.

24.5 KEY WORDS

Aisle		Passage between rows
Docking		Berthing of a ship or boat for loading or unloading
Logistics		Process of transporting and supplying
Pallets		Wooden planks on which goods can be stacked
Navigable	:	River or canal in which ships or boats can ply
Trusses		Supporting structure
Waterways	:	Rivers or Canals

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24.7 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

Food collection can be in the forrn of:

- Government stocks
- Loans, aids and grants from NGOs
- Community Collection

2) Your answer should include the following points:

- Price stabilisation
- Food subsidies
- General food distribution
- Employment creation programmes
- Special programmes for livestock (cattle)

Check Your Progress 2

1) Your answer should include the following points:

- Proper warehousing
- Good storage practices

2) Your answer should include the following points:

- Road transport
- Rail transport
- River transport
- Air transport

UNIT 25 HYGIENE AND SANITATION

Structure

25.0 OBJECTIVES

After studying this Unit, you will be able to:

- describe the importance of sanitation and hygiene during and alter disaster situation;
- highlight the methods ensuring proper hygiene and sanitation: *and*
- explain the ways to provide proper hygiene *and* sanitation after disaster situation.

25.1 INTRODUCTION

Sanitation refers to all conditions that create unhealthy conditions, especially with regard to dirt and infection and specifically to the drainage and disposal for sewage and refuse from houses. The World Health Organisation (WHO) defines sanitation as the means of collecting and disposing of excreta and community liquid wastes in a hygienic way so as not to endanger the health of individuals and the community as a whole. Thus the basic objective of all the sanitation programmes should be disposal of human excreta arid community wastages without endangering the public life. The problem of proper hygiene and sanitation has increased manifold due to higher rates of population growth leading to insanitary conditions. The other limitations in providing the adequate sanitation. condition are lack of funds, lack of trained personnel and lack of knowledge about acceptable alternative technologies. All these factors contribute to lowering the satisfactory sanitation service level.

Disasters worsen the already inadequate sanitation situation. Certain special measures must be adopted to improve the sanitation condition and to check any spread of epidemic in the aftermath of the disasters like flood, cyclone, earthquake etc. This unit deals with the available sanitation means and how to improve the hygienic and sanitary conditions in the emergency situations.

25.2 IMPORTANCE OF PROPER SANITATION

During the planning of sanitation measures for any community, safe disposal of excreta is of great importance for health and welfare of the concerned population. Sanitation is the highest priority for the local governments over the years now to ensure basic health of the communities. There is a direct relation between better provision of sanitation facilities, safe drinking water supply and health care at the local level. Thus improved sanitation and safe drinking water supply should be

tlie highest priority areas to achieve tlie target of improved health in the urban and rural areas of the country. Keeping all these factors in mind sanitation must be given tlie highest importance by according it tlie status of basic human need like food, housing, health etc.

Tlie urban areas are increasing at a very fast rate. These urban centres attract a large chunk of poor population from countryside. Majority of these people do not have adequate resources to take care tlie housing needs. Thus majority of this type of population give rise to slums and squatter or unauthorised settlements at the periphery of towns and cities. In all such localities, health risks are at peak. Higher density levels of population give rise to airborne respiratory infection and diseases due to unhygienic conditions. Malnutrition witli in the community makes it highly susceptible for water borne diseases. Since proper water supply is insufficient in most of tlie cases, the water borne disease can spread widely within the community. Thus adequate sanitation is of prime importance for tlie well being of the communities in general and in the aftermath of disasters in particular.

25.3 MEANS AND METHODS OF ADEQUATE SANITATION

A large number of sanitation technologies are available. Tlie selection of most suitable option must be done after careful analysis of all factors including cost, acceptability, operation and maintenance and locally available resources. Various factors can affect tlie selection of tlie most suitable sanitation option as discussed in the following paragraphs:

i) **Water** Supply Levels

The amount of water supply available to an individual holds the key in proper selection of sanitation option.

Options like tlie Ventilated Improved Pit (VIP) Latrines are available where no water is required except for toilet hygiene. This type of options must be utilised when water supply is insufficient. (say 20-25 litres per capita/daily).

If tlie water supply is up to 50 litres per capita daily tlie options like pour flush and vault toilets are tlie better options. Similarly, if there are no constraints on water supply, cistern flus11 toilets witli conventional sewerage or septic tank options are more suitable.

ii) Soil **Conditions**

Local soil conditions play a very important role in determining tlie sanitation option except for those options, which are completely contained over tlie ground like vault toilets and bucket latrines. Soil stability and permeability are tlie two soil characteristics, which determine the technology selection. The impermeable soil conditions are least appropriate for a majority of the options available. In case of unstable soil, tlie bases of pits must be lined as in case of Ventilated Improved Pit and Pour Flush toilet options. Rocky soils are tlie most unwanted soil type for any type of sanitation option. In case tlie ground water table is within 1 metre below the ground surface, various toilet options, which require pits, are not possible at all.

iii) **Population** Density

Tlie population density is also a very important factor in determining tlie sanitation option. In highly dense areas, VIP latrines are not possible and pour flush toilets and septic tanks with soakways are feasible only under favourable conditions. Conventional sewerage pourflush systems and vault toilets are feasible for these areas.

iv) **Other** factors

Various factors including costs, reuse potential, environmental factors and institutional constraints must be given due consideration prior to finalising the sanitation option for a particular locality.

25.3.1 Sanitation Options

i) Open Defecation: Open defecation is a very common sight in the rural areas of the country. People generally defecate over the places like rubbish heaps, manure heaps, and in the fields. This encourages flies, which may spread various diseases. Other type of infections also develops due to this practice. This is the most undesirable means and must be avoided in the vicinity of human habitation.

ii) Shallow Pits: This method comprises the digging of a shallow hole and covering the faeces with soil. Pits dug once can be utilised for longer durations also. The ekcavated soil is heaped beside the pit and some portion of it is put over the faeces after each use. Decomposition of faeces is quite rapid. The method costs nothing and is a good source of fertilizer to the farmers. However, this method creates a lot of fly nuisance and leads to spread of hookworm larvae over the ground, if the pit is not dug unto one-metes depth.

iii) Simple **Pit** Latrines: This type of latrine consists of a slab over a pit, which may be 2m or more in depth. The lavatory has a squatting hole or a seat so that excreta fall down in the pit directly. The slab is firmly supported on all sides and raised over the ground to prevent the water entry into the pit. This is a low cost technique, which requires no water. This type of latrine gives a bad smell and may create fly and mosquito nuisance, if the tight fitting cover over the squatting hole/is not provitled. When the pit is full up to half, a new pit has to be dug.

iv) Ventilated **Improved Pit** Latrines: The ventilated improved pit (VIP) latrines are the improved version of simple pit latrines, where the pit is provided with a vent pipe extending above the latrine roof. The inside of the super structure is kept dark. The vent pipe is provided with a netting to prevent flies and mosquitoes. This type of sanitation system is hygienic, low cost method, which requires no water. The system controls the fly and mosquito nuisance with minimal requirement of user care and involvement. The other advantage is the smell control. However, this type of latrine is highly unsuitable for high-density areas and may pollute ground water. Ventilated improved double pit latrine is another latrine of this type, but with two pits. One pit would be used until full and then sealed while second pit is in use. The first pit is emptied after filling up of the second pit and used again.

v) Pour **Flush** Latrine: Pour flush latrines have a trap providing water seal beneath the squatting plate. The water seal is cleared of faeces by pouring sufficient quantities of water to wash the solids into the pit. The water seal prevents the flies, mosquitoes and smell reaching the latrine from the pit. The pit is usually connected with the latrine through a short length pipe. It is convenient to have two pits instead of one pit. Both of these pits can be utilised alternatively. This type of latrine is a low cost sanitation measure, which also controls the odour, fly and mosquitoes. This type of latrine can be upgraded by connecting it to sewer, when sewerage becomes available. The only drawback is that this system requires large quantity of water.

Composting Latrines: In tlie composting latrines, excreta fall into a watertight tank to wliicli inorganic materials like ash or vegetable waste is added. A careful control over moisture content and chemical balance decomposes tlie excreta into good manure, which can be utilised as fertilizer. Tlie pathogens get killed during tlie decomposition process. Tlie composting latrines are of two types. First is tlie continuous composting while tlie second one is with two containers used to do tlie composting in batches. Tlie method requires very small quantity of water and produces safe and stable humus. The technique is not for high population density areas and requires good quantities of inorganic biodegradable matter. For using this method an extremely high degree of user care and motivation is a must.

vii) Septic **Tank Latrines:** A septic tank is a rectangular watertight settling chamber, located below the ground level. The septic tank receives both excreta and flusli water from flush latrines and the raw sewerage from the other household activities. The retention time in tlie tank is usually 1-3 day, during wliicli tlie solid particles settle down to the bottom, where they get digested and a thick layer of scum is formed over the surface. The effluent from tlie septic tanks is usually discharged to soaltways or leaching fields. Tliis system works very effectively in the permeable soil conditions and in tlie areas free from flooding and waterlogging. Now a day tlie septic tanks with two compartments are commonly used. The septic tanks are usually used for tlie individual household but can also be used at small community level. Tlie septic tanks require large areas, higher costs and high level of user attention.

viii) Aqua-Privy: Aqua privy has a watertight tank immediately under the squatting hole. Tlie excreta drops down into the tank through a pipe. The bottom of tlie pipe is submerged into the water in tlie tank thus preventing tlie smell, flies and mosquitoes entering tlie latrine. The tank functions like a septic tank. Tlie effluent usually drains out through a soak pit. A vent pipe is also provided for ventilation. Tlie water level must be maintained by adding sufficient quantities of water after every use to check tlie losses due to evaporation and leakage. The sludge so formed must be removed regularly. This system is less expensive than tlie septic tanlcs and there is no need for piped water supply. Tlie technique is applicable in permeable soils to dispose of the effluent and dislodging requires careful handling by municipality staff. A significant amount of water is also needed.

ix) **Overhung** latrines: In this type of latrine, the excreta drops directly into a water body like river, sea etc. The strong current of water takes away the excreta. The local communities must be aware about the higher level for health risks associated with tliis type of latrine and must take the preventive measures. Tliis is a very cheap option of sanitation but leads to pollution of river/sea.

x) **Bucket** Latrines: Tliis type of latrine contains a bucket or other container located immediately below the squatting hole for collection of excreta. These buckets are periodically removed for treatment or disposal by a night soil labourer cal led scavenger. This system requires very low initial cost but has a very high health risk for those who collect tlie night soil. It is also against human dignity and has been given up in most places.

xi) Vault **and** Cartage Systems: Tlie vault latrines consist of a watertight tank to store the excreta until a vacuum tanker removes them. The vaults are emptied on regular intervals, when they arc nearly full. The performance requires an efficient service alongwith an efficient infrastructure. Irregular collection can lead to tank overflow and may create unhygienic conditions. Tliis is not a commonly used method.

xii) ***Sewerage System:*** The sewerage system is designed to transport a mixture of excreta and waste water from households to the central treatment plant through a network of underground pipes. The system provides highest level of user convenience for all type of waste water disposal. involving no health risks and a very minimal maintenance. Tlie treated water can be utilised for irrigation purposes. The major hurdle is the very high initial cost, skilled labourer, larger amount of water requirements making the system more urbanised and water intensive. If discharged into a water body it requires adequate pre-treatment.

Check Your *Progress* 1

Note: i) Use tlie space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What do you understand by sanitation? Describe the importance of tlie same.

2) What factors are kept in mind for selection of appropriate sanitation options.

3) List the acceptable sanitation options.

25.4 HYGIENE AND SANITATION IN POST-DISASTER SITUATIONS

Communicable diseases or epidemics need not occur in the post-disaster situation unless large number of peoples are evacuated or clisplaced from their homes and placed in the crowded and insanitary camps. Tlie sanitary deficiencies in these camps may expose the habitants of the camps to serious health hazard during their stay over there: Proper disposal of excreta and solid waste and vector control are

of primary importance and require immediate attention. We shall discuss here some of the hygienic ways of managing public conveniences in post-disaster situations.

i) **Excreta** Disposal: Unsatisfactory disposal of excreta is common after natural disasters. In the absence of proper sanitation measures any of the following may result:

- more flies and more breeding places
- unpleasant smells

  underground and ground water contamination
- food contamination by flies
- increase in disease incidences

a) **Existing Sewerage System:** The sewerage system and treatment plant may be put out of service due to natural disasters. Earthquake may destroy the sewerage network, pumping station or treatment plants. Similarly, floods may block the sewerage system and inundate the treatment plant. Immediately after any disaster situation, a detailed survey must be carried out and a damage report must be prepared. Based on this report various measures can be taken on high priority:

- rapid repair of sewers, with temporary arrangements to bypass damaged section,
- cleaning blocked sewers,
- disinfecting the treatment plant after dewatering format and making it operational;
- temporary arrangements for discharging sewage.

b) Temporary Shelter and Camps: For temporary shelters the appropriate sanitation measures are necessary. The choice is usually between shared and individual facilities. Individual family facilities are always preferred, as the satisfactory maintenance of shared facilities is always a problem. But most of the time, individual family facilities are not possible and only shared facilities can be provided for relief camps.

During the identification and development of the camp, the first priority must be to designate a specific area for people to excrete. The method requires a very careful supervision and management to keep pollution at a minimum. Men, women and children must be encouraged to use it and prevented from defecating in the open. This area must be fenced and must be kept clean by regular removal of excreta from the site and use of disinfections.

Open surface defecation, if it has to be resorted to, can be improved by digging shallow or deep trenches into which people can excrete directly. In this method the faeces can be covered with fresh soil on daily basis to get better sanitation.

Other methods recommended for post-disaster sanitation. are aqua privy, mobile latrines and separate urinals.

ii) Solid Disposal: The aqcumulation of refuse or rubbish in a camp can constitute a health risk. The rubbish either is buried, burnt or removed from the camp site. To expedite the disposal of refuse, separate containers for

storing and collection of organic and inorganic wastes must be utilised. The refuse thus collected must be disposed off either through sanitary landfill, incineration or burial.

In the rural areas special care must be taken for the collection and disposal of animal dung. The best method of disposal is to bury it into trenches.
Another serious problem in post-disaster stage is the disposal of dead animals. Burial is the only solution for big animals while burning is feasible for small animals like cats and dogs. When carcasses me large, it is not possible to bury all of them without heavy excavation equipments. The carcasses awaiting burial should be sprinkled with kerosene to protect them from the predatory animals.

The waste water from make shift hospitals, water points, mass feeding centres and milk distribution centres must be disposed off properly. The usual way is to drain away this water into a soak pit.

iii) **Vector Control:** The post-disaster situations are most favourable for rapid increase in the population of insects and rodents. These can create a health risk and spoil and destroy large quantities of food items, which are already scarce in disaster emergencies. The vector problem generally develops in densely crowded conditions where sanitation conditions are inadequate. Flies, fleas, lice, mites, mosquitoes and bedbugs are disease vectors that develop in uncontrolled environments. Vector control must follow a definite plan and programme. Special teams must be organised to control various types of vectors. The team leader must have adequate knowledge and experience in combating this type of situation.

Check Your Progress 2

Note: i) Use tlie space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What effective steps can be taken for restoring excreta disposal system in post-disaster situation?

2) Apart from efficient management of human excrete disposal, what are the otlier important steps to ensure good hygiene and sanitation in relief camps in post-disaster situation?

25.5 LET US SUM UP

Hygiene and sanitation assume great importance in health management in disaster situations. Sanitation can be described as the means of collecting and disposing of excreta and community wastes in a hygienic way. Keeping in mind the different areas, their water supply levels, soil conditions and population density, a proper planning of sanitary system should be done. Adopting any sanitation option should be guided by these conditions, as this will greatly minimize the problem of likely epidemics during or after disasters. However, when the existing sanitation system gets disrupted, rapid repair should be done and temporary arrangements for discharging sewag should be made. Adequate precaution and sanitary measures should be taken in the temporary shelters and relief camps.

25.6 KEY WORDS

Biodegradable		Capable of being automatically reduced to lower organic level; capable of getting slowly reduced to nothing by natural processes.
Effluent		Out flow from sewage tank
Humus		Soil after decomposition of leaves etc.
Leaching fields		Fields for percolating water
Sludge		Thick sewage or slushy sediment
Soil Permeability	:	Capacity of soil for penetration of water
Toilet Hygiene		Proper washing up oneself after toilet
Vector		Insect carrier of disease

25.7 REFERENCES AND FURTHER READINGS

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25.8 . ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- Emphasis upon the definitions of sanitation
- Repeat the importance of sanitation by mentioning the points as what will happen in case sanitation is not maintained. See sec. 25.1 and 25.2

2) Your answer should include the following points:

- water supply levels;
- soil conditions;
- population density and
- other factors such as cost considerations, reuse potential and environmental factors.

3) Your answer should include the following points:

Based on the amount of available water supply, soil conditions and population density, the .followingare the acceptable sanitary options

- simple pit latrines
- ventilated improved pit latrines
- pour flush latrines
- compositing latrines
- septic tank latrine
- sewerage system

Check Your Progress 2

1) Your answer should include the following points:

- rapid repair of the damaged excreta disposal system;
- appropriate measures for providing excreta in temporary shelters and camps.

2) Your answer should include the following points:

- disposal of garbage;
- disposal of dead animals;
- control of disease carrying agents/vector like flies, fleas, lice, mites, and mosquitoes.

UNIT 26 REHABILITATION: SOCIAL AND ECONOMIC ASPECTS

Structure

26.10 OBJECTIVES

After studying this unit, you should be able to :

- explain the meaning and concept of rehabilitation,
- appreciate the significance of rehabilitation,
- ,discuss the social aspects of rehabilitation,
- highlight the economic aspects of rehabilitation; and
- describe the various activities for ensuring social. and economic rehabilitation.

26.1 INTRODUCTION

Because of the peculiar geography and geology of the area, the Indian sub-continent in general and India in particular are visited by a number of disasters, year after year. Most of the major types of natural disasters like floods, cyclones, earthquakes, droughts, landslides etc. occur frequently and hence the people of the country are familiar with them. Due to periodic disastrous situations, a major portion of the limited resources of the nation, are required to be diverted into various activities related to disaster management, including the distribution of relief and arrangement of rehabilitation of the affected communities. This puts severe strain on the developing economy of the country. Thus, it becomes utmost necessary for the decision makers, policy planners and the local communities to utilize the available resources in appropriate manner to strengthen the ability of the community to face such onslaughts and to mitigate their adverse effects.

Disaster management activity for any type of disaster can be divided basically into the following three stages :

1. Pre-disaster stage
2. Emergency stage or during disaster stage; and
3. Long-term post-disaster stage.

The pre-disaster stage activities include the preparedness and mitigation aspects for facing the disaster in a planned and coordinated manner. The next phase, just after the occurrence of disaster involves the rescue and relief operations. During this stage, when survival is the prime goal, we have to rescue the affected population and to provide immediate relief. The most important phase of disaster management starts with the passing of the emergency phase and concerns the rehabilitation of the affected communities with the long-term objective of Protection against such events. These phases are interconnected and interdependent.

26.2 REHABILITATION: CONCEPT, FACTORS AND SIGNIFICANCE

The most important aspect of any post-disaster effort is the rehabilitation of the affected 'communities. This envisages resetting of the disturbed communities through rebuilding of the affected communities in terms of social and economic aspects as well as rebuildinglretrofitting of the damaged houses. The main objective of any rehabilitation package should be to bring back the affected regions/communities to normalcy and to provide the opportunity to the affected community to restart their socio-economic and cultural life as early as possible. The rehabilitation package should not be an exercise merely of providing help either financially or of rebuilding/repairing/retrofitting the damaged houses. Any rehabilitation programme should be focused on the redevelopment of the affected communities/regions rather than merely on the provision of facilities. The basic concept behind any rehabilitation package should be to bring back the affected communities/areas to at least its original state that existed prior to the disaster. Efforts should be made to incorporate developmental aspects in the rehabilitation process taking care of the fact that this does not delay the process unduly. Besides, the package should also aim at strengthening the existing infrastructural facilities to face possible future disasters in a far better manner.

The rehabilitation package offered after any disaster may be classified into the following categories:

1. Housing and Infrastructure Redevelopment
2. Social Rehabilitation Programmes
3. Economic Rehabilitation Programmes
4. Other Related Programmes and Activities.

The housing and infrastructural part should cover the requirements and other necessary details pertaining to housing, civic, amenities, roads, bridges, electric power supply network, communication network, water supply schemes, irrigation and related structures, public buildings etc. The social rehabilitation programmes should cover health, education, and special programmes for children and women. The economic rehabilitation package should cover the special programmes for rehabilitating agricultural farmers, labourers, artisans, animal husbandry, special training programmes, social forestry and also programmes to provide immediate employment such as Food for Work Programme, Jawahar Rozgar Yojana, and Pradhan Mantri Rozgar Yojana. The package on other related programmes and activities should include all remaining portions of the rehabilitation package like development of better environment in the area by creating green belts and repairing public buildings and monuments.

26.3 REHABILITATION : SOCIAL ASPECTS

As mentioned above, the social rehabilitation package may include the following components:

1. Strengthening/restrengthening of existing health facilities and infrastructure
2. Rehabilitation of educational activities within the disaster affected region
3. Rehabilitation of women and children affected by the disaster.

26.3.1 *Healthcare Facilities and Infrastructure*

Due to any disaster like earthquake, cyclone, floods or landslide etc., many people lose their lives. A large number of people receive injuries of varying degrees, thus requiring immediate medical attention. At the same time, large number of health institutions in the affected areas become inoperational due to the damages that occur in the aftermath of the disaster. So, the need for improved health facilities is felt within the emergency period itself.

In case of earthquakes, majority of injured people may sustain fractures of various types (bones of the extremities, pelvic, etc.); head injuries and other internal injuries. Fbr all these; necessary surgical treatment must be provided within the shortest possible time. For this purpose, the authorities in the affected areas must, if need be, take the help of defence forces within the emergency period itself. The defence personnel are well-versed to handle this type of situation and could even quickly establish temporary hospitals at the affected sites.

For proper information exchange and coordination of medical support, control rooms must be established at various important points. Information exchange must be done among the various state level health departments, including the directorate of health services, directorate of medical education, district hospitals and rural hospitals within the affected areas. These control rooms may play a very vital role in the overall management of emergency period and the rehabilitation of the healthcare infrastructure within the affected area. They may also be utilised for collection and storage of immediate medical supplies received from national and international agencies. The supplies may comprise infusion fluids, antibiotics, surgical equipments, dressing materials, field dispensary units, emergency medical kits along with chlorine tablets and insecticides, which are in urgent demand and require immediate distribution among the affected communities.

After any disaster, the most important task for the authorities would be to check the outbreak of any disease or the spread of any epidemic. For this purpose, anti-epidemic measures, in the form of disinfection of water, insecticide spray and disease surveillance must be started in the first instance. The following are some of the important points, which could be the key for a successful health care operation after any disaster :

i) A very prompt and quick coordinated response from all concerned including the NGOs.

ii) Quick evacuation of seriously injured cases just after the calamity, for minimising the mortality among the disaster affected people.

iii) Appropriate and efficient management of hospitalised cases.

iv) Prompt and effective anticipatory, anti-epidemic measures to prevent the outbreak of any epidemic in the aftermath of the disaster.

v) Effective and safe logistic support for essential items including the medicines, e.g., maintaining the old chain wherever essential.

During any disaster situation, the various . state, national and even international agencies whether governmental or non-governmental, seem full of enthusiasm and also respond overwhelmingly to the situation. But, the following are some factors, which may hamper the smooth functioning of the health sector infrastructure unless all efforts are well-coordinated:

i) Lack of communication between various functionaries, hospitals and even among the concerned officials.

ii) Shortage of sufficient accommodation for indoor activities for different operations related to efficient discharge of health facilities and even to store the medicines properly.

iii) An additional demand for different types of equipment and related materials from within the disaster-affected area.

iv) Improper and inefficient facilities for necessary electric power supply to carry out the necessary tasks related to health facilities.

v) Lack of trained staff to handle the mental health or trauma cases effectively.

vi) Lack of trained manpower to help in the rehabilitation services in the form of physiotherapy and occupational therapy.

vii) Lack of efforts and coordination related to sustainable disaster management; and

viii) Lack of overall training in handling disaster healthcare in a professional manner.

The only effective solution to overcome these shortcomings lies in adequate preparedness and pre-disaster planning and training. If the health sector personnel are trained in handling the situation likely to arise due to a disaster, it will definitely reduce the pressure at the time of actual crisis situation. For proper management of the situation, the health sector requires a well-defined preparedness plan. To make the plan efficient and workable, additional facilities within the existing hospitals are also required.

a) Objectives of the Preparedness Plan for Health Sector Infrastructure

The following points should be considered while preparing the health sector to take up the challenges posed by any disaster:

i) Since the occurrence of disasters cannot be prevented, the improvement in the ability of the masses at local level, to meet the challenges posed by such calamities is one effective way for providing proper and adequate response to the calamity.

ii) Just after disaster, there are grave dangers of outbreak of an epidemic. Effective preventive measures must be set up in motion by involving the existing network of rural health centres, public dispensaries and even through the representative bodies like panchayats at village level and zilla parishads at district level. The sole aim of the exercise must be to prevent the outbreak of the epidemic. The rehabilitation plan must concentrate on strengthening and upgrading the preventive measures.

iii) In order to develop a mechanism to monitor and sustain recovery efforts throughout the disaster management phase, we have to:

- Improve the communication network at various levels.
- Increase the capacity of the existing facilities (e.g. addition of beds in the hospitals etc.)
- Equip the hospitals to support the additional work load in case of an emergency.
- Create and operationalise rehabilitation and mental health aspects within the existing healthcare centres.

b) Creation of **Additional** Facilities within the **Existing** Health **Institutions**

Facilities for housing the injured patients is critically important for effective management and care after any calamity. The shortage of proper space for accommodating the patients, members of the medical teams and proper storage places for medicines and related equipment is usually felt. This situation results in the shifting of the patients either to the far off places or to make-shift hospitals. Both the situations are undesirable and should better be avoided. The ideal solution is the conceptualization of these problems during the rehabilitation planning phase by providing additional infrastructure.

After any disaster, a large number of victims need to be hospitalised for treatment. Most of them are discharged soon after first aid, but these people are likely to require physiotherapy and/or occupational therapy. These types of facilities generally do not exist in most of the primary health centres; rural hospitals or even in some cases at district hospitals. An attempt must be made to provide the trained staff in these two types of therapies for better and quick rehabilitation of the affected communities.

For effective rehabilitation of the persons affected by the post-disaster trauma, we require the service of psychiatrists, which is generally not available in most of the hospitals. Proper attention must be paid to this aspect also and an attempt must be made to provide the specialist psychiatrist at least at the district hospitals. At the emergency stage itself, we require the help of psychiatrists. For this purpose, we should try to arrange mobile trauma care units. The members of these units can visit the affected area frequently and assist the health officials.

During any type of disasters, electric supply network becomes a major casualty. The damage to these facilities may hamper the effective utilisation of healthcare facilities: Thus, alternative arrangements for power supply must be made. For this purpose, electric generators may be provided to the hospitals and other health care institutions. Another type of breakdown that takes place during the disaster situation is the communication network. This also affects the overall efforts of rescue, relief and rehabilitation. There is a need for alternative arrangements to be provided during disaster situations. For this purpose, amateur HAM-radio network may be encouraged to assist the various health sector institutions also.

26.3.2 Resurrection of Educational Activities in the Disaster Affected Region

Most of the disasters including earthquakes, cyclones, floods etc., leave behind in their wake widespread destruction, which includes educational buildings and equipment. The immediate task before the Department of Education and

the authorities is to restart the educational activities at all levels. This ensures not only a continuity in the education process but also help the community, especially the young among them, by diverting their attention from the negative and depressing thoughts resulting from the disaster. For this purpose, educational equipment, text-books, writing materials etc., must be provided at the first instance. Any rehabilitation programme must include the rebuilding of the fully damaged buildings and repair/retrofitting of the partially damaged buildings. Classes may have to start in the open or in tents to begin with. Teachers may have to shoulder more teaching load.

For proper restoration of education activities, the teachers and the children of the disaster affected areas require counselling. These people require someone to share their sorrow and grief. They also require encouragement and motivation to start their life once again. For this purpose, the help of local voluntary groups may be sought. The responsibilities assigned to these local groups may include the following:

i) counselling and encouraging the children to attend the schools regularly

ii) assisting the administration in providing the writing materials, work books etc. to the children

iii) helping the school administration for ensuring the participation and cooperation of the children in all activities of the school

iv) developing an atmosphere for students to seek knowledge and information

v) inculcating conducive attitudes among the students to play a positive role in self-development

vi) establishing village level education committees for properly running the schools within the villages, and

vii) arranging for volunteer teachers wherever the disaster has resulted in shortage of teachers.

For achieving good results in restarting the education activities in the disaster affected areas, a participatory approach is necessary. At the district level, the Zilla Parishad officers along with District Inspector of School can identify a few local groups to take up this challenge and conduct the orientation programmes for these groups. The objective of these orientation programmes must be to train the group members in identification of target groups, methodology to be adopted and carrying out of the various educational activities within the affected villageslareas.. In carrying out these tasks, the role of the voluntary organisations must be facilitative and supportive.

26.3.3 Rehabilitation of Women and Children Affected by Disasters

The most vulnerable group due to any .disaster in physical, emotional and/or economic terms is women and children. The rehabilitation of this group must be a major component within any rehabilitation package. The emphasis of any rehabilitation programme for women and children must include the following :

i) Women and Children should, as far as possible, be resettled/rehabilitated in familiar environs.

ii) An attempt must be made to rehabilitate the widows and orphans within their extended family or in a foster family in case of orphans.

iii) The mental health of such affected groups must be strengthened through programmes of regular counsel ling.

iv) The economic independence of widows must be ensured with the help of suitable programmes.

v) The Proper health, nutrition and hygiene aspects must be taken care of within the long-term rehabilitation of the women and children groups.

a) Development of Physical Infrastructure for Women and Children

i) **Anganwadis** : The anganwadis must be activated/reactivated (as the case may be), within the shortest possible time, after any disaster. The anganwadis may act as day care centres for the children, besides providing nutritional diet to them and to expecting and lactating mothers. The anganwadi 'workers are very effective in providing counselling to the affected community. In fact, experience has shown that the anganwadi workers are the opinion leaders among the village women folk.

ii) **Community Centres** : During rehabilitation process, at least one multi-purpose community centre per village must be set up. These centres would serve as the meeting places for women, counselling centres and even training and recreational points for the women folk within the village itself. Another function, these centres can play is to act as creches for children of women who are working or engaged in social activities like training etc.

iii) **Female Children Home** : The girl child is most vulnerable and suffers the most in any type of calamity. To take care of the young and single girls, a provision for residential female children homes can be made at least at block level as a iong-term measure. These homes can provide proper education/training etc., to make these girls self-reliant and economically independent.

b) Development of Economic Activities for Women and Children

i) Vocational training for improving the skills of the women and children groups is a must. The vocational training must be provided through the existing network of ITIs (Industrial Training Institutes). At least, one Industrial Training Institute must be available within a district. Besides providing the training to this group in the traditional trades like tailoring, embroidery work etc., some non-traditional trades like Radio, T.V.Repair, can also be identified for providing training to the group members.

ii) Self-help groups can be created. A rehabilitation package must emphasise the need for organising the self-help groups of women. These groups must provide the counselling and .training to the women folk to effectively create and handle the economic assets. These groups may be very effective in making the disaster affected women economically independent.

The entire rehabilitation programme for women is based on intensive counselling, interaction as well as training. For the effective implementation of socio-economic rehabilitation programme for women, a large number of training prbgrammes must be started for NGO workers, anganwadi workers and other village level government functionaries.

As of today, many of the NGOs have an expertise in organising effective rescue and relief operations but they require training in the long-term rehabilitation efforts. To fulfil the greater need of training, a training of trainers centre cbuld be developed at the district level, within the disaster affected/prone region.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What do you understand by the rehabilitation of disaster-affected communities?:

2) What are the essential components of a rehabilitation package for the benefit of a community affected by a disaster?

3) What are the main programmes under the Social Rehabilitation Plan?

26.4 REHABILITATION: ECONOMIC ASPECTS

Generally speaking, the concept behind the economic rehabilitation of the disaster affected area is to reattain the same level of economic status of the entire region as in the pre-disaster stage. In the situation arising due to a disaster, a large number of people lose their close relatives, physical property, means of livelihood and remain under the traumatic conditions for quite' some time. The main purpose of the entire package of economic rehabilitation is to 'bring the affected community into the mainstream again,

The economic rehabilitation of any disaster affected area may include the following components :

- Agricultural rehabilitation of disaster affected area;
- Rehabilitation of artisans and marginal businessmen affected due to the disaster, and
- Rehabilitation of animal husbandry in the area affected due to the disaster.

26.4.1 Agricultural Rehabilitation of Disaster Affected Areas

During any disaster, a large number of farmer families suffer losses of lives and property. The losses to crops, livestock, poultry, seeds and other agriculture inputs, farm implements and equipments are some of the hardhitting after effects. Besides, a large number of families suffer from various types of injuries/diseases and require treatment in the hospitals. Those families which survive the wrath of nature during the calamity, remain mentally and psychologically depressed and are riot in the proper mood to carry out the different normal operations of farming.

Loss of farm implements and equipments required to carry out farming operations and loss and/or damage to the seed and fertilizer stocks storecl make it impossible for the farmers to undertake various activities related to farming including primary tillage, sowing/harvesting of crops and related activities. In view of this, it becomes necessary to take up the agricultural rehabilitation in the disaster affected. region urgently. This entire programme can be divided into:

a) Short-term Measures for Agricultural Rehabilitation

b) Long-term Measures for Agricultural Rehabilitation

Short-term Measures for Agricultural Rehabilitation

The short-term measures for agricultural rehabilitation include the sowing of the next crop after the disaster and harvesting of the remaining portion of the crops affected by the disasters. Due to the losses caused by the disaster, the farmers remain unable to restart the farm activities. It is thus necessary to provide assistance to the affected farmers in carrying out the different operations necessary for sowing/harvesting. Most of these activities are labour intensive and require large number of agricultural labourers. The agricultural labourers can be Hired from the neighbouring areas, which are not affected by the disaster but they will have to be paid wages, which shoot up during the disaster relief work. Therefore, . some cash grant or loan will be needed to be made available to the farmers.

Another immediate requirement of the disaster rehabilitation package is to provide fertilizers to the affected farmer families. Most of the farmer families suffer losses and remain financially unable to purcliase necessary seeds and fertilizers in disaster situations. It then becomes important on the part of the government or voluntary groups to provide requisite quantity. of seeds and fertilizers to carry out the necessary agricultural activities.

Long-term Measures for Agricultural Rehabilitation

In the aftermath of disasters, a large number of agricultural implements and equipment are either damaged or lost along with the agricultural inputs. Hence, in addition to the provision of free fertilizers and seeds, the necessary equipment /tools must also be provided to them, besides providing these to the landless agricultural labourers on free/subsidised rates.

The farm implement kits to be distributed to the farmers must include the tools necessary for sowing and harvesting depending on the season. The tool kits for farm labourers must include the small equipment necessary for support operations in farming like "khurpies" and sickles.

In the severely disaster affected areas, the loss of bullocks and other farm animals hamper different farm operations like ploughing, sowing and harvesting of crops, etc. It may be necessary to provide bullocks to the affected families particularly marginal farmers to restart all those activities once again.

After any type of natural disaster, a majority of irrigation wells and pump sets as also irrigation/distribution system get damaged. A proper and scientific survey must be carried out to quickly assess the actual situation/condition of these structures after which adequate urgent rehabilitation of these structures and systems should be the first priority.

26.4.2 Rehabilitation of Artisans and Small Businessmen Affected due to Disasters

In most of the disaster affected areas, a large number of artisans along with the small businessmen lose their livelihood. For a large number of people under this category, the disaster results in loss of a market place for the final products or raw materials. Due to the decentralised nature of working of artisans/craftmen, it becomes necessary to provide them with small work sheds, necessary tool kits and soft loans to enable them to secure raw materials and to market the final/finished products. Another way is to rehabilitate the affected people under this category by starting the rural industrial units at the block level within disaster affected areas. Within these .units, various identified artisans like carpenters, black-smiths, gold-smiths, tailors, potters, machines, cycle/rickshaw repairers, etc., may be provided basic infrastructural facilities like working sheds, internal roads, electricity and water supply. However, experience has shown that such artisans or small shopkeepers prefer to restart their work at their original places and do not like to relocate themselves in a separate business area scheduled from the residential area. Therefore, ascertaining the wishes of the community is essential. Rehabilitation process should not disturb their traditional customs or life styles.

A large number of small businessmen like small shopkeepers, tea stall owners, flour mill owners, etc., might have suffered damage to their respective units. The rehabilitation of all such affected people under this category should also have the provision of monetary loans on easy terms apart from some cash as outright grant.

26.4.3 Rehabilitation of Animal Husbandry Affected due to Disasters

Animal Husbandry is an important and integral part of village life. It is a useful resource and serves as a means of livelihood for farmers particularly in the agricultural system of the country. It therefore becomes necessary to rehabilitate the farmers by replacing the lost livestock, by providing fodder during emergency period and by constructing the damaged cattle sheds. After any disaster, the trained animal husbandry people should take up the rescue and relief work of trapped animals under debris, removal and disposal of dead bodies, treatment of injured animals, vaccination against any epidemic, and establishment of cattle camps. Proper care in terms of health, provision of fodder, water, housing and proper sheds must be taken up. Any livestock rehabilitation package should include the following:

- replacement of the dead milch cattle- to the affected farmers.
- free cattle feed for about 2 to 3 months.
- preventive medication for entire livestock to check the spread of any disease among the surviving cattles.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What are the main features of the economic rehabilitation of disaster affected areas?

2) What are the main components of the rehabilitation package for artisans and small businessmen affected due to disasters?

3) What are the main features of the rehabilitation of animal husbandry affected due to disasters?

26.5 LETUSSUMUP

Since disasters like floods, droughts and earthquakes occur quite frequently in our country and our scarce resources have to be diverted to relief and rehabilitation work, this unit has laid emphasis on the basic concept behind any rehabilitation package in order to bring back the affected communities and areas to their original state that existed prior to the disaster. It has also discussed the rehabilitation package offered after any disaster, which has been classified into infrastructure redevelopment, social rehabilitation and economic rehabilitation

programmes. The unit has paid special attention on the rehabilitation of educational activities, agricultural rehabilitation as well as rehabilitation of women and children in the aftermath of a disaster.

26.6 KEY WORDS

Artisan: A skilled manual worker, a handicraftsman, a mechanic.

Infusion Fluids:' Medicinal liquids that are injected into the body of the patient, e.g., injections, glucose and saline solutions

Social Forestry: Growing of plantations for the use of villagers' basic needs preferably with their participation in the process.

Occupational Therapy: Treatment of patients by providing a creative occupation or hobby.

26.7 REFERENCES AND FURTHER READINGS

Misra Girish K. and G.C. Mathur eds., *Natural Disaster Reduction,* Reliance, New Delhi, 1993.

Vinod K. Sharma ed., *Disaster Management,* NCDM, *I.I.P.A.* New Delhi, 1994.

26.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress **1**

1) Your answer should cover the following points:
   - Rehabilitation envisages resettling of the disturbed communities
   - This is achieved through (a) Rebuilding and retrofitting the damaged buildings including houses, and (b) Restoring the socio-economic status of the community

2) Your answer should include the following points:
   - Repair, retrofitting, redevelopment of housing and infrastructure
   - Social rehabilitation programme
   - Economic rehabilitation programme
   - Other related programmes such as environmental improvement in the area

3) Your answer should include the following points:
   - Strengthening or restrengthening the healthcare facilities in the disaster-affected area
   - Rehabilitation of activities related with rehabilitation of women in the area
   - Resurrection of educational activities affected by the disaster in the area

Check **Your** Progress **2**

1) Your answer should include the following points:
   - Agricultural rehabilitation of the disaster affected area
   - Rehabilitation of artisans and marginal businessmen
   - Rehabilitation of livestock

2) Your answer should include the following points:

- They should be helped in the repair of their damaged place of work or should be provided alternate workplace if their original shop is destroyed beyond repair
- They should be provided with basic tools for their craft or trade
- They should be provided small loans on easy terms to restart their work
- In the process of rehabilitation, the artisans and small businessmen should not be forced to abandon their traditional area of work, customs or lifestyles.

3) Your answer should include the points:

- Replacement of the dead milch cattle to farmers
- Preventive medication to cattle against spread of diseases.

UNIT 27 RECONSTRUCTION AND REHABILITATION AS MEANS OF DEVELOPMENT

Structure

27.0 OBJECTIVES

After studying this unit, you should be able to :

- understand and explain the interconnection between disaster management activity and development activity
- discuss how rehabilitation can be incorporated as part of development planning
- describe the different elements of reconstruction and rehabilitation as a means of development.

27.1 INTRODUCTION

In areas where in spite of best mitigation efforts, disasters do take place and cause serious damages should also be viewed as opportunities to reconstruct and rebuild the entire socio-economic as well as physical structures to match new requirements. Post-disaster reconstruction and rehabilitation need not be viewed merely as a disaster management activity, but also as a development activity. This approach is also applicable to pre-disaster situations, where the preparatory disaster mitigation activities may be incorporated as a part of the overall development plan for the area. The prime objective of such an approach is to integrate the rehabilitation process with the overall development process and to seek out opportunities even in threat situations.

The action that follows an occurrence of a disaster is usually two-pronged. As an immediate succour to the affected community, relief operations may be commenced providing for food, healthcare and temporary shelter. If, however, the damage is very high and the disaster is likely to recur, a long-term rehabilitation strategy may be launched as a part of the overall development of the area.

27.2 DISASTERS AND DEVELOPMENT

The housing especially in rural and semi-urban regions in India varies considerably according to varying climatic factors and environmental constraints of disasters such as earthquakes, cyclones and floods. This diversity also reflects the cultural identities of local communities.

During rehabilitation and reconstruction, it is important to stress upon the building standards, materials, technologies and planning apart from architectural guidelines that permit local artisans and households to build functionally efficient housing in response to their own needs, affordability and creativity combined with adequate resistance to withstand destabilizing forces during disasters.

Specialised building codes and planning guidelines should be prepared for housing in areas that are disaster prone. Since in most cases, the damage to houses occurs in remote rural areas where settlements are small consisting of poor population; and the houses are built with traditional locally available biomass based materials. The strategy should be to maintain a continuing system of developing appropriate technology, imparting education and training, creating awareness for inducting improved technologies and upgrading the skills of local artisans and building infrastructure. While devising structural as well as non-structural mitigation strategies, it is necessary to recognise and integrate the positive elements of indigenous technology/locally available materials and the cost-effective traditional coping mechanisms of the people residing in risk prone areas. During reconstruction and rehabilitation, the' first issue that comes into picture is to provide housing for all the survivors of a natural disaster.

a) Housing

Location : The first and the most important issue is the location on which the houses will be built up. The relocation on non-agricultural piece of land will be preferred. But if such a location is far off, it will not be practical, since the people would like to be relocated nearby. In such a case, if use of agricultural land is necessary, this would further affect them economically.

While selecting a house site, the following points should be considered depending upon the vulnerability of the area to the particular disaster(s).

i) Earthquakes:

a) The nature of the soil should be taken into consideration while designing the foundation of the building.

b) Avoid narrow ridges, steep slopes, narrow valleys and sites near cliffs or large gullies.

c) Prefer sites with hard bedrock at or near the surface.

d) Prefer sites where landslide are unknown in the surrounding area.

e) Prefer sites where there is no sign of active "faulting " and avoid areas near ponds or swamps or deep or long cracks in the ground.

ii) Cyclones:

Cyclones are characterized by heavy rains, very strong winds and storm surges. Therefore, prefer a site away from seacoast, flood plains and lakesides to avoid flooding risks. Hence the following types of lands are to be avoided: '.

a) land at a low elevation relative to lagoon, river or surrounding lands.

b) land which lacks natural outlet to discharge the very large volume of water; and

c) land at the foot of slopes, which will receive direct surface run-off.

iii) Landslides:

a) Avoid a site near an unstable slope, at the foothill of the slope or in an area with known history of landslides.

b) Local geographical conditions will indicate severity of rislc

c) Avoid an area near a place where quarrying is being done or has been done.

d) Avoid a deforested area in the mountains

iv) Flash Floods:

a) Avoid low lying areas, wetlands and lagoon mouths.

b) Avoid edges of inland lakes.

c) Avoid flood plains and particularly the flood ways.

d) Avoid housing in narrow defile or gorge.

e) Avoid downstream banks and flow ways below dams; and

f) Provide protective measures such as channelisation, ponding areas and flood walls, wherever feasible.

v) Snow Avalanches:

a) Avoid areas of heavy snow or rain in hilly areas. I-Ieavy snowfall can be associated with heavy rain.

b) Prefer sites where avalanches are unknown in surrounding area.

c) Avoid formation of snow pockets on roof and on site.

d) Design roofs with slopes greater than 50 degree to dislodge the Snow load.

e) Snow load may be assumed to be 2.5 kg/sqm./cm. in depth.

After deciding the location, the housing component is broken up into the following sub-components:

1) Acquisition of **Land for** Relocation Sites along **with** the Compensation

After the location is finally decided, if it falls up in the Government land, the process of acquisition becomes easy as the Gbvernment is itself the owner of the land. But if that piece of land is owned by somebody else, then the Government will have to pay due compensation to the owners. Often it becomes very difficult to acquire land but as a charitable cause the owners often agree tp it. Still, the compensation has to be given by the Government. Often due to lack of funds and coordination, and delays in receiving the funds, the process is slowed down. This leads to imbalance and confusion among the people. Therefore, immediate funds must be raised in order to help people and no beneficiaries should be included during this process.

2) **Landuse**

Developing a policy .framework for landuse on the basis of an analytical study of potential hazard areas is very necessary. Many of the disasters can be avoided by proper planning and avoiding habitations in the areas prone to natural hazards.

3) Reconstruction of the Mouses

This involves the reconstruction of the damaged houses, which is based upon the number of survivors or the disaster affected people. During reconstruction, the following aspects should be considered:

In-site Reconstruction: After the disaster is over, people are generally given relief funds, in order to reconstruct their houses. Most people, in the aftermath of a disaster or even after the disaster is over, opt to stick to that very land and try to rebuild on that piece of land. This happens mostly because the people are emotionally attached to that land.

Repair and Strengthening:

Many existing buildings do not meet the strength requirements against disasters, especially non-engineered residential buildings. This is partly so, because of original structural inadequacies, material degradations or unsafe alterations carried out over a period of time. The very purpose of strengthening of such structures is to upgrade their resistance to disasters or in case of structures damaged due to a disaster, to make them safer under future occurrences. Most of the time, the relative cost of reconstruction as against repair and strengthening becomes a deciding factor in the selection of the appropriate alternative.

Pilot Strengthening of Undamaged Houses:

This operation could be undertaken by the house-owners at their cost and at their own pace. A pilot programme should be organised in order to select the houses so that they could be strengthened. Qualified consultants could be employed to develop technical solutions and cost estimates for such pilot houses. Apart from this, publicity through the various media for strengthening their houses could also be made use of. Training the local skilled workers should also be carried out through the suitably located building centres. The Housing and Urban Development Corporation (HUDCO) has taken a praiseworthy initiative to establish numerous building centres in the country where local masons and other artisans are trained.

Construction of Model Houses

Model houses and buildings should be constructed to demonstrate cost-efficient building techniques, the use of loeal materials, and incorporation of disaster resistant construction features. The objective of this exercise would be to improve traditional building techniques, and generate confidence among residents about the use of appropriate construction material such as stone, and its by-products.

b) Infrastructure

The second important issue after housing is the provision of the infrastructure facilities. This component is further classified into the following components:

i) Upgradation of the Transit Shelters:

The activities undertaken are:

a) Improving flooring

b) Providing bathrooms

c) Strengthening the sheds

d) Improving ventilation

e) Improving drainage and internal roads

ii) Infrastructure and Amenities in Relocated Areas:

This sub-component is tied to the housing construction programme in the relocated areas. Administrative approval for the sanction of funds should be provided for the construction of the access roads to the relocated areas.

iii) Roads and Bridges:

Often when the disaster occurs, roads and bridges are disrupted. So, it becomes very important to construct/repair the roads and bridges in order to have smooth and quick transport network. This will not only help the people in the post-disaster period to come back to their normal life and pace but will also help in forming connections with the entire region.

iv) Public Buildings:

Repair/Reconstruction of the public buildings eg. administrative buildings, health centres etc., should be done so that the people are benefited. I.T.I.'s (training centers) should be established in order to train the skilled, local artisans, who can then use the modem techniques along with the traditional ones to construct the houses and other buildings keeping in view , adequate safety measures.

v) Repair and Strengthening of Historic Monuments:

The required fund should be sanctioned by the Government so that the historic monuments of national importance are preserved. As such, the structures are normally old structures, and therefore vulnerable to be affected during disasters. .

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) While selecting a house site, what factors must be kept in mind?

2) What type of infrastructural facilities need to be provided in a disaster affected area?

27.3 RECONSTRUCTION AND REHABILITATION AS MEANS OF DEVELOPMENT

27.3.1 Social Development

The consequences of disasters are particularly adverse on certain vulnerable groups such as those below poverty levels with poor perception of risk and no institutional supporl. Records of past disasters suggest that the following groups of people are particularly at risk and require special attention:

- Single parent families;
- Women, particularly when pregnant or lactating;
- Mentally and physically handicapped people;
- Children; and
- the Elderly .

People living or working in remote areas and seasonal migrant labour groups may also be at risk and pose special problems for both relief and mitigation. If people are aware of potential hazards, their nature and their likely impact, and understand what actions need to be taken to reduce risks, then they become less vulnerable. This is where illiteracy and lack of information create serious handicaps in disaster management. Risk perceptions of various groups need to be assessed and awareness programmes need to be initiated. Poverty levels are important because the poorer the people are, the more they suffer when exposed to severe disasters. They are, in fact, exposed to risks everyday. Risk perception also relates directly to the level of awareness and perception of risk. In sum, if there are groups whose livelihoods are at risk, living or working in densely populated areas, with low perception of risk, and without institutional support, the cumulative effect would be high social vulnerability. Apart from all this, the social development is also affected by the life styles, living habits, occupation and cultural patterns.

In rural areas, normally the housing pattern is according to the traditional patterns and beliefs of the people. In some cases, during the development stage, these create a set of obstructions as well. For example, in villages, it is seen that in the past, the whole village used to develop according to the caste system with some living inside the village, according to their domination and the others outside the village. For rehabilitation/reconstruction, it becomes very difficult for the Government to plan and provide for this kind of traditional social

structure as they normally design according to the number of liouses required. However, the position has progressively changed and the social order has accepted restructuring. In some pockets, there could be some resistance, which can be broken only through education and increased social interaction.

27.3.2 Economic Rehabilitation

For economic rehabilitation, apart from making the economic loss assessment, it becomes necessary to mobilize funds. Most of the funding is provided by the government at the state and central levels. As far as tlie central government is concerned, the scheme of financing the relief expenditure arising out of natural calamities came into force w.e.f.1st April, 1990, consequent upon the acceptance of the recommendation of the Ninth Finance Commission. These Finance Commissions are appointed by tlie Government of India every five years and make recommendations for a five year period.

The Eleventh Finance Commission has already recommended the financial arrangements for 2000-2005. Apart from the Government sources, help in the form of both relief measures and funds is 'sometimes received from international agencies and through voluntary organisations. The monetary assistance from such organizations, especially the international ones, is assigned to the Prime Minister's National Relief Fund.

Economic rehabilitation generally comprises tlie following sub-components:

i) Provision of safe drinking water to ensure healthcare
ii) Provision of roads to facilitate transportation of persons and goods
iii) Clearing drainage congestion to avoid floods and water logging
iv) Creating local opportunities for income generation by value addition to local produce, and encouraging new products based on local raw material
v) Education and training to create awareness on disasters and steps to mitigate the averse impacts
vi) Replacement of agricultural implements, cattle, small shops etc., lost in disasters
vii) Creation of healthcare facilities especially for the elderly, handicapped and the sick.

27.3.3 Afforestation

Forests play a crucial role in environmental equilibrium apart from providing food, fuel, fodder and timber for sustenance of the people. Looking upon these as a cheap and renewable source of energy, construction material and wooden articles for homes and offices have led to extensive deforestation with adverse consequences for human, plant and animal life.

The Report of the National Commission on Agriculture appreciated the productive and protective functions of forests and recommended proper investment in social forestry to meet fuelwood and small timber needs of the rural people. As a result, the programmes for social forestry and farm forestry gained momentum.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) Which sections of people should receive special attention while planning a social rehabilitation package?

2) Throw light on the different sub-components of economic rehabilitation.

27.4 LET US SUM UP

Reconstruction and rehabilitation should be viewed basically as developmental activities to be taken up in extreme demand conditions such as in the aftermath of disasters. Therefore, the approach to such programmes should be positive with stress on building new socio-economic and physical structures. This unit has laid emphasis on the need to view disaster management activity as a development activity while devising structural as well as non-structural mitigation strategies. It has stressed the point that it is necessary to recognize and integrate the positive elements of indigenous technology, locally available material and traditional cost-effective coping mechanism of the people residing in risk prone areas. The' unit has thrown Light on the prime areas of social and economic development by drawing attention on construction of houses, infrastructure development and rehabilitation of vulnerable groups such as women, handicapped, children and elderly through adequate financing schemes and promotion of job opportunities.

27.5 KEY WORDS

Avalanche: Large mass of rock debris or snow that moves rapidly down a mountain slope, sweeping and grinding everything in its path.

Defile: A narrow long pass or passage between hills - so narrow that persons can march only in **a** file.

Faulting: **A** fracture or crack in the earth's surface.

Lagoon: **A** shallow lake formed at the mouth of a river or near the sea, but separated from it by a sand,mound.

27.6 REFERENCES AND FURTHER READINGS

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27.7 ANSWERS TO CHECK YOUR PROGRESS EXPERSISES

Check Your Progress 1

1) Your answer should include the following points:
   - Location-keeping in view of the impact of the likely disaster
   - Preference of hard bed rock sites
   - Avoidance of land which lacks natural outlet for water flow or which receives direct surface run-off
   - Avoidance of low lying area, flood plains, edges of inland takes, downstream banks etc.
   - Acquisition of land for relocation

2) Your answer should include the following points
   - Upgradation of transit shelters
   - Provision of amenities in relocated areas
   - Reconstruction of roads and bridges
   - Repair and reconstruction of public buildings
   - Repair and strengthening of historical monuments

Check Your Progress *2*

1) Your answer should include the following points.
   - People below poverty level
   - People with poor risk perception
   - People with no institutional support
   - Single parent families
   - Women and children
   - Aged and handicapped

2) Your answer should include the following points
   - Provision of safe drinking water
   - Provision of roads
   - Clearing drainage congestion
   - Creation of local job opportunities
   - Education and training
   - Replacement of implements, farm cattle, small shops etc. lost in disaster
   - Creation of healthcare facilities specially for the elderly, handicapped and the sick.

UNIT 28 AGRICULTURE AND IRRIGATION

Structure

28.0 OBJECTIVES

After studying this unit, you should be able to:

- discuss how natural disasters can damage agriculture and irrigation systems,
- throw light on the nature of losses to agriculture and irrigation system in cases of droughts, floods and cyclones, and
- explain the nature of rehabilitation measures to restore agricultural activities.

28.1 INTRODUCTION

Agricultural activity is often adversely affected in any unforeseen weather changes or variations in physical conditions. This gets further accentuated in case of natural hazards as the impact is much more severe and large-scale. Three types of natural disasters cause maximum crop loss. Cyclones, which are prevalent in coastal areas and are accompanied by high speed winds from surge and heavy rain; Floods, especially river water floods, which may inundate vast areas of agricultural land submerging all crops; and Droughts, which may make it impossible to grow crops due to lack of moisture and the resultant dryness.

In areas where natural rainfall is insufficient or not well-distributed, successful agriculture becomes heavily dependent on irrigation systems; natural disasters may also cause damage to the irrigation systems thus crippling agricultural activity. Both man-made irrigation and natural irrigation systems get altered depending on the nature and severity of the natural disaster. Adverse effects on irrigation system have long-term impact on agricultural activity. The immediate impact on agriculture is the loss of crop and income to the farmers, depending on the severity of the damage, while the loss felt by the community may be long-term or short-term.

Reconstruction and rehabilitation of agriculture and irrigation activity is usually two-pronged. As a short-term measure, relief may be provided to the affected community by distribution of essential food items (e.g. through the Public Distribution System) or by provision of alternate employment, As a long-term measure, rehabilitation may be provided through the provision of improvement of irrigation systems. Sometimes when the existing system is damaged due to natural disaster, the community itself may be asked to help in restoring the irrigation through participation. Other measures may include, alternate cropping

and soil conservation practices, watershed management, and afforestation. All these can provide sufficient protection against future crisis. This unit will try to familiarize the learners with techniques to combat losses caused to agriculture and irrigation.

28.2 DAMAGE CAUSED TO AGRICULTURE AND IRRIGATION BY NATURAL DISASTERS

Agriculture and related infrastructure get severely affected by cyclones, which are accompanied by torrential rains, hurricane winds and storm surge. The torrential rains cause river water levels to rise in a very short time causing flash floods. When high storm surge enters inland, there is a flood like situation with high amount of salt intrusion on the top soil of the land. The timing of cyclone is also significant. It means if a cyclone occurs when the crop is ready for harvest, very high wind speeds can cause great damage. The damage caused by floods to agriculture, in any area, is determined by the severity of the flood, the extent of area affected, the duration of the flood, the speed of the flood currents; and the nature of crops grown in the area. Here too, the timing of floods is an important factor. If floods come at a time when there are no standing crops in the fields, there will be no loss of crop, and the fertilising silt depositecl and moisture left may even be a boon to the farmers. Floods, which come early in the cropping season are likely to cause nominal damage as the affected area can be resown or replanted after the disaster. However, floods coming late in the cropping season may cause considerable damage depending upon how severe they are.

Another important aspect is the cropping pattern and crop varieties followed in' the flood prone area at the time of floods. A crop like paddy suffers less as compared to other crops like maize, jowar and bajra. In fact, paddy can easily tolerate mild submergence for a few days. A study of flood affected districts of Uttar Pradesh and Bihar made by the National Flood Commission bears this out. A year of severe floods in 1971 in Uttar Pradesh and 1974 in Bihar had been selected for both the states, and the districts selected in each state were those, which had been more severely affected by floods as determined by the percentage of crop area submerged. It has been found that the decline in production in the Uttar Pradesh districts was as high as 85 per cent in maize and 65 per cent in the case of both Jowar and Bajra, while in Bihar districts, production and yield of maize crops suffered by about 26 per cent. The paddy crop, on the other hand showed little or no decline in production in the selected districts of either of the states.

Assessment of Crop Damages

General

The assessment of economic loss due to natural disasters is done by assigning monetary value to all losses including food production. The assessment of crop damage inay be done with the help of crop-wise information on:

- areas completely damaged, partially damaged and resown; and
- yield under normal, partially damaged and resown conditions

The farmers have to be well-adapted for regular flood conditions and should keep seedlings of rice ready for replanting. The gross crop area affected by floods is the total area submerged. The crops are completely damaged with no production in some areas, whereas the damage is partial in the remaining areas.

Some of the areas where damage is complete are resown. Therefore, such areas are not counted along with completely damaged areas. Rice is the most suitable crop for replanting purposes under flood-affected conditions. An important point to note is that the agency making the assessment of damages and its purpose behind such assessment plays a notable role in the accuracy of such assessments. Therefore, the method and the process have to be transparent and unbiased in order to be credible.

Damage by Floods

The practice followed in India to estimate damages in agriculture due to floods is based in terms of loss of potential output. It is seen that this may result in overestimation of damages if the land is resown or replanted as may happen if floods come early in the cropping season. Here, the damage assessment in terms of loss of inputs would be more realistic. Such assessment requires information on crop areas completely destroyed and areas replanted or resown; and norms of input loss in case of areas completely destroyed. Damages have to be determined with reference to the stage of the crop at the time of the floods. When floods come quite late in the cropping season so as to eliminate any possibility of resowing or replanting, then the damage should be measured in terms of loss of potential output. Quantification of this loss would raise questions like how to determine the yield of the affected crop and what prices to use for finding their monetary value .

Beneficial Effects of Floods on Agriculture

So far, we have considered the unfavourable consequences of floods on agriculture. However, there are several favourable or beneficial effects also, though these are not counted or well-known. The most important and well-known of these is the effect of fertilising silt deposited in the flood plains. Most of the flood plains which are known for their fertility such as the Indo-Gangetic Plain, the Godavari Plains in India, the Nile Valley in Egypt, and the Yangtze in China, owe their origin to deposition of silt for millions of years. Flood plains have, therefore, fostered great civilisations. There is a general acceptance that silt brought by flood has a fertilising value which results in bumper crops. Inundation of flood plains is also known to wipe out soil borne pests like rodents. Similarly, prolonged in'undation inhibits weed growth. The residual moisture content after the flood may enable farmers to raise a good rabi crop; for the same reason, crop yields located on high lands may increase. Floods also help in removing dirt and filth and flushing out pools of stagnant water.

Damage by Droughts

Droughts have always had a direct and significant effect on agriculture activity. The level of impact is related to the severity and nature of drought on the one hand and the social and economic status of the community on the other. Succinctly put, drought proneness is said to arise out of "the juxtaposition of and interaction between two distinct types of sub-systems: an ecological system characterised by scarcity of water resources and an uncertain and variable, rainfall pattern, and as importantly, a socio-economic sub-system charactcrised by the virtual absenck or insignificance of non-agricultural incomes for an overwhelming majority of the population".

The case of Kalahandi and Bolangir Districts (Orissa)needs to be noted. Paddy is grown under' rainfed conditions, which is a good 1000 mm and above, but

unaided by artificial irrigation, any failure of rains at the time of maturity in September, results in the failure of the crop. In an area, which is predominantly inhabited by backward tribes and is already at low subsistence level, the impact is almost immediate, recurrent and very severe.

Damage to Irrigation

Water is essential for human beings, animals, plants and microbes. If you ever visit a river after the withdrawal of monsoon, you will find people growing various crops including vegetables on the banlts of the river. Thus, the plants, which will grow here will send roots to the water front so that they don't get desiccated. It is a well-known fact that the water content in parts of a plant varies from about 50 per cent to 90 per cent. Traditionally, agriculture in the Indian sub-continent has depended on the annual rainfall cycle. As about 80 per cent of the annual rainfall on an average is received during the four month monsoon season, there is a large dependence of agriculture on the monsoon season. However, such dependence on natural systems has restricted the increase in agricultural yields. This is because about 60 per cent of the arable area in the country is rain-fed and depends on rain only. Lack of rainfall, has often led to crop failure and drought conditions. Also, it has not been possible for sowing crops during non-monsoon seasons due to lack of supply of water. In such situations, artificial means of irrigation have considerably helped in maintaining sustained and increased yields. But, irrigation systems need large funds and time to build. Moreover, these are often opposed by environment activists.

Often irrigation systems also suffer damage and dislocation due to natural disasters. Floods, for example, can cause canal systems to overflow or cause breaches in embankments not only damaging the irrigation system but also crops, life and property. Even the natural drainage systems get altered by floods and vast tracts of land may be rendered unsuitable for agriculture. Quite often hill torrents emerging from the foot-hills into plains keep changing their course as a result of which a wide area goes under the river bed and is rendered unsuitable for cultivation. For example, the river Chenab in the state of Jammu and Kashmir spread over a large width of 10 to 12 kilometres near Akhnoor and the Kosi river in Bihar, (before it was embanked) is reported to have changed their course springing over a vast area rendering large tracts uncultivable. As no crop is grown in such areas, these do not figure in the calculation of damages associated with floods.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What do you understand by assessment of crop damages?

2) What are the beneficial effects of floods on agriculture?

28.3 MEASURES TO COMBAT THE LOSSES CAUSED TO AGRICULTURE AND IRRIGATION

28.3.1 Alternative Cropping Pattern

The worst feature of tlie damage inflicted by a natural disaster is its itnpact on the production of crops and consequent unemployment of agricultural labourers. A flood or a cyclone can inflict a very severe damage to crops as well as human life and property, but its effect is quite often localised and the areas, which are not affected usually enjoy the benefit of niore rainfall. The overall consequence of floods on tlie production and rural employment situation, therefore, is much less intense than that of a drought, which not only covers a much larger area but also lingers on for months and in some cases upto a couple of years. This, therefore, underscores the importance of adopting crop stabilisation strategy. This strategy in a situation of drought involves various techniques:

Crop Stabilization Strategies

Crop Life Saving Technique:

The essence of Crop Life Saving Technique lies in water harvesting and moisture stress alleviating practices. Subject to the dynamics of weather conditions, a plan of operation of alternative crops may be kept ready with a provision of choice between alternative cropping strategies to suit different weather conditions. The new high yielding varieties particularly wheat and rice are highly sensitive to timely availability of adequate doses of water. Some other crops like bajra and jowar can even survive during periods of soil moisture stress. Therefore, cropping pattern in such a contingency should be tilted in favour of these crops.

Compensatory Cropping Programme:

Another technique in tlie crop stabilisation strategy is tlie compensatory cropping programme. This has two dimensions; one is to try to compensate the crop loss in the most seriously affected areas by intensifying production programme; and to increase the yield in most favourable areas where there has been good rainfall or where irrigation facilities are available. The second is to make up for the crop loss in the same area by sowing cash crops or pulses or fodder or rabi groundnut or rabi jowar etc. as the case may be as soon as the season changes and some rainfall is available.

Intermixed Cropping:

Effects of short drought periods of a few weeks can be overcome by adopting correct agronomical practices like deep tillage, deep furrow and mulching, which improve availability of soil moisture. Each year the choice of crops depends upon tlie commencement of the rainy season- its early start. This can vary by as much as 30 days, hence alternative seed packages have to be kept ready as a

measure of contingency planning. One of the effective ways of reducing the impact of variability in the precipitation process is to have a system of intermixed cropping. The agriculturist who is supporting himself from dryland farming will always be better off over a series of years by growing a mix of 2 or 3 crop varieties simultaneously, each having a different period of germination and growth. Short duration crops like grams, mustard and pulses can be very well intermixed with others like sorghum and wheat.

It will be desirable to provide a stronger scientific base to such practices because there are natural limitations on the irrigation facilities that can be provided to the drought prone areas. In the Deccan plateau, more than half of the drought prone region has to still depend on the dryland farming practices, after having developed the water resources of this area fully. The crops that are very sensitive to moisture stress should not be encouraged in the drought affected areas.

28.3.2 Watershed Management

Significant proportion of rain water drains away even in water scarce drought prone areas. Much of this water can be harnessed through appropriate structural measures like construction of check-dams, contour-bunding, and nala plugging. These can be supplemented by providing vegetative cover wherever feasible and economical. This strategy is useful because it has shorter gestation period, better environmental effects and greater amenability to local level decentralised planning. While allocating water for irrigation purpose, the needs of small and marginal farmers should receive preferential treatment and water should be equitably distributed. The use of water should be restricted to growing of those crops, which require less water per hectare for their optimum growth and yield. There should also be a provision of water for common grazing grounds or fields which grow fodder.

28.3.3 Water Harvesting in Small Catchments

In order to ensure effective irrigation, a two-pronged strategy may be aclopted at a macro-scale through large projects or at micro-scale through water harvesting in small catchments. Large reservoir projects have many advantages and benefits therefrom. They are also impressive but often have several financial, administrative, political, social, environmental and operational problems. Several changes could occur during the long gestation period that such projects take for completion. Meanwhile, the crops and varieties, management practices and market structure could undergo a considerable change.

Whenever irrigation is introduced in high rainfall areas, a way has to be found to use up or remove the water stored in the reservoir. This will either involve drawing out of excess water through a well-organised drainage system or letting the water evaporate into the atmosphere. It is the first alternative, which is often discussed. However, it is a very costly alternative, which the slope of the terrain may not always permit to operate. Usually, we require 1,000 – 1,500 mm of rain water to obtain 6 tonnes or more of rice, and about 300-350 mm to obtain 3-4 tonnes of wheat. However, in order to achieve these yields, additional inputs such as fertilisers, pesticides, mechanisation and other management practices are essential.

If the underground water table starts rising, efforts will need to be made to ensure that there will be no consequential waterlogging, rise of water table and salinity. In most of the semi-arid regions of India, where dry farming is practiced, the annual rainfall is 600-1000 mm or so. But this rainfall is erratic and confined to a short duration. Consequently, despite total water availability, there is a deficiency of water for crops. The time-tested old practice has always been of conserving natural run off in tanks, ponds and lakes. The water so stored is used for drinking, for life saving and irrigation of crops, or even as a pre-sawing

irrigation method for a rabi crop. In recent years, efforts have been made to revive tlie practice. The provision of traditional mode of irrigation through small storages calls for a carefully planned management of the scarce rain water. Interestingly, the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, has rediscovered the utility of farm tanks as an innovation for South India, and has advocated water harvesting and tank construction as a major activity for semi-arid regions.

28.3.4 Canal Irrigation

Canal Irrigation is one of tlie ways to compensate the losses caused to agriculture in case of disasters. Larger canal systems enable to transfer the water from one region to another, which has many advantages. For instance, a region sufferin_ from drought or low rainfall could receive water from another region, which has had better or abundant rainfall. It is based on a source of water supply not subjected to tlie floods or drought in another region. As a result, the regions could benefit from the complementarity. Largeiscale canal irrigation is usually linked to a storage reservoir or a barrage in a river. However, large projects and canal irrigation are not without problems. It would suffice for our purpose here to note that each has its own role in rendering irrigation benefits and enhancing agricultural production.

Development of ground water, particularly that is based on deep tube wells has a significant role in irrigation and agriculture. Such ground water facilities would enable conjunctive use of surface and ground waters as well. However, they have relatively high recurring running changes and are dependent on the vagaries of sources of power for running engines/pumps. Furthermore, care has to be taken to avoid overuse or waste of ground water.

28.4 DEVELOPMENT OF PASTURE LANDS, LIVESTOCK, FARM FORESTRY AND OTHER RELIEF SCHEMES

There are various other steps that can be taken to combat losses caused to agriculture and irrigation in disaster-affected areas. Some of tlie areas where attention needs to be paid relate to afforestation with special emphasis on social and farm forestry, development of pasturelands, development of sheep husbandry, livestock development, dairy development etc. Though these areas are already a part of tlie centrally sponsored Drought Prone Area Development Programme, they constantly require a special focus. Both forestry and horticulture, once these have gone through initial stages, need less water than food crops. With the help of judicious planning, it is possible to take up one small area after another where water from available irrigation sources can be assured on priority basis to plants while they arc young.

Livestock need pastures and fodder crops, which in turn need less water than food crops. Therefore, there is scope for growth of livestock provided other conditions needed for it like veterinary facilities; arrangements for marketing of milk and milk products are adequately met. Livestock helps agriculture as it provides bullock for farming and transportation and dung cake for manure and bio- gas plants. Other relief schemes could be suspension and remission of land revenue, provision of temporary employment to affected persons, strengthening of public distribution system, and development of village industries.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) Which are the different crop stabilisation techniques that can be adopted in disaster prone areas?

2) What are the different steps other than watershed management, canal irrigation and alternative cropping pattern that can be taken to combat losses caused to agriculture and irrigation in disaster affected areas?

28.5 LET US SUM UP

Agriculture and irrigation are severely affected by natural disasters. Floods, cyclones and droughts cause maximum damage to irrigation and as a result to agricultural production. This unit has analysed the nature of damage caused to agriculture and irrigation by natural disasters. It has focused on some beneficial effects of floods on agriculture. To combat the losses caused to agriculture and irrigation, it is essential that damages in terms of money as well as potential output are properly assessed and appropriate crop stabilisation techniques are adopted. Many practices such as alternative cropping pattern, watershed management, water harvesting in small catchments and canal irrigation could be adopted with advantage. The disaster affected areas can benefit from innovative employment and technical upgradation schemes. Public distribution system, village industries and marketing facilities need to be strengthened in order to provide relief in disaster affected areas. This unit has also thrown light on these aspects in some detail.

28.6 KEY WORDS

Conjunctive: Combined, connecting

Deep Furrow: Furrow is a narrow field ditch, excavated between rows of plants for carrying the irrigation water through. Spacing of furrow is determined by the proper spacing of the plants. The size of furrow may vary from 8-10 cm deep and as much as 400 m long.

Desiccated: Dried or devoid of moisture

Dryland Farming: Farming in a region characterized by low availability of water, mostly depending only on rainwater.

Juxtaposition: Placing side by side.

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28.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check **Your Progress 1**

1) Your answer should include the following points:

- The assessment of economic losses due to natural disasters is done by assigning monetary value to all production losses.
- Loss is calculated on tlie basis of crop-wise information
- Partially damaged areas are not counted with totally damaged areas
- Damage on agriculture due to floods is based in terms of loss of potential output and also in terms of loss of inputs.
- Norms of input loss have to be determined on the basis of stage of tlie crop at the time of floods.

2) Your answer should include the following points:

- Silt deposited in the flood plains acts as good natural fertilizer
- Prolonged inundation retards weed growth
- Soil affected by pests is wiped out

  Stagnant water is flushed out thus removing dirt and filth.

Check **Your Progress** 2

1) Your answer should include the following points:

Crop Life Saving Technique

- Compensatory Cropping Programme
- System of Intermixed Cropping

2) Your answer should include the following points:

- Water harvesting in small catchments
- Afforestation
- Development of pasture lands and sheep husbandary.
- Livestock and dairy development

Reconstruction nnd Rehabilitation	• Suspension and remission of \land revenue • Adoption of traditional mode of irrigation through small storages • Strengthening of public distribution system • Conservation of rain or runoff in tanks, ponds or lakes • Canal irrigation

UNIT 29 MOUSING TO RESIST DISASTERS INCLUDING RELOCATION

Structure

29.0 OBJECTIVES

After studying this unit, you should be able to:

- explain the necessary features to resist earthquake farces;
- describe planning and designing for cyclone resistant construction; and
- discuss the requirements necessary for safe housing in flood prone areas.

29.1 INTRODUCTION

Natural disasters are a common feature of in the country. All major natural calamities including floods, cyclones and earthquakes cause a large-scale damage to houses year after year in different parts of the country. The thickly populated states like Uttar Pradesh, Bihar, Assam and West Bengal are under threat from more than one type of natural disasters. The northern, central and eastern parts of the country are susceptible to higher flood damages. The cyclonic storms pose major problems in the various coastal districts of most parts of the country, especially Orissa, Andhra Pradesh, West Bengal, Gujarat and Tamil Nadu. The northern and north-eastern parts of the country are under the seismic zone of moderate to severe intensity.

The intensity of natural disasters can be reduced considerably by proper planning and- designing of houses. Since the majority of houses in rural areas of the country are being built by the local semi-skilled masons, the improvement in the skills of thew' building construction workers through training can reduce major losses to houses. This unit will help in understanding some of the basic principles to be followed to build disaster resistant houses.

29.2 EARTHQUAKES

Earthquakes are considered to be one of the most dangerous and destructive natural disasters. The impact of this phenomenon is sudden with no warning and therein lies its damage potential. The maximum damage in case of an earthquake is due to the collapse of poorly constructed buildings and failure of infrastructural facilities. The building types can broadly be divided, from earthquake point of view, into (i) engineered buildings and (ii) non-engineered buildings.

The engineered buildings are those, which are structurally designed by qualified engineers and architects taking into consideration the specified loads including earthquake and wind loads etc., as per the codal provision. For example the R.C.C. frame and shear wall buildings, steel buildings with rigid joints are engineered buildings.

The non-engineered buildings are those, which are constructed by people through local semi-skilled masons and petty contractors etc. Almost all the rural and most semi-urban and urban houses fall under this category, which are weak from the seismic point of view. We will therefore discuss the problems related to non-engineered construction.

29.2.1 Damage to Houses by Earthquakes

During an earthquake, the whole structure including its contents and fixtures, whether resting on floor or attached to the walls, are shaken from their position of rest. The supporting members, wall piers and columns, which would carry the vertical load without earthquake or wind are subjected to horizontal bending and over-turning effects. The nature and extent of damage depends upon the type of structure and its capacity to withstand the complex vibrations generated by the earthquake. The behaviour of buildings during earthquake and type ofdamages of the most commonly used structural system are discussed in the following paragraphs:

a) Earthen Buildings

The performance of earthen houses during earthquakes is generaly poor. The occurrence of wide cracks in the walls, separation of walls at the corners and complete collapse of walls and roofs are very common. The heavy mass of debris results in major losses after tlie collapse.

b) Brick Buildings

The performance of the brick buildings during an earthquake depends on the type of roof, mortar used and overall quality of construction. The performance of buildings under this category has been observed to be poor with pitched roofs with no firm binding effect with the walls, poorer with mud or weak mortarsand still poorer with poor quality of construction. Buildings having rigid roof slabs constructed in cement mortar, generally behave better than others. Cracking is a common feature of these types of houses. Cross cracks are formed in the masonry piers between openings, vertical cracks near the corner leading to the separation of walls through the joints. The separation of roof slab over the walls and failure of parapet walls and staircases are also very common features after the quake.

c) Stone Masonry Buildings

Tlie performance of stone masonry buildings during an earthquake is most disastrous, resulting in complete collapse of the structure. The stone buildings constructed with dressed stones witli cement mortar are able to withstand tlie earthquake forces.

d) Wooden Buildings

The earthquake performance of wooden buildings is generally good. Tlie buildings with wooden frame and cladding with sheeting, boarding, 'ikra' walling, bamboo matting etc., give excellent performance during an earthquake.

29.2.2 Earthquake Resistant House Construction

a) Location and Siting

The choice of site for a building from tlie seismic point of view is mainly concerned witli tlie extent of stability of the ground during earthquake tremors. Different types of grounds behave differently as discussed below.

- **Stability of Slope:** Hill-side slopes liable to slide during an earthquake should be avoided and only stable slopes should be chosen for building location. It should be preferable to have several blocks on terraces than have one large block witli footings at different elevations. A site subjected to tlie danger of rock falls should be avoided.
- **Loose Sands or Sensitive Clays:** These two types of soils are liable to be destroyed by the earthquake so much as to lose the original structure and thereby undergo compaction. This would result in large unequal settlements and damage to tlie building. If the loose cohesion-less soils are saturated with water, they are apt to lose their sheer resistance altogether during the shaking and become liquified.

A site with sufficient load bearing capacity and free from defects should always be chosen and its drainage conditions improved so that no water accumulates and saturates the ground.

b) Layout

Tlie layout of the house/houses slioiild have:

- **Symmetry:** The building as a wliole or its various blocks should be kept almost symmetrical about both the' axes. Symmetry is also desirable in the placing and sizing of doors and window openings. Asymmetry leads to torsion during earthquakes and should always be avoided.
- **Rectangularity:** Simple rectangular shapes behave better in an earthquake than shapes with many projections. It is desirable to restrict the length of a block to three times its width, If longer lengths are required, twoseparate blocks with sufficient separation in between should beprovided.

  Separation of Blocks: Separation of a large building into several blocks may be required so as to obtain symmetry and rectangularity of each block. For preventing hammering or pounding damage between the blocks, a physical separation of 3-4 cm. throughout the height above the plinth level will be adequate as well as practical.

- **Simplicity:** Simplicity is the best approach for earthquake resistant design. Ornamentation involving large cornices, vertical or horizontal cantilever projections etc., are dangerous and undesirable from the seismic point of view. Where this type of work is unavoidable, it should be reinforced with steel, properly embedded into the main structure of the building and securely fastened internally.
- **Enclosed Area:** It is advisable to have separate enclosed rooms rather than one long room. **A** small building enclosure, with properly interconnected walls acts like a rigid box against the earthquake strength.

c) Design Aspects

- **Earthen. Houses:** For resisting the earthquake forces and better performance during the quake, following points must be taken care of:

  i) Restricting length of rooms to about 4 m. maximum and storey height to about 2.8 m.

  ii) Using symmetrical rectangular house plan, and arranging openings symmetrically.

  iii) Restricting the width of openings to one-third of the wall-length and placing these away from the corners by about three times the wall thickness.

  iv) Using clay soil with about 10 per cent clay and adequate fibrous admixtures, both for adobe units as well as for mortar.

  v) Using adequate bond beams on all outer and inner walls with full continuity at junctions. The bond beam could be of R.C.C., wood or bamboo.

  vi) Selecting a roof of minimum weight as far as possible.

- **Brick Buildings:** For earthquake resistance, the following measures have been effective not only in preventing collapse but controlling the propagation and widening of cracks:

  i) Symmetry and rectangularity to be kept in building plan.

  ii) Symmetry to, be kept in location ofopenings.

  iii) Simplicity in elevation is needed, which means avoidance of all ornamental work etc. .

  iv) Intersectjng internal walls in good number are desirable so as to divide the total plan in square enclosures of not more than 6 m. side each.

  v) Total width of opening in a wall to be not more than 50 per cent of wall length in one and two storey houses and not more than 40 per cent in three storey buildings.

  vi) Width of piers between openings or from opening to wall corner to be not less than half the height of the opening.

  vii) Use of steel or wooden dowels going into walls meeting at corners or T-junctions desired to provide effective bonding between them:

  viii) Use of R.C.C. band at plinth level, lintel level and roof level. This is the one single feature, which is most effective ensuring the integrity of the enclosure like a rigid box.

- **Stone Buildings:** For stone masonry buildings, all the protective measures as for brick buildings are useful. For random rubble and half-dressed stone masonry, the following additional measures are necessary :

  i) Provision of 'through' stones or bonding elements along the wall thickness at regular intervals of about one element per sq. m. of wall.

  ii) Restriction of the thickness to not more than 45 cm., since larger thickness encourages undesirable filling materials inside, adding to mass and strength reduction.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What type of damages do you expect in a building in case of an earthquake?

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2) Suggest some methods needed for earthquake resistant construction.

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29.3 CYCLONES

Severe cyclonic storms are responsible for large casualties and considerable damage to property and agriculture. The destruction due to this type of natural disaster is confined to coastal areas only. The principal dangers in case of a cyclone are from :

i) Gales and very strong winds

ii) Torrential rain; and

iii) Storm surges or high tidal waves.

In a cyclonic storm, maximum damage is caused due to coastal inundation by storm surges. The maximum penetration from a severe cyclonic storm surge varies from 10 to 20 km. inland from the coast. Heavy rainfall and the

resulting floods come next in order of devastation. Very strong winds of the order of 100-200 bmph complete the destruction.

The destruction of lite and property, collapse of buildings, felling trees, flying debris, electrocution, rail and aircraft accidents and disease from contaminated food and water during post-cyclone period also contribute to loss of life and destruction of property.

29.3.1 Damage to Houses by Cyclones

The damage pattern due to a cyclone should be considered under three different categories of structures :

i) Engineered Structures

ii) Marginally Engineered Structures; and

iii) Non-engineered Structures

Fully-engineered structures are those that have been designed and built veiy carefully taking into account the wind forces generated due to a storm. Such structures include multi-storey buildings, steel towers, industrial buildings, etc. Non-engineered structures are those that have been built without any guidance from a qualified engineering professional and generally consist of one/two storey residential buildings ctc. Marginally-engineered structures are those where only nominal engineering attention is provided during construction and design details as also the codal requirements are usually ignored. The damage pattern in these types of buildings is summarised below:

i) Engineered Structures

- Overturning of bridges
- Damage to bridges due to high water waves
- Collapse of high steel towers and chimneys
- Blowing off doors and windows including breaking of glass and total collapse; and
- Blowing off of roofing materials from truss roofed industrial buildings

ii) Marginally-engineered Structures

- Severe damage to such buildings due to lack of proper connection between walls and roof and improper strength of the structure
- Blowing off of railing and parapet walls
- Improper consolidation leading to failure of foundation in the elevated situations

  Twisting of transmission towers including electric and telephone poles.

iii) Non-engineered Structures

- Weak connections among various elements of the building leads to total failure of the structure
- Failure of roofs including blowing off of the covering material

  Failure of walls due to high wind pressure

- Blowing off of the projections over the openings
- Buildings with flat roofs (except R.C.C. slab roofs) suffer higher damages.
- Buildings with mud mortar construction collapse due to tidal waves.

29.3.2 Cyclone Resistant House Construction

A study of damaging effects of cyclonic forces on various types of structures gives rise to certain measures for cyclone resistant construction, With the help of these measures, we can reduce tlie damages to structures considerably. The following are a few guidelines for proper construction in the cyclone-prone areas :

a) Location and Siting

i) The building sites, which offer shielding from high winds, such as tlie main landward side of a hill range are preferable.

ii) The building site should be chosen at a ground level above tlie probable maximum tide level, or tlie ground sliould be raised to that level.

iii) The foundation should be taken up to a natural firm level, so that tlie resistance under the footing may not be lost due to floocling. Piles sliould be usecl if site considerations require so, from bearing capacity or scouring point of view.

iv) The water retreating to the sea applies substantial scouring action. Pitching of slopes will be therefore desirable.

v) Sites, which lead to wind concentrations should be avoided. Protrucling ledges on hill slopes may be such locations.

b) Layout

In case of prevailing strong winds, the orientation of building should be with minimum exposure to the wind. The buildings sliould be shaped in such a way that tlie wind pressure on it is reduced. It is desirable to place the smallest face of the building across the prevailing high wind direction.

There may be a considerable blocking of wind by erecting wind breaks on tlie windward sides of the buildings. In the layout plan of settlement, if successive rows of buildings are spaced apart at less than seven times their heights, the wind movement will be reduced. The solid wind breaks like walls cause eddies over the top, which reduce their utilities. Barriers like belts of trees are more effective because they offer a greater depth of protection. Such barriers produce significant results for the first 5 to 10 times or so of their heights in horizontal distance. The optimum porosity of the barriers is in the range of *30-50* per cent. *A* lower figure will cause a greater reduction in windspeed, but an open barrier will be more effective for a greater distance.

c) Design Aspects

i) Roofs: Flat roof arrangement should be avoided, since it results in higher negative pressure (suctions) compared to that on inclined roofs. R.C.C. slab roofs are, however, suitable in view of their weight and rigidity.

- The span of the sheeting, connections of the sheeting to purlins and purlins to trusses, roofs overhangs at eaves level and the roof anchors with walls should be designed for appropriate pressure. Bolts for sheeting connections should invariably be used with washers so as to avoid punching through under wind sections. ,
- Roofs arid their anchors with the walls should be properly designed.
- The purlins should be adequately anchored to the gable ends and diagonal 'bracing installed in the plane of the roof using purlins as the struts so as to provide stiffness against the failure of gables.

ii) Projections

- The projecting elements like antennas and tall chimneys above the roof should be avoided as far as possible. If necessary, they should be kept low and adequately anchored to the structure.
- The horizontal projections such as eave projections, sunshades etc., are subjected to very high uplift force due to strong winds during a cyclone. The projection lengths should be kept to a minimum and designed for pressures as per the recornmendations of the building code.

iii) **Walls** and Supporting **Frames**

- To avoid collapse of the walls inwards on windward side or outwards on the other faces, they should be adequately designed for appropriate design wind pressures. Where necessary, the walls should be reinforced with vertical steel reinforcement or buttressed.
- Providing a reinforced concrete band (sing beam on all external and internal load bearing walls) will greatly improve their individual stability as well as integral box like action and increase the stability of the buildings to make them cyclone resistant to a great extent. Joint reinforcement should alternatively be provided at wall junctions, for instance, in every fourth layer.
- Adequate diagonal bracing must be provided in frame type constructions, both in the vertical and horizontal planes and along both the principal axes of the building.
- In-fill walls, par-titularly on external faces, should be properly secured to the columns.

  Reinforced masonry (brick walls, hollows, concrete block masonry, sandwich walls etc.) should be encouraged in cyclone-prone areas.

iv) Door and Window Openings in Walls

- Large sheets of glass in windows or doors commonly shatter because they are too thin to withstand the local wind pressure. Quite common is also their breakage when struck by wind borne missiles. Ways to combat this danger are:

  a) to reduce large areas of glass by glazing bars or mullions, and

  b) to use wired and/or thicker plate glass.

Use of smaller glass panes will be economical initially and easy to replace later when broken. Additional advantage of avoiding breakage of glass by reducing the size or strengthening large window areas is that this reduces the chances of sudden entry of violent wind into the building, which is a major cause of uplifting of roofs.

- Door and window frames should be anchored to the walls or columns adequately through hold-fasts.
- The bolting or locking device of the door and window shutters should be simple and strong so that they could bc used quickly in order to resist the cyclonic wind pressure adequately and keep the shutters closed.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

I) What are the main dangers in a cyclonic storm?

2) Explain the damage that can be caused to buildings in a cyclone.

3) Suggest a few steps for cyclone resistant house construction.

29.4 FLOODS

Floods cause large-scale-human suffering and loss of assets. Every year, a large number of people lose their lives and property due to this type of natural disaster. The economically weaker sections of society are the worst

sufferers as their dwelling units get damaged or washed away by high flood water currents More so, because these are often located in areas vulnerable to floods such as river banks or flood plains. Floods also cause widespread damages and loss of various kinds of properties like crops, livestock, communication and irrigation systems etc.

Floods are one of the major problems faced by our country every year. Occurrence of floods is a very common phenomenon in many states, causing widespread damages to agriculture system, which is tlie backbone of the economy. Apart from agricultural losses, floods disrupt the entire life of the affected area by damaging the communication systems, transportation network, houses and buildings. arid other infrastructural facilities. It is estimated by the Ministry of Agriculture that over one million houses are damaged annually on an average.

29.4.1 Damage to Houses by Floods

Due to increasing population pressure and economic compulsions, a large number of people are shifting to the flood- prone areas and taking up building activities, thus obstructing the natural function of flood plains of carrying away tlie excess water during tlie flood situation. All this results in increasing vulnerability of houses and buildings due to floods, Tlie extent of damage to the houses depends upon the particular type of flood they are exposed to. Different types of damages due to floods can be explained as :

a) **Severe Damage** to **Houses:** Houses subjected to a large mass of water striking them with force can collapse totally. This is typical of storm surge that accompanies cyclone. Tlie sea waves may reach several meters above sea level and strike the structure with a great force. Flash floods also bring upon sudden pressure on the structures due to strong force of water and cause complete destruction. Even buildings constructecl with R.C.C. may get damaged. 'Kutcha' structures made up of thatch, mud, etc. are wiped out completely. In locations, where the houses are built on loose soil, when severe inundation takes place, complete collapse of the structure is likely.

b) **Partial Damage** to **Houses:** Riverine floods are characterised by low speed and long duration. Prolonged inundation can be expected from riverine floods, which give rise to the following categories of house damage:

   i) The soil gets softened leading to tlie sinking of foundations. This may result in uneven sagging of roof, resulting in the damage of roof covering and supporting systems, cracks in the walls, sinking of floors and scouring of foundation by a slow and steady flow of water.

   ii) The standing water causes deterioration of furnishing, painting, distempering and plastering. All the timberwork of house gets soaked leading lo decay.

c) **Other Effects** on Houses: Floods can also have a devastating effect on land by eroding the upper strata leaving behind a rugged surface, which is unsuitable for construction. The 'reverse process is also a common phenomenon where the flood water brings with it large volumes of fine silt, sand or other materials and deposits on an existing settlement either burying it or blocking it. This phenomenon is very common with flash floods, which have the requisite momentum to carry soil and other material coming in their way.

29.4.2 Flood Prone Area Planning

a) **Urban and Rural Land Use:** Tlie rural areas traditionally liave a large amount of vegetation and afforestation resulting in reduced runoff in small watersheds. Thus, the chances of occurrence of flash floods due to heavy rainfalls in such small catchments are unlikely. Changes in tlie land use pattern liave a great impact on the overall flood disaster situation. The changes in land use, from rural to urban, have an adverse impact on the hydrology of the region and thus increase the flood potential of tlie catchment areas. The urban areas have a lot of paved surfaces in terms of roads, residential areas etc., giving rise to flash floods situation. While planning for the urban areas, these aspects must be given due consideration.

b) **Flood Plain Zoning:** It is a well-known fact that tlie flood hazards reduce as the distance from river or water channel increases on account of increasc in the elevation of land surface. The regular encroachment of floocl plains has forced us to exercise some controls on buildings in such areas. Taking into account tlie variability of the flood hazard, zones are demarcated depending upon the degree of risk and potential damages. Based on the floocl plain zoning concept, tlie flood plains can be divided into the following.

i) Prohibited Zone, where chances of inundation are high and frequent

ii) Restricted Zone, where there could be flooding but less frequent and less vigorous than in tlie prohibited zone. Therefore, some construction activity (non-residential) could be allowed.

iii) Warning Zone where flooding could occur occasionally but there will be sufficient time to warn and to evacuate, if necessary.

29.4.3 Flood Resistant House Construction

Damage to individual buildings and structures may be prevented to some extent by incorporating in their design, the ability to withstand inundation and the strong force of very fast flowing water. Tlie following are some measures which may be helpful in reducing tlie flood damage to houses considerably :

i) **Location and Siting:** The construction of tlie house should be restricted to tlie zones involving least risk. The development of any kind in the prohibited zone should be totally disallowed to avoid the damage to property and to avoid flood situation upstream, causing threats to settlements there. A limited building activity and planned agricultural activities could be taken up in the restricted zone. In this area, minimum ground floor level, flood proofing arrangements etc., should be provided in the buildings, if any.

People wishing to settle down in the warning zone must be warned and advised about the risks involved. The building should be constructed on tlie best bearing soil and on tlie highest ground available locally.

ii) **Layout:** Layout of the settlement should be such tliat it does not block the free flow of water. Ground drainage and escape lanes sliould be incorporated in the settlement layout. Growing of vegetation and afforestation in the catcliment areas and along tlie river banks should be promoted. A thick plantation around the individual house should be grown. Special care should be taken up to protect the adjacent buildings from damages due to collapse of buildings.

iii) **Design Aspects:** The houses, if built should be made on raised mounds, which should be thoroughly compacted and made of locally available soil. When houses are built on silt, they should have a rigid framework construction or should be adequately braced to reduce the risk of damage of overturn in case of floods. Houses constructed with mud are highly vulnerable. and must be given water-proofing treatment.

The roof levels should be sufficiently high above the danger level in order to provide emergency protection. The choice of roof type and area should be such that it gives protection for a minimum period of one day to tlie people who take shelter over there till they could be evacuated.

Check Your Progress **3**

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of tlie unit.

1) Describe the various categories of house damage due to floods.

2) What do you understand by the term flood plain zoning?

3) What are the ways of constructing a flood resistant building?

29.5 LETUSSUMUP

Though not much can be done to prevent natural disasters, the intensity of their impact could be reduced considerably through adequate planning and designing of disaster resistant houses and other structures. This unit has discussed the fact that most of the damage to housing occurs during earthquakes, floods and cyclones and

is caused due lo the poor quality construction and unsafe locations. Focus has to be on safe location and sitting of building, proper layout and engineered design, which are essential for housing to withstand the wrath of any type of natural disaster.

29.6 KEY WORDS

Adobe: Rectangular shaped bricks and blocks used for construction

Cantilever Projections: Projections that are supported at only one end. These do not have columns to support them on all sides.

Cornices: The end edges of the sloping wall

Claddings: Material such as slate, stone etc., put on the roof or wall.

Eaves Level: Starting point of sloping roof

Fibrous Admixtures: Material such as straw, hair, cow dung etc, mixed with soil for the purpose of house construction

Gable Ends: Roofs corner joints or ends to support the wall

Lintel Level: Top of the door or window

Mullions: These are iron bars or rods used to provide support to enlarged windows or doors

Plinth Level: Uppermost level of the foundation at which damp proofing is usually clone

R.C.C: Reinforced Cement Concrete

Scouring Action: Clearing out channel or harbour by heavy flow of water

Trusses: These are made of wood/steel, they have a rectangular profile to provide support to long stands

Wall Piers: Material that provides support to the wall

Dowels: Long thick pieces of wood or iron that are inserted into the walls at the corners to provide support to the roof before it is set.

29.7 REFERENCES AND FURTHER READINGS

G.C. Mathur, *Housing in Disaster Prone Areas*, National Buildings Organisation and U.N. Regional Housing Centre, **ESCAP,** New Delhi, 1986.

Girish K. Misra and **G.C.** Mathur eds., *Natural Disaster Reduction*, Reliance, New Delhi, 1993.

Vinod K. Sharma ed., *Disaster Management*, NCDM, **IIPA,** New Delhi, 1994.

29.7 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- Complete collapse of walls and roofs in case of earthen buildings
- Severe damage to brick buildings using mud or weak mortars
- Formation of cross cracks in the masonary piers, vertical cracks near tlie corners in brick buildings

- Failure of parapet walls and staircases in brick buildings
- Complete collapse of stone masonary buildings

2) Your answer should include the following points:
   - Proper location and siting
   - Symmetrical and simple layout of houses
   - Engineered design

Check *Your* Progress 2

1) Your answer should include the following points:
   - Loss of life and damage to property
   - Collapse of buildings
   - Fellingoftrees
   - Overturning of bridges
   - Collapse of towers
   - Twisting of transmission towers
   - Failure of walls
   - Blowing off of the projections over openings
   - Electrocution
   - Rail and aircraft accidents
   - Disease and spread of epidemic

2) Your answer should include the following points:
   - Blowing off of doors
   - Blowing off of railing and parapet walls
   - Failure of roofs
   - Failure of building walls
   - Total collapse of buildings under combined onslaught of torrential rain and very strong winds

3) Your answer should include the following points:
   - Safe location and siting
   - Proper layout
   - Engineered design

Check Your Progress 3

1) Your answer should include the following points
   - Complete destruction of houses
   - Partial damage to houses
   - Soil erosion, bringing in silt and debris

2) Your answer should include the following points:
   - Prohibited zone
   - Restricted zone
   - Warning zone

3) Your answer should include the following points:

Construction aspects related to:

- Safe location and siting
- Proper layout; and
- Engineered design

UNIT 30 RETROFITTING, REPAIRING AND STRENGTHENING OF HOUSES

Structures

30.0 OBJECTIVES

After studying this unit, you should be able to:

- throw light on the prevalent traditional methods used for the construction of buildings
- discuss the modern techniques for construction of buildings and important features to resist the forces generated due to disasters; and
- highlight the methods used for repair and retrofitting of buildings

30.1 INTRODUCTION

In the wake of a natural disaster, widespread damages to buildings and other man-made structures are the usual occurrence. Most of tlie damaged buildings include mud, stone or brick houses in general and R.C.C. building to a less extent. The damage pattern after any disaster is of varying degrees like few of the buildings may suffer only such damages, whose repair is possible and economical in comparison to reconstruction of tlie building. In any disaster rehabilitation project, repair and restoration of buildings is a major component. This task must be started at the earliest. Besides the repair of buildings after the disaster situations, the most important building activity is to provide necessary strength in the existing building in order to improve their resistance to the violent forces of disasters like earthquake and cyclones. The provision of additional strength in the existing structures is termed as 'retrofitting'. **A** large number of houses in the country are in rural areas, constructed in the traditional manner, using locally available materials. These houses usually do not have any of tlie necessary features to resist the disaster phenomena. Thus additional strength must be provided in these structures, particularly in tlie areas vulnerable to higher degree of disaster occurrence. In the present unit, some of the basic concepts related to repair and retrofitting are discussed.

30.2 TRADITIONAL METHODS OF CONSTRUCTION OF BUIDLINGS

The traditional methods construction of buildings are those techniques, which have merged over a long period of time. These techniques are the outcome of physical, climatic and psychological needs of human beings and have been evolved over decades arid centuries through trial and error. Many of the

traditional methods are still valid and should be adopted because these are cost effective. In the evolution of these techniques, a major role is being played by the availability of building material in a particular region. Based on the building materials, the various types of prevalent building form may be classified as:

i) **Earthen Buildings:** The material used in the construction of earthen houses is clayey earth either in mud lump form or rectangular shaped bricks and blocks, called adobe. The naturally available soil is used without or with a little treatment by mixing fibrous materials like straw, hairs, cow dung etc. The wall sizes in this type of construction differ depending upon the number of storeys to be provided. The size of rooms within the earthen buildings depend upon the type of roofing system.

ii) **Stone Buildings:** The basic unit of stone masonry is the natural stone, which is used in masonry work in random rubble, half-dressed and fully dressed state; the mortar being mud, cement or lime. Most common type of building construction is the random rubble in mud, in the areas, where stone availability is quite good. This type of construction is quite cheap as no dressing of stones is required, while fully dressed stone construction is sparingly used due to higher costs of labour. The half-dressed stone masonry have the half-dressed side of stone on the outer side. In this type of construction, two independent wythes are constructed with lose materials filling between the wythes. The width of the walls depend upon the number of floors, while the room sizes are dependent upon the type of roof and floor of upper floors in case of multi-storey buildings.

iii) **Wooden Buildings:** The wooden buildings include those buildings where the main load bearing structure consists of wooden column, beam frames, although cladding may be of brick or stone. The wood used in construction includes logs, sawn lumber or bamboo.

iv) **Brick Buildings:** This is the most common type of building these days. The basic material for construction is the fired bricks, prepared in various sizes by moulding and fired in different types of kilns and clamps. The standard size used in our country is 23.8 cm x 11.4 cm x 7.6 cm (i.e. 9" x 4.5" x 3"). The wall thickness used in this type of construction is as follows:

- for non-load bearing or partition walls,11.4 cm or half brick.
- for load bearing walls for one storey in mud mortar 23.8 cm or full brick.
- for load bearing walls for two storey in cement mortar 23.8 cm or full brick.

The room width is in between 3 to 3.5 m while the length may be between 4 to 8 m or even more.

The buildings constructed in a traditional manner do not have necessary features to resist the forces generated due to the disasters like earthquakes and cyclones thus, making these buildings unsafe from earthquake/cyclone point of view. In the country, a huge quantity of housing stock had been constructed using these practices. For making these houses earthquake resistant, we have to use the techniques of retrofitting. The necessary characteristics/properties of disaster resistant construction are described in the next section on modern techniques for construction of buildings.

30.3 MODERN TECHNIQUES OF CONSTRUCTION OF BUILDINGS

The modern methods of construction of buildings include those materials and techniques, which are helpful in reducing the damage due to any disaster like earthquake and cyclone. For proper design and construction of buildings in various parts of the country, the National Building Code, developed by the National Building Organisation (NBO) is available. The Bureau of Indian Standards (BIS) has also developed various codes on the earthquake and cyclone resistant construction of buildings. A few codes related to earthquake resistant construction are:

- Criteria for Earthquake Resistance Design (IS:1893-1984)
- Improving Earthquake Resistance of Earthen Buildings (IS:13827-1993)
- Repair and Seismic Strengthening of Buildings (IS:13925-1993)
- Improving Earthquake Resistance for Low Strength Masonry (IS:13928-1993)
- Ductile Detailing of Reinforced Concrete Structures (IS:13920-1993) and
- Earthquake Resistant Design and Construction of Buildings (IS:4326-1993).

The various codes on earthquake resistant design emphasize the following features in a building for proper earthquake resistance.

- Structural integrity of all elements of the building like walls and roofs
- Diaphram action in roofs and floor.
- Provision of bands at different levels like plinth, sill, lintel and roof.
- Reinforcement around openings.
- Provision of reinforcement at critical sections.

To achieve these features, the buildings have to be designed by qualified architects and must be constructed under the supervision of qualified engineers in a proper manner as per the requirements laid down in the codes. The basic purpose of achieving the above mentioned features is to develop certain properties for earthquake resistant building to minimise the losses.

The desirable properties for earthquake resistant design are ductility, deformability and damageability. Ductility and deformability are inter-related concepts, signifying the ability of a structure to sustain large-scale deformations without collapse. Damageability is the ability of a structure to undergo substantial damage, without partial or total collapse. The basic properties necessary to achieve earthquake resistance are discussed in the following paragraphs:

i) **Ductility:** The ductility of a building is the ability to bend, sway and deform by large amounts without collapse. The opposite condition in a structure is called brittleness. The brittleness in a building arise due to the use of brittle construction materials like adobe, stone, brick and concrete blocks and from the wrong design of structures using otherwise ductile materials. The brittle materials generally fail under the loads, leading to heavy damages in case of earthquakes and cyclones. The property of brittleness can be changed to ductility within the buildings

through the addition of modest amount of ductile material such as wooden elements in the adobe construction or steel reinforcement in masonry and concrete construction. The materials like wood and steel are inherently ductile. These are the materials, which can save the structure from collapse in case of earthquake if they are properly placed at the points of maximum tensile stress.

ii) **Deformability:** The deformability is the ability of a structure to displace or deform substantially without collapsing. A deformability action is a must to achieve the earthquake resistance. The basic necessity to achieve this property in a structure is that, it should act as well-proportioned, regular and well-tied single unit, so that excessive stress concentrations are avoided and are easily transferred from one component to another. To achieve this, no joint or connection should fail during the earthquake. Deformability is the property of the structure as a whole, while the ductility in turn is applied for materials as well structures.

iii) **Damageability:** Damageability of a structure is the property, which refers to the ability of a structure to undergo substantial damage, without partial or total collapse. The key to achieve good damageability is the provision of several safety members to resist earthquake forces. In such a case, if one member connection or joint fails, there should be something else to share its burden to avoid a complete collapse. This can be achieved by introducing several load paths in order to support the structure.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) What are the different types of traditional buildings?

2) Discuss the necessary features of earthquake resistant construction.

30.4 REPAIR AND RETROFITTING OF BUILDINGS

After an earthquake, one of the challenging jobs with the administration is of repairing and strengthening of the damaged and undamaged buildings. For this purpose, we require very specialised techniques and services of technical

experts/personnel. Before going into further details, it is necessary to distinguish between the various terms commonly used during this phase. A few of the commonly used terms are:

i) **Superficial Repair:** Various activities carried out under this include replastering of walls, repairing of doors and windows, and redecorating buildings.

These types of works do not improve the strength of the structure.

The different types of repair works can be described as:

- Patching up of defects such as cracks and fall of plaster and replastering it.
- Repairing doors, windows and replacement of glass panes.
- Checking and repairing electrical and gas connections.
- Rebuilding of non-structural walls
- Redecoration works like white washing, colouring and interior decoration.

It is evident from above that all these activities don't increase the strength of the structure.

ii) **Structural Repair:** This category includes the rebuilding of cracked walls and damaged roofs, repairing pillars, columns and other damages. This type of repair work improves some of the lost strength of the structure but not all because only parts of the building are dealt with; and the repaired building is not as strong as it is when new.

Various activities undertaken for structural repair include:

- Removal of portions of cracked masonry walls and columns and rebuilding them in richer mortar.
- Addition of reinforcing mesh on both faces of the cracked walls, holding it to the wall through nails and then plastering it.
- Injecting epoxy like material, which is highly adhesive, into the cracks in walls and columns.

iii) **Structural Strengthening:** It requires adding strength to the weakened or damaged building to restore its lost strength. The lost strength of the structure can be achieved by strengthening the various elements like beams, column walls and foundations. After all this, the structure will be as good as new. Structural strengthening requires an expert assessment of the damage, engineered design of the strengthening work and competent executers.

The seismic behaviour of existing buildings is affected due to various inadequacies, material degradation due to time and various changes carried out during the period when the structure is under use. Due to various social and other factors, it is not possible to replace such buildings. Thus it becomes very important to strengthen the existing buildings seismically.

iv) **Strengthening after the Earthquake Damage:** Here the strength of the structure has to be improved to resist the earthquake forces, which are dynamic in nature. To achieve this, a few new structural elements may be required to be added to take care of the earthquake forces.

(a) Retrofitting of the Seismically Weaker Structures

Any structure constructed at any time is governed by the prevalent state of art at that time. After the passage of so many years, the techniques adopted become outdated and the strength of the structure reduces considerably. Thus the weaker structures pose a serious threat to life and property in the areas prone to disasters like earthquakes and cyclones. The only means left to mitigate the threat from any potential earthquake on cyclone is to retrofit the structure. It is a very challenging task to retrofit the structure in comparison to construction of a new disaster resistant structure. The objective of any retrofitting technique should be to satisfy the codal requirements for necessary strength to resist the disaster forces. The techniques adopted must be economical and technically viable. The retrofitting technique is explained with a case study of Latur Earthquake affected area in the following section. Latur was affected by an earthquake in 1993.

Retrofitting of the Houses in the Earthquake Affected Areas of Marathwada Region

An earthquake of magnitude 6.4 rocked the Marathwada region of the Maharashtra state. Due to this earthquake, the districts of Latur and Osmanabad were the worst affected in terms of physical losses and human lives lost. The major reasons for such widespread damages include the faulty construction practices adopted throughout the region. Some salient features of house construction practices that have been adopted in the region are:

- The region is full of good quality Granitic and Basalt stones. The easy availability of the stones, make it the primary building material for the construction of dwelling units.
- Most of the villages are located on Black Cotton soil.
- For superstructure of the house, stonewalls are in extensive use. The thickness of the wall vary up to 3-4 feet and is generally constructed into two wythes, without any bonding in between. The cavity left between the two wythes is filled up with all kinds of lose material. In most of the cases, the stones used for walling purposes are round and irregular in shape and are of varying sizes. The mud mortar is used for binding these stones, which is having no affinity with stones.
- The predominant roof over rooms and verandahs in the region consists of timber under structure which is overlaid with 30 to 50 cm of earth or even more. This under structure of timber usually consists of post and beam system. The posts are spaced about 1.2 m apart in one direction and 2.4 m in other. This 1.2 m x 2.4 m space is known as 'Khan(d)', means measurement. Thus the Khans are built adjacent to each other to form a room 2.4 m deep and of any length depending upon the number of Khans. The corner post of the Khan rests on a square stone to transfer the load to the ground. The top of the posts usually have capitals on which brackets are placed. On the brackets rest the large timber beam. The wooden planks are placed over these beams.

The dwelling units constructed in such a fashion had no earthquake resistant features. So, when the earthquake came after the rainy season, the houses constructed in the above mentioned manner crumbled like a pack of cards, leading to extensive damage to life and property. Some of the weaker points identified in these houses from earthquake point of view were :

- Wooden under structures.
- No bonding between the walls of the stone structures.
- Massive weight of the walls and the roofs.

To retrofit the undamaged houses or houses with minor damages, a very large project was launched by the Government of Maharashtra. In all about 1,80,000 houses were to be strengthened for earthquake resistance. For retrofitting these houses, following components were adopted :

i) Strengthening the wooden frame to increase its lateral strength by installing knee bracing.

ii) Stitching the outer and inner wythes of the stone walls by the installation of 'through' stones.

iii) Providing a seismic belt or a tie-band around the house.

iv) Weight reduction over the roof by soil removal and water proofing.

(b) Repair of Damaged Structures after a Disaster

After any disaster of high severity like cyclone or earthquake, the maximum damage takes place to the man made structures in general and non-engineered buildings in particular. The damage pattern depends upon the type of building materials and techniques used for the construction of buildings. Commonly found damages in earthen and brick buildings are described in the following paragraphs.

Damage Pattern Observed in the Non-engineered Dwelling Units:

The majority of houses built up by the local people themselves in traditional style and manner. The most commonly used building materials for wall construction include bricks, stone, mud in lump form or burnt brick/block etc. The dwelling units usually have no provision for any features to resist the forces generated by an earthquake or cyclone. In case of an earthquake, commonly found damage pattern in various types of dwelling units are :

- Vertical cracks in the walls
- Inclined cracks in the walls
- Cracks at the corners
- Separation of walls at the corners
- Out of plumb tilting of walls after separation
- Shifting of roofing materials like rafters, joists, tiles, etc.
- Falling down of loose roofing components
- Falling down of plaster, tiles, electric installations etc. from the walls

To repair the damages that occur due to an earthquake, very specialised techniques are required. The repairing methods for the damaged houses constructed with brick walls have been discussed as follows :

a) Fill the cracks with a cement, sand (1:6) mortar. If the crack in the wall is quite thin then, fill it up with cement past.

- If the wall is severely damaged, or a large number of cracks have occurred, the replacement of the wall will be a better option. For reconstructing the wall, sufficient support with wooden log has to be provided to the roof. Construct the wall in cement, sand (1:6) mortar.

b) If the reconstruction of severely damaged walls is not possible, the following method can be adopted:

- remove the plaster from the wall around the cracked portion
- clean the wall with the wire brush
- put rectangular iron wire mesh on both the sides with holders over the cracked wall along the clean portion
- plaster the wall over the wire mesh using a cement, sand (1:3) mortar.

c) For the repair of wall separation at the corners:

- fill up the crack as in (a) above
- put a 4-5 metre long rectangular wire mesh on both sides of cracks inside the room. Similarly, put 7-8 metre long rectangular wire mesh on both the sides of the cracks outside the room as in (b). For best results, the wire mesh must be connected with nut and bolt across the wall.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of the unit.

1) In what way is the retrofitting of seismically weaker structures done?

2) What is the damage pattern observed in the non-engineered buildings in case of an earthquake?

3) How are the damages caused to the brick buildings due to an earthquake repaired?

30.5 LET US SUM UP

This Unit has discussed the basic concepts related to repair and retrofitting of disaster affected buildings. The unit has highlighted the traditional methods of construction such as earthen buildings, stone buildings, wooden buildings and brick buildings and the modern methods that lay emphasis on disaster resistant structures and follow codes related to earthquake resistant construction. The unit has also thrown light on the desirable properties for earthquake resistant design such as ductility, deformability and damageability. There are different ways of repairing and retrofitting the buildings such as superficial repair, structural strengthening and retrofifting of seismically weaker structures. The unit has discussed them in some detail. In order to illuminate the point further, a case study of Latur region in Maharashtra has also been made.

30.6 KEY WORDS

Diaphram Action in Roofs/Floors: For earthquakes resistant construction, the diaphram action of the building has to be strong enough to withstand the seismic activity. It is possible if the walls, roof and the floor are fixed to other property. If these move together as a single entity, the diaphram action is stronger.

Load Bearing Walls: They are walls that take the load of the entire roof and superstucture.

Maximum Tensile Stress: Maximum resistance offered by a material (wooden, steel etc) to increase the length of the member used in construction

Several Load Paths: A building can have several load paths such as columns, load bearing walls or both. With the help of load paths, the load of the roof is transferred to the ground.

30.7 REFERENCES AND FURTHER READINGS

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30.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points
   - Earthern buildings
   - Stone buildings
   - Wooden buildings
   - Brick buildings

2) Your answer should include the following points
   - Ductility
   - Deformability
   - Damageability

Check Your Progress 2

1) Your answer should include the following points
   - Strengthening of wooden frame
   - Stitching of the outer and inner wythes of the stone walls
   - Provision of seismic belt around the house
   - Weight reduction over the roof.

2) Your answer should include the following points
   - Vertical cracks in the walls
   - Cracks at corners
   - Inclined cracks in the walls
   - Separation of walls at the corners
   - Tilting of walls after separation
   - Shifting of roofing material
   - Falling down of plaster etc., from the walls

3) Your answer should include the following points
   - Filling of cracks with cement and sand mortar
   - Cleaning of the wall with wire brush
   - Repair of wall separation at the corners

UNIT 31 MONITORING

Structure

31.0 OBJECTIVES

After reading this Unit, you should be able to

- explain the concept and significance of monitoring
- discuss various methods and techniques for effective monitoring of a disaster management related programme; and
- highlight the problems in the process of monitoring.

3 . INTRODUCTION

There are various programmes related to different aspects of disaster management such .as prevention, preparedness, mitigation, response, rehabilitation and recovery. For any such programme, information about the progress and effectiveness of the programme is required. Monitoring is the process by which all such information about the programme is generated and critically analysed. Monitoring provides feedback to the programme manager or administrator as to whether the means and resources of the programme are being utilised and implemented and whether the desired objectives are being achieved. Programme Monitoring is basically an appraisal of the following aspects:

1) The extent to which the target population (affected community) is being served.

2) The quantity and quality of staff performance; if these are satisfactory and could lead to the achievement of the goals or objectives of the programme.

3) The peoples' perception about the designed programme and method of its implementation.

4) The acceptance of the programme methodology and technology by the people concerned in the local community.

5) Whether progress and implementation comply with predesignated standards, laws and regillations imposed on the agency by internal or external funding sources, regulatory agencies, professional bodies, experts and others.

6) Short-term and long-term gains of the programme in economic terms.

31.2 MONITORING: CONCEPT AND SIGNIFICANCE

First of all we should understand the concept and importance of monitoring in a project and the stage at which it can be started. Monitoring can be started right from the beginning after the planning objectives have been clearly spelt out. The first and foremost job is to identify tlie following clearly and unambiguously.

a) goals and objectives of the programme or project

b) target group

c) methodology/technology involved

d) staff required and their experience, interest and training in tlie area

e) available resources

Monitoring starts with the delineation of performance standards consistent with the planning objectives. The next step will be tlie systematic collection of information on regular basis on performance, based on designated standards. With this information, one can find out and make a judgement about the extent to which deviations exist between the actual performance and the expectations from the programme.

Monitoring provides information to the decision maker about the gap between actual and expected performance of the programme so that appropriate administrative decisions can be made as to whether the programme operation, its methodology etc., should be changed or modified slightly or abandoned. Further significance of monitoring lies in obtaining peoples' response and developing public relations as well as help in reporting programme activities to the sponsors/donors. The format of information to be collected about the programnie operations is normally designed to assess performance standards as mentioned earlier and to analyse whether project is on course. This information may then become tlie basis for annual reports to sponsors generating documents for public information and publicity and so on. Monitoring is more significant in the projects in which it is difficult to get any direct quantitative measures of the programme's effectiveness. For example, in most of tlie rehabilitation projects, the programme is not according to the needs and expectations of the target group. In case it was monitored on a regular basis from the beginning changes or modifications could have been made to cater to the needs of the affected people. Otherwise not much can be achieved if such knowledge becomes available only towards the end of tlie programme. Tn areas in which effective and reliable technologies have been developed, monitoring is required to measure the effectiveness and help in the evaluation of the programme. For example, in flood affected areas, for monitoring cholera vaccination programme, all that would be necessary is knowledge whether the whole target population has been vaccinated and wliether medically appropriate performance standards have been met by the staff.

Monitoring for Administrative Decisions

The primary purpose of monitoring is to enable 'the administrator to make rational and informed decisions about programme operations. If. the officer concerned follows a 'Management by Objectives' approach in which the objectives are clearly and rigorously specified, lie would like to use monitoring

information for even minor corrections in tlie programme and will modify it accordingly. The officer concerned has an accountability of the programme towards various groups such as funding agencies, tlie community (target group), professionals and others. Monitoring generates necessary information to assist in appropriate administrative decisions as discussed below:

1) **Staff allocation** - Whether to reallocate staff to different programmes or to various activities of the same programme.This can result in increase or decrease of staff according to the need/requirement.

2) **Funding** - Sponsors may be asked for an increase in tlie operational budget for a modified programme or some activity within the programme. Other funding agencies or potential sources also could be approached if the sponsors are not in a position to increase funding.

3) **Modify programme objectives - In** the face of budget cutbacks, existing activities may be reduced or restructured and programme may be modified accordingly.

4) **Legal requirements - In** case tlie programme is deviating froni the legal requirements of the state or central government, policies and practices can be suitably modified to comply with legal requirements.

5) **Quality and extent of services** - The administrator has responsibility for many other decisions that bear on tlie quality and extent of services or work delivered to tlie sponsors or client organisation. Monitoring provides inputs to revise programme where necessary, select, train and supervise staff, devise patterns of staff organisation and development, manage tlie fiscal activities of the programme with adequate and established accounting and auditing procedures, reporting to the sponsors about tlie periodic progress in tlie project, and make budget requests accordingly.

In brief, it can be concluded that tlie administrator and his staff who are responsible for the overall implementation of tlie programme are benefitted the reviewing of tlie programme operations, through monitoring procedures and for enabling right decisions based on systematic, reliable and valid monitoring information.

31.3 ROLE OF MONITORING IN DISASTER MANAGEMENT PROGRAMME

Monitoring has an important role to play in all tlie three phases of disaster management as is explained below:

A) **Pre-disaster phase:** This is tlie phase in which the administrator, voluntary organisations and the community are involved in the programmes related to prevention and preparedness pertaining to the occurrence of disasters, These are planned activities and monitoring of such projects is very much needed for their successful implementation. For example, tlie Government and Non-Government organisations constructed of large number of cyclone shelters on the east coast in Andhra Pradesh, Orissa and Tamil Nadu. These are to provide temporary shelters to the affected community at the time of cyclones, If we critically examine the type of shelters constructed 20 years back and now, there is a lot of difference in structure, location and use of these shelters. Gradually these shelters, made only for emergency habitat, were modified into multipurpose buildings so that these structures can be utilised by the community in the normal situation as well and thereby ensure proper upkeep and maintenance. Proper

monitoring and evaluation of projects/programme had made it much more useful for the community than it was planned by the authorities/organisations.

B) Disaster Situation: Rescue, evacuation and relief as well as temporary resettlement and rehabilitation are some of the important activities undertaken at the time of disaster. Monitoring is very useful to the decision makers in this situation also and will help make the operations quick, effective and acceptable to the communities.

C) Post - disaster Situation: Relief and recovery are some of the important post-disaster activities. Monitoring can make these more effective and help the administrator in taking appropriate decisions. Monitoring helps in seeing the progress of the project successfully to its final completion. For instance, in 1993 Latur earthquake occurred in which 20 villages were badly affected. The first and foremost post-disaster work was to provide temporary shelter to 60,000 affected people with in the shortest period of time. Providing food, drinking water and ensuring sanitary conditions were important tasks for the administrators. Monitoring played an important role in the timely and effective completion of the project.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) What is meant by Monitoring especially with reference to any programme?

2) Comment on the significance of monitoring.

3) How is monitoring important at various stages of disaster management?

31.4 MONITORING METHODOLOGY, TECHNIQUES AND PROBLEMS

As mentioned earlier, there cannot be a single method or technique for monitoring. It will vary from project to project and would depend on the goals and objectives of the project. There may be a few personal interviews; group discussions might be sufficient for the purpose or it may require a large survey with a set questionnaire and proper sampling technique. It would also depend on tlie size of tlie project or target population. In a disaster situation, when tlie affected community is large, it is important to know how to collect information/data, analyse and interpret the same to achieve useful results.

Tlie most important problem in monitoring is collection of data. In the process of monitoring, data is gathered for three main purposes, viz.,

a) description

b) explanation

c) prediction

Though, these three purposes cannot be exclusively separated but there is a logical progress from description to explanation and then to prediction. Description is the first step towards explaining tlie nature, underlying causes, relationship and context of a phenomenon or process.

Descriptive data would answer questions of WHO will be involved in the project, WI-IEN it will be started and WHERE it will be started and implemented but it will not be able to explain HOW and WHY it will be implemented and the methodology part is mostly not covered in tlie descriptive data. Tlie data generated for physical and financial monitoring are typical examples of descriptive data. Although this type of data record the progress, describe tlie relationship between expenditure and achievement of physical targets, and identify possible deviations from the planned course;-they would not explain tlie reasons for shortcomings or bottlenecks in tlie progress. Most of tlie data secured from beneficiary are also descriptive.

In a project, where we would like to find out reasons for its success or failure, which is more a diagnostic study, normally some explanation is required. For example, when project staff are trying to find out why the beneficiaries are not responding properly to a technically sound package of rehabilitation, which has proved highly successful in another part of the country or elsewhere in the world, they are searching for local factors and conditions which could possibly explain the cause of this unexpected phenomenon. They are seeking to answer tlie question of "why".

Prediction is based on an understanding of tlie causes like description and explanation, and project the scene in tlie future that will affect the overall design, scope and modes of data collection and the analysis.

Data gathering is one of tlie most important aspects of monitoring and evaluation. There are two types of data collection as follows :

1) **Qualitative Data** - result in information which can best be described in words.
2) **Qupntitative Data** - produce numerical data.

In the context of disaster management, the qualitative data describe the situations, events, people, their participation, interactions and observed behaviour of people, direct quotations from affected people or media or from

prepared documents or reports, state memorandums, correspondence between district-state-central governments, official records and case studies. Qualitative data mainly focus on the signs and symbols that decode the reality seen by the target population. For instance, during any rehabilitation programme, in case a number of persons respond in the same manner,-the investigator will become more cautious and will also seek to examine the context and manlier in which they have responded or spoken. An attempt will be made to see if they all meant the same. Both verbal and non-verbal behaviour are examined in qualitative studies in order to understand the views, attitudes, and perspectives of tlie respondents. The qualitative method is retractive and there is an ongoing opportunity to revise interview or observe records as the study progresses so that new facts can be brought to light.

Quantitative data is normally gathered by a structured survey, with a set of questionnaire to a sample of respondents at one set of time or at various time intervals. In this type of method, iteration is not common. The investigator is not usually expected to ask additional questions even if they feel that these questions will be useful in the project review. Nor can the investigator discard an interview even if the respondent did not give candid answers. The advantage of the structured surveys are tliat the interview mode and construction of questions can be standardized on the basis of experience so tliat bias introduced by either the enumerator style or the respondent's misunderstanding is controlled. This type of survey can be used to compare the standard of living of the target group population before and after the disaster or to see the nutritional status of the population. The quantitative data is often obtainable from the records of project agencies and other institutions. The statistical officer at the district or state level may have extensive data on his files which can be recorded, aggregated, disaggrcgated and reanalysed for diagnostic studies and impact evaluations.

Qualitative data can be collected by the following ways:

- indepth interviews with individuals respondents. The flow of ideas is more frequent in such conversations.
- group interviews such as (a) community meetings and (b) focused group discussions after sufficient notice and advertisement had been made for ensuring good attendance. In such meetings two to three interviewers are better than a single investigator. Focusecl group discussions are good with small number of invited participants. The interviewer should just introduce the subject and initiate the discussion and keep it focused on the desired topic as often, this type of discussion tends to deviate from the main topic.
- third method is participants observation. This involves direct, extensive observation of an activity, behaviour or relationship. Participant observation can also include qualitative interviews with the informants.

Most of the projects, of some development activity or disaster management require both quantitative and qualitative data. Both have their strengths and weaknesses. Choosing the right and appropriate method for monitoring will be the responsibility of the monitoring staff.

Problems **of Data** Collection

The most important constraint for collection of data is the extent of available resources. It is useless to design a data collection operation to reach a widely dispersed sample of population or respondents with the use of questionnaires

and in depth interviewing techniques if neither tlie logistic resources to manage such an operation nor the skills to collect and observe accurate data are available. Another important constraint will be the availability or otherwise of the time within which the complete data is to be collected and analysed.

Data Analysis and Interpretation

From tlie foregoing description, the importance of proper data collection is clear. Accurate data processing, analysis and interpretation are equally important parts of monitoring for effective decision making. It has often been seen that even important data collected by researchers does not get interpreted. In recent years with the help of computers, a large amount of data can be handled easily and quickly. There is a need to discuss the objectives and goals of the research with the programmer so that the right software could be used for data analysis. Computerisation should be considered carefully during project preparation stage itself as part of designing of the information system.

In case of monitoring of disaster management projects, if an existing and well tested manual system works efficiently and no extensive data gathering is required, computerisation will not be an immediate concern. However, in the report preparation, in view of the many revisions of tlie draft from time to time, we can use word processing capability. Computers are helpful in handling survey data particularly if large number of variables are used in a survey.

Interpretations, based on proper data analysis can provide useful information to the decision maker such as about the following:

- staff performance
- time frame for the project
- people's perception about tlie programme
- proper utilisation of funds
- further requirement of financial resources and manpower
- selection of activity measures
- major or minor changes required in the activities or programme as a whole.

Check Your Progress 2

Note : i) Use the space given below for your answers
ii) Check your answers with those given at the end of this Unit.

1) What is the main purpose of data collection?

2) What are the types of data collected for monitoring?

3) How are data analysis and interpretation important in monitoring?

31.5 LET US SUM UP

Monitoring is the process by which information about programme operation is generated and critically analysed. Monitoring provides feedback to the administrator as to how the programmes' means and resources are being utilised and implemented. By monitoring, the decision makers get an idea about the extent the target group is being served as well as the quality and quantity of work done by the staff. Monitoring gives an idea about the acceptance of tlie programme by tlie people and the need for changes or modifications in the activities.

Monitoring can be started right from the beginning of the programme just after tlie identification of goals and objectives, target group, methodology/technique involved, and available resources. Monitoring generates information enabling administrative decisions regarding staff allocation, funding, need for modification or change in objectives, legal requirements as well as quality and quantity of services.

There are several methods/techniques for monitoring, depending on the project programme. There may be personal interviews, group discussions, brief surveys or large surveys, where considerable extent of data is required. It is important to identify the correct methodology for a project and proper collection, analysis and interpretation of data.

Data may be gathered for three main purposes - description, explanation and prediction. Similarly data may be of two types (i) Qualitative data, which result in information which can best be described in words and (ii) Quantitative data - which produce numerical data. The available resources and time are the two major constraints for the data collection.

Accurate data processing, analysis and interpretation are equally important parts of monitoring for effective decision-making. Use of computers is very common in data processing now-a-days, as they can handle a large amount of data, particularly if there are more variables. But data should be handled and processed by skilled, experienced persons to get correct results.

31.6 KEY WORDS

Management by Objectives : It is a process wherein purposes and goals are stated clearly before resources are spent, effort expended and work done. It defines each individual's major areas of responsibi lity in terms of resu lts expected.

Retractive Where a revision is permitted.

Sampling It is the task of selection of a small part of some thing for examination or analysis in order to estimate the quality or nature of the whole.

31.7 REFERENCES AND FURTHER READINGS

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311.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- Monitoring is basically the task of appraisal of various aspects relating to a programme or activity.
- With regard to programme monitoring, it involves appraisal of the extent to which the affected community is being served, appraisal of staff performance, peoples perception about the programme and its implementation of policies with certain designed standards. laws, regulation and the short-term and long-term going of the programme in economic terms.
- Monitoring ensures that the specified standards and legal requirements are being followed.

2) Your answer should include the following points:

- Monitoring provides necessary information to the decision maker about the gap between the actual and expected performance of programme so that appropriate correction measures can be taken in time.
- It obtains peoples' response and help in developing public acceplance.
- It facilitates reporting activities of programme to the sponsors/donors.
- It enables the administrator to make rational and informed decisions about programme operations.
- It generates specific information about any aspect like staff allocation, funding, quality and extent of services etc. that facilitates appropriate administrative decisions.

3) Your answer should include the following points:

- During Pre-disaster phase, monitoring enables timely completion of programmes and projects. ,
- During Disasters, monitoring helps to maintain a clear picture of the situation and to take additional decisions as the situation demands.
- During the post-disaster scenario, monitoring helps in effective and timely use of resources in the programmes for relief and recovery of the affected community.

Check Your Progress 2

1) Your answer should include the following points:

- The main purpose of data collection is to gather information for (a) describing the 'underlying causes, relationship and context of a phenomenon or process. (b) explaining reasons for its success or failure; (c) predicting the scene in the future.

2) Your answer should include the following points:

- There are two main types of data collected for monitoring. They include (a) Qualitative data which result in information that can be described (b) Quantitative data that produces numerical data.

3) Your answer should include the following points:

Data analysis and interpretation provide useful information to the decision maker about the following and are thus important in monitoring.

- Staff performance
- Time frame for the project
- People's perception about the programme
- Proper utilisation of funds
- Further requirements of financial resources and manpower
- Selection of activity measures
- Any major or minor changes required in the activities or performance as a whole.

UNIT 32 EVALUATION

Structure

32.0 OBJECTIVES

After reading this Unit, you should be able to :

- explain tlie meaning and significance of evaluation;
- describe methods and techniques for effective evaluation; and
- discuss problems in evaluation of a project;

32.3. INTRODUCTION

Monitoring and Evaluation are the most important parts of programme assessment. There is a very thin line separating the two. Programme monitoring tells us the extent to which programme operations follow specifications, whereas evaluation is the process by which programme effectiveness and efficiency are assessed. For example, in a programme of providing vocational courses for women in a drought-affected area, monitoring tells the administrator whether there are sufficient staff and technical resources, and they are correctly implementing the programme's strategy for imparting appropriate skills. Evaluation shall on the other hand provide information regarding how the women participants have improved their skills. In other words, evaluation tells us how effective the programme has been.

32.2 EVALUATION: COMPONENTS AND SIGNIFICANCE

Evaluation has two significant components, as follows:

a) Effectiveness

Assessment of effectiveness as part of the evaluation process will answer questions like how successful the programme is. For example, in a vocational rehabilitation programme, how many people secured and sustained job placements. In temporary shelters of flood affected people, how effective the social hygiene programme was in reducing cases of communicable diseases. In coordinating relief, how the distribution within the given community was and whether there was unnecessary duplication of services.

b) Programme Efficiency

Efficiency is the ratio of programme effectiveness to programme efforts. Efficiency is mainly related with the cost, in terms of money, time, and manpower (staff) resource. This will help the decision maker to vary his

programme strategies to achieve the desired goals and objectives more efficiently. This is a very important and useful exercise for administrative decision-making.

Effectiveness and efficiency are the two essential aspects of evaluation but they do not necessarily go hand in hand. There are many examples where programme is very much effective but requires large sums of money, time and staff input. On the other hand, there are others that are highly efficient but are limited in their accomplisliments. Even then, ideally, an efficient and responsible administrator attempts to maximise both effectiveness and efficiency through programme evaluation.

32.3 TYPES OF EVALUATION

There are two types of evaluations, viz.

a) Summative Evaluation

b) Formative Evaluation

Tlie administrator or the manager of a programme has to decide about the required type of evaluation - whether a Summative or Formative type of evaluation. In Summative evaluation, an experimental model is employed. In a target population, representative sample is selected through probability sampling technique. The sample population is divided into experimental groups (one group is minimum), which receive a specified and highly standardised programme intervention, and at least one control group (which receives no intervention). Measurements prior to intervention are taken on both experimental and control groups. Similar parameters are noted after the intervention to determine whether changes have taken place that can be attributed to the prograinme intervention. This type of model requires a lot of statistical knowledge or consultation, because it raises many technical, practical and ethical problems for the evaluator. In case this model is used properly, it can explain about the programme policy and its impact. Research consultants mostly prefer this type of evaluation, whereas administrators, who do not want to generate generalised knowledge or do not have adequate technical or material resources to implement such model, prefer formative evaluation.

In formative evaluation, programme objectives and interventions are specified and translated into measurable indices. The data collected and analysed in this evaluation is relatively simple and logical. The formative evaluation is less costly, requires less expertise and time and has minimum of practical and ethical problems. It provides immediate feedback of results, Formative evaluations do not generate knowledge that can easily be applied to other programmes. They make possible inferences which elaborate cause-effect relationships.

Evaluation provides information to the administrator to take decisions about the expansion, reduction (contraction), or modification of any social programme during or in the post-disaster situation. There are many decisions such as service delivery, staff allocation, intervention strategies and budgetary priorities, where evaluation is very 'useful.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) What do you understand by evaluation?

2) Distinguish between monitoring and evaluation with examples.

3) What are the types of evaluation?

32.4 DESIGNS FOR EFFECTIVE EVALUATION

Most of the evaluation strategies are based on research and usually need full time staff for implementation. However, in projects of disaster management, self-evaluation with minimal reliance on research work or dependence on permanent research staff has to be resorted to.

There are six designs that can be used by the administrators in formative evaluation:

(i) The 'After-only' Design - This attempts to measure the results of programme intervention just after it has taken place. No data are collected before, the only one measurement is just after the programme intervention. As a result, it is not possible to determine whether the changes seen in the recipient community is due to the programme interventions and whether it can sustain and that too for how long.

(ii) Pre-testlpost-test design - In this design, one measurement is taken before and one after the programme intervention. This design can give correct idea of changes in the target community after the programme interventions.

Both the above designs do not take adequate account of internal validity.

iii) Interrupted Time Series' Design - In this design, a ' series of measurements are taken before the intervention which functions, as

baseline data and similarly a series of measurements taken after the intervention, to determine whether changes attributed to tlie programme are sustainable and stable over a period of time. This design is also not perfect and controls all factors affecting internal validity, and not produce completely undisputable findings which can be generalised for other projects. But it generates information, which is highly informative about a specific programme. This design is mainly to study the effectiveness of the programme.

Implementation of Interrupted Time Series Design

There are certain principles for tlie Interrupted Time Series Design, given as below:

a) Framing Objectives - Identifying the programme objectives to evaluate the effectiveness of a programme in specific and concrete terms is tlie first principle. Role clarity that WHO in the programme are expected to do WHAT to WHOM, WHERE and WHEN. These questions will help in answering the extent to which objectives are achieved.

The programme objective should be operationally defined.

b) Intervention Strategy -This should be specified. A complete and behaviourally specific description of intervention strategy is necessary to determine whether tlie staff or people involved are providing tlie required or intended intervention. The specification of intervention strategy is important for implementing new programme based on evaluation of previous effectiveness studies. For example, in cholera vaccination in temporary shelters, officers claim that the programme was highly effective and checked tlie epidemic, but if we do not bother to specify rigorously what medical and paramedical staff did, the evaluation will not be of any use for any new programme.

c) Baseline Measurements - Variables for measuring effectiveness should be identified and series of measurements should be taken at regular and appropriate intervals. The measurement conditions should be standardised and applied consistently for baseline as well as post intervention measurement.

The baseline data should be represented graphically. Separate graph for each effective variable is ideal.

d) Programme Implementation - After baseline data, programme strategy should be introduced and interventions should be standardised so that the target group gets equal/same services or treatment. Immediate, complete and standardised interventions provide clearer interpretation of the impact of the programme.

e) Post-intervention Measurements - This should be on tlie same lines as in collection of baseline information, using the same time intervals, standardised procedures and effective measures. A series of post-intervention measurements, taken throughout the period of intervention provide correct comparison of programme effectiveness.

f) Comparing Pre and Post-intervention Patterns - If we make a graph of the baseline and post-intervention data, trend lines can be compared. In case there is no definite visual trend, means of information or other statistical methods (correlation, regression etc.) can be applied to compare the two.

Interrupted Time Series studies normally conducted before new programmes, policies or intervention stategies are implemented.

iv) Replicated Cross-Sectional Survey Design

This type of survey is mainly used to generate information about perceptions, attitudes, beliefs and behaviour of clients who are at various stages of programme processing and implementation. This type of survey design is only applicable to programmes that are cyclic and continuous and that process relatively large number of persons. In projects of disaster management, it can be employed in training programmes, counselling programmes and treatment programmes.

Following principles for implementation of Replicated Cross-Sectional Survey design are important.

a) Identification of Programme Stages if the programme is cyclic. Sequence of stages more should be determined. These stages will be sampling stages. A sampling point should be located at the end of each pre-stage. There should be at least three sampling points - prior to the programme entry, after intervention begins and after intervention ends.

b) Specifying programme objectives and selection of variables for measuring effectiveness.

c) Listing of Interventions to be evaluated.

d) Describing the persons at each sampling point and drawing samples.

e) Compare the background characteristics of persons at various stages of tlie programme.

f) Calculation of scores for effectiveness for time sampled groups.

g) Data analysis and interpretation.

v) Comparative Experimental Design

The next design, which is mostly used for assessing the relative effectiveness and efficiency of alternative programme interventions is known as "Comparative Experimental Design". It measures the impact of intervention as compared to lion-intervention, This design is most useful when administrator wants to know what kind of personnel are most effective in providing services, how much of a particular service is most effective and which services are most effective and efficient.

In disaster situation, when administrative decisions have to be made regarding services to be provided to the affected community, this technique can be applied. For comparative experimental design, following principles are taken into consideration:

a) Identification of programme objectives - components of the programme and factors, which will be manipulated and compared, should be carefully identified with operational definition.

b) Specifying target population and sample.

c) Developing norms for monitoring costs of programme variations.

d) Allocation of programme recipients in experimental groups.

e) Taking effectiveness scores prior to intervention.

f) Implementation of intervention strategies.

g) Measuring effectiveness after intervention.

h) Data collection, analysis and interpretation.

After the effectiveness data is analysed, relative effectiveness, costs of the various interventions and finally cost-effectiveness ratios can be computed for each intervention. This relative effectiveness and relative efficiency information can be used for deciding future programme interventions.

vi) Crossover Comparative Designs

Crossover comparative experimental designs are used to compare the relative impacts of different interventions strategies without denying any of the interventions to any of the experimental groups, The name itself indicates that in this evaluation, comparable groups of clients are given different interventions, impact is measured and then the kinds of interventions received by experimental groups are switched (crossed over) and impacts are again measured. This way, the effectiveness of every intervention strategy on every experimental group is assessed. This will provide a greater number of comparisons than in non-crossover designs.

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) List the important types of designs used for evaluation.

2) What are the principles of interrupted time series designs?

3) Where is the 'Replicated Cross-Sectional Survey Design' generally used?

32.5 LET US SUM UP

Evaluation is the process by which programme effectiveness and efficiency are assessed. Effectiveness is the rate of success of programme, whereas efficiency is the ratio of programme effectiveness to programme efforts. Efficiency is mainly related with the cost, in terms of money, time, human resource etc. This helps the decision maker in finding out the relative costs of various programme strategies to achieve the same goals and objectives. Many a times effectiveness and efficiency do not go together. A most effective programme may require more financial resources, time and manpower. But ideally, an administrator should take both the components into consideration.

There are two basic types of evaluation – **Formative and Summative evaluation.**

The selection of design for evaluation is the most important part. It varies From project to project and depends on evaluation objectives.

Evaluation provides information to the administrator to take decisions about the expansion, reduction or timely modification of a programme. There are decisions such as service delivery, staff allocation, intervention strategies, budgetary priorities where evaluation is extremely useful.

32.6 KEY WORDS

Intervention	Programme or project dealing with a community.
Sampling	A model of the population or a subset of the population that is used to gain information about the entire population.
Randomisation	By chance; not according to any series or scheme.
Score	Points made in an evaluation

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32.8 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Your answer should include the following points:

- Evaluation is the process by which the effectiveness and efficiency of programmes are asscssecl.

2) Your answer should include the following points:

- Monitoring is the activity that appraises the execution of a programme according to the given specifications. For example in a programme ot providing vocational course for women in a drought affected area. monitoring involves examining whether these are sufficient staff and technical resources, the programme is imparting appropriate skills to the women etc.
- Evaluation is the process that assesses the programme efficiency and effectiveness. Through this activity, it can be evaluated as to how many women have improved their vocational skills and to what extent.

3) Your answer should include the following points:

- Summative Evaluation, which requires statistical knowledge and it raises many technical, practical and ethical problems.
- Formative Evaluation, the data collected through this are relatively simple, logical, requiring less expertise, time and has minimum of practical and ethical problems.

Check Your Progress 2

1) Your answer should include the following points:

- The after-only design.
- Pre-test/post-test design
- Interrupted time series design
- Replicated cross-sectional survey design
- Comparative experimental design
- Crossover comparative designs.

2) Your answer should include the following points:

- Framing objectives
- Intervention strategy
- Baseline measurements
- Programme implementation
- Post-intervention measurements
- Comparing the pre and post-intervention patterns.

3) Your answer should include the following points:

- The replicated cross-sectional survey design is mainly used to generate information about perceptions, attitudes, beliefs and behaviour of clients who are at various stages of programme processing and implementation.

- It is applicable to programme that is cyclic and continuous and involve relatively large number of persons.
- In disaster management projects, it can be employed in training, counselling and treatment programmes.

UNIT 33 REVIEW

Structure

33.0 OBJECTIVES

This is the last unit of this course on disaster management. After studying this unit you should be able to:

- explain in an overall manner about disaster management;
- highlight the importance of preparedness and mitigation in disaster management;
- discuss the urgency for timely relief and rehabilitation;
- describe report writing on the post-disaster scene bringing out relevant important aspects of information for area- based approach; and
- draw lessons from a disaster to handle any likely future event with greater confidence.

33.1 INTRODUCTION

As you commence the study of this unit, you have already gone through the various aspects relating to disaster management that are considered necessary for a basic understanding of the subject, at the certificate level. This should have, hopefully, awakened a desire in you to seek a more advanced level of understanding for the benefit of not only yourself but also the community in which you live.

Every post-disaster review in the wake of a calamity should serve the important purpose of identifying the immediate and long-term needs of the affected community. Even more importantly, it should enable the policy makers and planners to draw appropriate lessons that will enable a likely future disaster to be handled with greater efficiency, lesser loss of lives and property. We shall briefly discuss these issues in this unit.

33.2 UNDERSTANDING DISASTERS

The history of tlie world has recorded that all along, natural disasters have resulted in a very heavy toll of death, destruction and human suffering. Recently compiled statistics reveal that during the period 1971 to 1955, on an average, disasters killed over 1.2 lakh people and affected more than 135.5 mil lion people every year. Asia and Africa account for more than 90 per cent of the above. In India, on an average, 4728 deaths were reported per annum in this period (1971-95) due to disasters, which affected over 63 million people each year. Table I gives broad details.

TABLE 1: Average Annual Toll due to Disasters (1971-95)

Region of tile World	No. of deaths	Affected people (In millions)
Asia	46,258	119.81
Africa	62,632	10.62
America	9,583	3.85
Europe	3,329	0.59
Oceania	113	0.67
TOTAL	121,915	135.54
India	4,728	63.72

Source: Disaster-watch: "DOWN TO EARTH", 31 October, 1997

Natural disasters such as those due to earthquakes, landslides, cyclones (and other high winds), floods, tidal waves, volcanic eruptions, wild fires, etc. are the matters of concern in this study of ours. Classified in terms of the number of incidents of disasters and by the type of natural disaster, during the same period 1971-95 (Table 3) almost sixty per cent of disasters around the world are due to high winds and floods. Two single incidents were responsible for the loss of over a quarter million people each. In the last two decades, the property loss clue to natural disasters was estimated to be between U.S. $25-100 hillion. The total losses would be even higher and these are reflective of the shattered economies and disrupted social structure that occur in the wake of disasters.

TABLE 2: Worldwide Natural Disasters (1971-95)

Type of disaster	No of incidents	% of total
High wind	1,650	31.5
Flood	1,508	28.8
Drought and famine	469	9.0
Earthquake	678	12.9
Landslide	232	4.4
Volcano	110	2.1
Others	593	11.3
Total	**5,240**	**100.0%**

Source: Disaster-watch, "DOWN TO EARTH", 31 October, 1997

Loss of valuable lives, human and cattle, and the heavy losses at the hands of nature are certainly not inevitable. It may be true that it may not be possible to prevent the occurrences of extreme natural phenomena, in the form of hazards like cyclone or earthquake, but the disasters they result in can most often be mitigated and the severity of effect blunted.

The world possesses adequate knowledge, which if properly applied, can lead to saving of lives and mitigation of the destructive impact of natural disasters, In fact, such concerted global efforts to reduce the destructive impact of natural disasters were launched in 1989 when the United Nations General Assembly proclaimed the 1990s as the "International Decade for Natural Disaster Reduction" (IDNDR). The overall primary objective was to reduce loss of life, property, damage and economic and social disruption caused by natural disasters. After the year 2000 when IDNDR was completed, the UN decicled to continue disaster reduction programmes under a new programme titled "International Strategy for Disaster Reduction" (ISDR).

The important thing to keep in mind is that the occurrence of an extreme natural phenomena (flood, cyclone, etc.) is not a disaster in itself. What leads to a disaster is the impact of that upon a community that is vulnerable to it. Understanding the natural force is necessary but even more important is the focus on the people and the infrastructure subjected to its force.

Every time a disaster takes place and in the wake of the large economic disruption caused by it, an analysis of the post-disaster scene takes place invariably. Workshops and seminars are held to discuss the various aspects of the tragedy. Invariably one significant conclusion comes out that the effectiveness of pre-disaster preventive measures in the mitigation of adverse effects is high and is achieved at much less cost as compared to the post-disaster relief and rehabilitation. Most often one of the conclusions drawn after such discussions is to the effect that the main thrust of disaster management should be shifted from disaster relief to disaster preparedness and disaster mitigation.

Check Your Progress 1

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) What is the new U.N. Programme after the completion of IDNDR?

2) What is the main basis for the present day conclusion that the main thrust of disaster management should be shifted from disaster relief to disaster preparedness?

33.3 PREPAREDNESS AND MITIGATION TECHNIQUES

Generally mitigation process is described in four basic steps viz, risk analysis, plan formulation, preparation for implementation, and implementation and maintenance.

Risk analysis provides a basis for different options of planned interventions to reduce the risks from natural hazards on settlements and for tlie preparation of the risk profile of a settlement. area or region. This process consists of successive steps of hazard assessment, vulnerability analysis, risk assessment and risk appraisal.

Plan formulation is to improve tlie risk of profile of a settlement. It does not limit itself to physical planning measures only but extends to engineering, functional and adaptation of institutional measures as well. Disnstcr mitigation planning needs to be comprehensive and will have to review a range of alternative strategies against clearly laid down criteria so that tlie objectives can be met and performance evaluated. The selection of the plan for implementation is a policy decision and requires the involvement of decision makers.

The preparation of tlie implementation phase is the next step. The instruments for implementation are identified and attuned to the plan proposals and tlie local conditions. These may relate to legal, financial, land tenure and community participation aspects of the plan implementation.

The final step is implementation and maintenance. This applies itself to details of project management, phasing, resources, maintenance aspects etc. The disaster mitigation process is an iterative one, running through successive steps, somewhat on the lines of the flow diagram in figure I below.

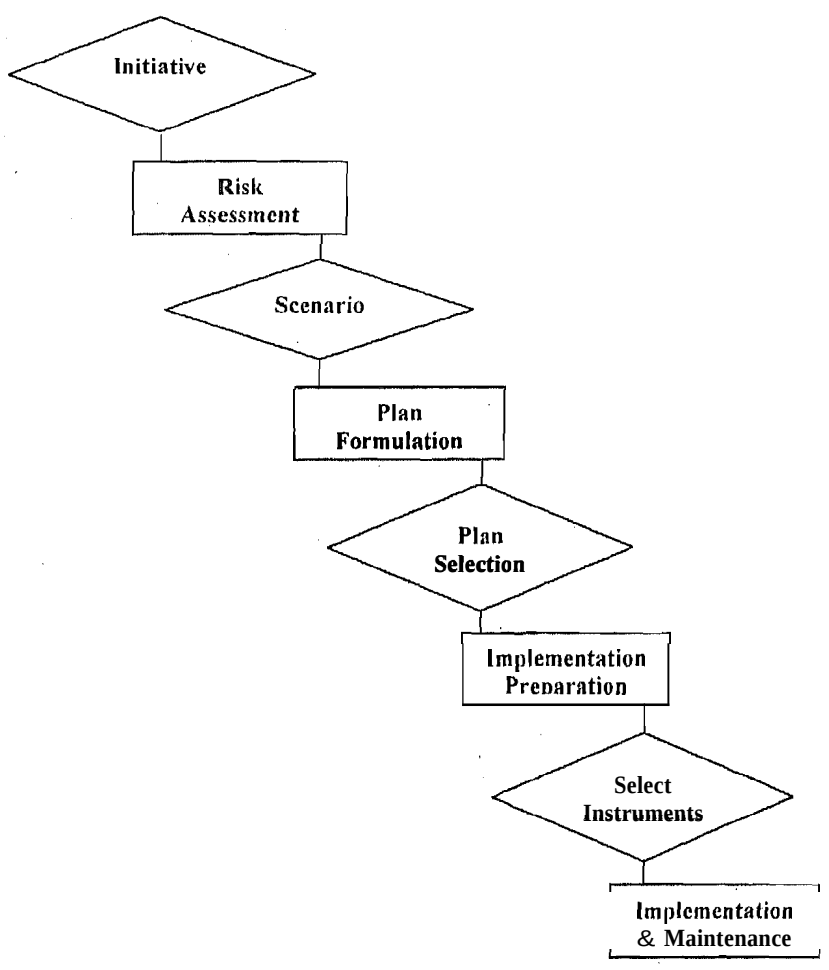

Figure I – DISASTER MITIGATION PROCESS (After UNDRO Manual)

You have already studied the specific manner of dealing with tlie different types of natural disasters such as floods, earthquakes etc. and all tliese mitigation options and processes are applicable to them. An important point to keep in view is that it will not be always possible to make a clear distinction between pre-disaster planning and post-disaster planning. Post disaster planning looks back in the light of what lias happened, tlie damage that has occurred etc., to mitigate the effects, not only this time, but also in future similar situations. Pre-disaster planning, on the other hand, looks into tlie future, anticipating an event with the intention of mitigating its consequences. Certain actions are not possible in certain types of situations. Prevention comprises steps that are taken to fully protect lives and property. For example, a storage dam upstream that is designed to completely store tlie flood water or a carefully implemented bypass channel that reduces the originally anticipated high flood in a downstream location. Mitigation makes the disaster less severe, but may not totally nullify its effects. In tlie post-disaster oriented approach, preparedness comprises several types of warning systems such as correct and timely cyclone warnings. Later the relief phase takes care of evacuation, supply of relief articles, shelter, social care etc.

Every disaster becomes an educative tool to reflect on the inadequacies in the existing method of managing disasters, and if we are able to draw the right lessons there from, it will enable improved disaster management in the future. It will be worthwhile to study some case studies of this type, international and national, in this context.

The Tangshan earthquake in China in 1976 was one which caused huge loss of life and property. All kinds of structures were severely damaged. 60% of highway bridges and 40% of railway bridges suffered damage. After the earthquake, extensive field observations and investigations were carried out by many professional teams. Many lessons were learnt.

While hundreds of multistoried brick buildings collapsed, those few that did not collapse had reinforced concrete columns, connected with closed ring beams at each floor at the junction of longitudinal and transverse walls. This led to tlie important lesson that the above measures could delay the shear cracks and increase the capability of preventing collapse. It was also found tliat roof structures fell down due to breaking of columns at tlie bottom or at points of cross-sectional change. Also weakness of bracing systems between roof frames and between columns caused longitudinal collapses.

No collapse occurred in industrial buildings with strong columns, light weight roofs and perfect bracing systems, as well as in buildings with folded plate roofs.

Nearly all of the ten thousand chimneys in Tangslian were destroyed but brick chimneys with vertical reinforcements anchored to ring beams were intact. Chimneys with vertical and circumferential steel angles, or straps, by way of strengthening proved to be effective.

A number of buildings, which had been strengthened after an earthquake in Tianjin in 1975, suffered little damage in the 1976 quake. For instance over 60,000 sq. meters of buildings of Tianjin power plant had been strengthened before the Tangslian quake and none of these collapsed in the 1976 shock.

As a result of these the building design code for Industrial and civil buildings earlier published in 1974 was revised after the 1976 slioclc. Similar design codes for hydraulic structures, roads and bridges etc. were also undertaken.

Each destructive disaster is to be taken as the nature's way of testing on a large scale of our structures, equipments and disaster mitigation capability and of the ability to draw timely lessons from nature.

The recent Indian experience in terms of the Uttarlcaslii earthquake of October 1991 has been discussed in the earlier units. Similarly tlie manner of tlie disaster mitigation resorted to the Latur quake of September 1993 and the lessons learnt there from was also discussed earlier. Lessons are still being drawn from the Bhuj (Gujarat) earthquake of January 26, 2001 described in an earlier Unit.

Most damaged houses in Uttarkashi were of poor quality, built in fieldstone using clay mud in place of mortar. The buildings in Uttarkaslii were classifiable in four broad types and each performed differently in this quake. Over 20,000 houses were fully destroyed and three to four times that number partially damaged. Tlie lessons learnt in this quake were:

1) Tlie rural stone houses were one to two-storeyed witli average plinth size 2.4m x 4m floor area, with intermediate floor being wooden declc type and pitched roofs consisting of slates resting on wooden purlins and round wood rafters. Random stone walls were dry packed or set in mud mortar. All such liouses were destroyed.

2) In Uttarkashi town also maximum damage occurred to old stone masonry houses. Buildings constructed in cement, mortar and those witli seismic bands suffered only minor damages.

3) Buildings in tlie Irrigation colony at Manery were mostly two-storeyed using cement concrete solid blocks in cement mortar with reinforced cement concrete slab floor and pitched roof on wooden rafters and CGI roof covering. They did not have seismic bands hut were having vertical steel bars at corners. None of these collapsed, though located within 10 km from the epicenter, but some of them had serious damage to walls in the first storey.

4) The houses in the Indo-Tibetan Border Force colony at Mahitanda built by CPWD to codal specifications including a seismic band as per Indian Standards were generally of single or double storey witli cement concrete blocks in cement mortar. Roofs were either sloping RCC slabs or CGI sheet on wooden purlins. There was no damage to them except for some minor cracking.

These revealed structural weaknesses, planning defects and construction and maintenance defects. Based on this experience, appropriate recommendations had been made for the type of safe construction tliat should be encouraged in such areas as also the manner of retrofitting needed.

We have studied here in some detail, what lessons were learnt from past disasters triggered by eartliqualces. Similar literature exists about the lessons learnt from past cyclone and flood havocs which had enabled a better planning for managing the likely future disasters of similar types. It is worth reiterating tliat a review of the details of how a disaster situation was managed and with what results is an important necessity to enable appropriate lessons being drawn there from. These alone will enable improved planning and implementation of disaster mitigation in tlie future.

33.4 RELIEF AND REHABILITATION

Relief and rehabilitation come immediately after the disaster. Tlie basic difference between them is that relief relates to the immediate days and weeks after tlie disaster when attempts are made to provide basic needs like food, clothing, shelter, medicine, etc. to the victims. Rehabilitation relates to the work undertaken in tlie following weeks and months, for the restoration of basic services to enable the population to return to normalcy.

We have already studied the various aspects of these activities in the earlier units. The policy on disaster management, as at present in vogue, seeks to provide relief and arouse tlie energies of social groups, NGOs etc. in the total organised effort to ensure the least damage to tlie affected population due to the natural calamity. Lives must be saved and deterioration and destitution of people prevented. It also aims at, community effort and shaping the infrastructure of society such that recurrence of scarcities and other calamities are minimised.

The approach of moving away from crisis management to risk management initiated some two decades back and thereafter to integrated disaster preparedness involving reliable early warnings, carefully planned emergency response and better community preparedness has also been found to be highly rewarding in as much as notable success was achieved in reaching timely relief in recent years.

A comparison of the major cyclones which resulted in disasters in 1977 and again in 1990 in Andhra Pradesh underlined tlie beneficial role of disaster-preparedness strategy. While both had similar destructive potentials, the loss of lives was drastically reduced from 10,000 in 1977 to 910 in 1990. Similarly the, loss of cattle came down from 230,000 in 1977 to 27,000 in 1990.

Similarly in the wake of unprecedented floods in August 1984 in the Godavari river in Andhra Pradesli (A.P.) based on Central Water Commission's timely and accurate flood-forecasts and warnings, the A.P. Govt. was able to niove over one million people who were living within 10 km of flood banks to places of safety. There are many more instances to show tlie preparedness approach as superior in dealing with relief and rehabilitation. This also points to the importance of preparing a detailed, factual and documented account of every disaster and the manner in which relief and rehabilitation were handled and tlie results thereof in a comprehensive manner. Each disaster situation must thereafter be reviewed to draw appropriate lessons for the future. Unfortunately, such detailed records are not available for most disasters of tlie past in the requisite details. Another matter of importance is the need to avoid exaggerated or inadequate documentation of the effects of a disaster. Most often, in recent decades, there had been a tendency to exaggerate highly tlie adverse effects and damages allegedly suffered in order to arouse sympathies or to obtain greater relief grants. This tendency needs to be eschewed.

The National Flood Commission in its report (1980) had drawn pointed attention to this aspect as under:

"It may be stated at the outset that the available data, which we have used, suffer from many deficiencies. These generally stem from factors like inability of the primary reporting agencies to assess the magnitude of the flood damages objectively, human bias in reporting, arbitrary methods adopted in estimating yields and crop values, absence of a suitable mechanism for supervision, checking and lack of coordination at the lower levels between concerned departments of the Govt. Possibility of deliberate distortion of these statistics with a view to gaining some governmental assistance and concessions in some areas also cannot be ruled out....."

In-depth disaster case studies should be prepared as soon as possible after the event. Further, these should be archived and disseminated widely and may be put on INTERNET as well. These case studies need to be multi-disciplinary and multi-functional. There can be no rigid format for all places or all types of events. However, a certain basic format has evolved over the years and the past cases reported will serve as some guide.

As a result of National Workshops on 'Building up of National Capability to cope with Disasters' held only a few years back, another important dimension of the two distinct components of Disaster mitigation viz. preparedness and relief was pointedly focused upon. Even though communities and their administration plan and execute policies and strategies appropriate to the requirements of both these domains, there is a subtle difference. Disaster relief involves adequate infrastructural set up and quick response on the part of the entire system, primarily dealt with by governments and institutions. On the other hand, disaster preparedness is a continuous process which has to involve all sections of society. This points out the important role of local communities and local institutions, which need to create and sustain disaster preparedness.

33.5 REPORT WRITING: AREA-BASED APPROACH

No place in India seems to be free from the likelihood of occurrence of disaster of one type or the other. Some states or regions suffer repeatedly and others now and then. it becomes obvious that an area should be prepared to face the different types of disaster situation that it is likely to face. Hence, an area-based approach to disaster proneness and disaster mitigation is essential.

For any area, detailed knowledge should be generated and the following aspects require focused attention:

- A chronological and spatial study of affected areas in their physical environment
- Inventoried details of individual disasters that had struck the area
- Evaluative study of the rehabilitation measures
- Detailed study of various relief measures at the local, regional and national levels
- Availability and adaptability of new technology to help local situations and possible dissemination patterns
- Study of infrastructure development in the affected areas
- Study of socio-economic profile of the area and changes therein
- Such other specific aspects to suit one type of disaster or other

Check Your Progress 2

Note: i) Use the space given below for your answers.
ii) Check your answers with those given at the end of this Unit.

1) List the four basic steps in the Disaster Mitigation process.

2) List the items on which detailed knowledge should be generated in writing to enable adoption of an area-based approach in report writing.

33.6 LET US SUM UP

We have now reached the end of the course. The overall objective in Disaster Management is to reduce loss of lives, properly damage and economic and social disruption caused by natural disasters. Our attempt presently is to reorient the approach to pre-disaster planning and preparedness even sustaining and further improving post-disaster relief and management capabilities. The public attitude which was so far accustomed to passive acceptance of the consequences of disasters should be turned towards disaster mitigation, utilising the opportunities of pre-planning, prevention, warning, preparedness and increased application of science, technology and research. Cooperation of NGOs and involvement of communities are essential and should be ensured.

Every past disaster is a text book case study to enable the community to face a future likely disaster situation with greater ability and better management. The preparation of actual case studies should be realistic, factual, accurate and cover all relevant aspects eschewing bias to achieve some hidden agenda. These need to be reviewed competently to draw lessons for the future.

33.7 KEYWORDS

Natural Hazard	An extreme natural phenomenon capable of causing a disaster.
Hazard Assessment	The process of identifying the probability of occurrence of a hazard of a given intensity in a specified area based on an analysis of natural processes and site conditions,
Risk	The probability of an expected loss in a given area triggered by a natural hazard to an infrastructure system and the people.
Risk Appraisal	The process of identifying risks in specific areas or specific infrastructure system and quantifying the risk in social and economic terms.
Disaster Preparedness	The reduction of disaster impact by requisite anticipatory planning and action.
Disaster Management	The efficient use of resources to coordinate the process of relief, recovery and reconstruction.
Mitigation	Actions taken to reduce the risk to lives and property and disruption from a natural hazard.

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33.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Uour Progress 1

1. Your answer should include the following points.
   - International Strategy for Disaster Reduction (ISDR)
2. Your answer should include the following points.
   - Effectiveness of tlie pre-disaster preparedness and preventive nieasures is high and visible as compared to post-disaster relief measures.
   - Tlie pre-disaster preparedness measures are achieved at much lesser cost.

Check Your Progress 2

1. Your answer should include the following points.
   - Risk Analysis
   - Plan formulation
   - Preparation for implementation
   - Implementation and maintenance
2. Your answer should include the following points.
   - A chronological and spatial study of the affected area.
   - Inventoried details of individual disasters that struck the area in the past.
   - Evaluative study of the rehabilitation measures that were taken.
   - Detailed account of various relief measures at the local, regional and national levels.
   - Availability and adaptability of new technology.
   - Study of the infrastructure development in the affected area.
   - Study of socio-economic profile of the area and changes therein.