South Asia Disaster Report 2009

SAARC

SAARC Disaster Mangement Centre, New Delhi

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Contents

Preface

SAARC Disaster Management Centre is happy to bring out the South Asia Disaster Report 2009, following on the reports of the last two years that had generated a lot of interest among the policy makers, scientists, researchers and practitioners on disaster management in the region and outside. Encouraged by the positive and enthusiastic comments received from the readers and reviewers, the professionals of SDMC have worked hard to improve the format and content of the report this year.

SADR 2009 like previous two reports is largely based on the International Emergency Disaster Database (EMDAT) maintained by the Centre for Research on Epidemiology on Disasters (CRED), Leuven. However, this year we have again tried to look beyond the global data base to the seamless information generated on a daily basis by the large number of newspapers published from the South Asia region. The SDMC has been scanning all these newspapers on a daily basis and compiling a weekly disaster update. Fifty four issues of these updates published during 2009 provided valuable inputs for the SADR this year. We have further looked into various other databases on natural and manmade disasters maintained by the National Governments, International Agencies and non-governmental organizations.

SADR 2009, like the report of the last two years, has been structured in three main parts. Part I covers the hydro-meteorological disasters of cyclones, flood, drought, glacial lake outburst, heavy snow fall, avalanche, heat and cold wave and forest fire; Part II includes the geological disasters of earthquake and landslides; while Part III captures the man-made and biological disasters. The introductory chapter analyzes the overall disaster trends during the year and the concluding chapter summarizes the main findings.

We are aware of the scope for further improvement of this report and shall appreciate constructive comments and suggestions from the readers.

New Delhi
May 2010

P G Dhar Chakrabarti
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Chapter 1

Introduction

The year 2009 witnessed an overall decline in the occurrence of natural disasters around the world. As per the global database on disasters maintained by the Centre for Research on the Epidemiology of Disasters (CRED), a total number of 335 natural disasters were reported during the year 2009 as against 350 in 2008 and annual average of 393 during 2000 – 2008.

***Table 1.1**: A brief on Global Natural disasters in 2009*

Indicators	2000-2008 Yearly Average	2008	2009
No. of country level disasters	393	354	335
No. of Victims	230.86 million	214.3 million	119.52 million
Economic damage (US$)	102.64 billion	190.30 billion	41.28 billion

***Source**: Annual Disaster Statistical Review 2009: The Numbers and Trends, CRED 2010*

The decrease in the number of disaster events was mainly due to a lower number of reported meteorological disasters in 2009 (85) compared to the annual average number of meteorological disasters from 2000 to 2008 (108). A decrease in occurrence was also seen for hydrological, geophysical and climatological disasters. All continents, except Africa, experienced a decrease in the number of reported natural disasters compared to the annual average of disaster occurrence during 2000-2008. The relative decline in number of victims as also economic damage due to disasters during the year was the absence of a 'mega disaster' in 2009. The largest disaster that occurred in 2009 was the earthquake in Sumatra, Indonesia on September 30th which left 1 117 persons killed and over 2.5 million others affected compared to the Indian Ocean tsunami in 2004 (226 408 deaths in 12 countries), or cyclone 'Nargis' in Myanmar in 2008 (138 366 deaths).

Types of Disasters

2009 had its cocktail of hydrological, meteorological, climatological and geological disasters. Hydrological disasters (flood, flash flood, coastal flood, wet mass movements such as landslides, avalanche etc) remained the most common disasters in 2009, accounting for over 53% of total natural disaster occurrence. A total of 180 hydrological disasters (82.8% floods and 17.2% wet mass movements) caused over 57.3 million victims in 2009. The number of victims increased by 27.4% compared to 2008, however remained far below the 2000-2008 annual average of 99.2 million. The economic damages from hydrological disasters were lower than in previous years, and accounted for 19.1% of the economic damages from natural disasters worldwide in 2009.

Meteorological disasters (storm surge, tropical cyclone, hurricane, typhoon etc) also caused a tremendous human impact this year, mainly

due to typhoons 'Morakot' (Kiko) and 'Pepeng' (Parma), tropical storm 'Ondoy' (Ketsana), cyclone 'Aila' and a major snowstorm, which all happened in Asia. The number of victims from meteorological disasters in 2009 increased by 220% compared to 2008. Although less pronounced, the number of victims from meteorological disasters in 2009 was also higher than the 2000-2008 annual average. Meteorological disasters accounted for 59.7% of total economic damages from natural disasters in 2009, above the annual average of 52.3 % for the period 2000-2008.

***Table 1.1**: A brief on Global Natural disasters in 2009*

Disasters	Number of Disasters		Victims in Millions		Economic Loss (Billion USD)	
	2000-2008 average	2009 Occurrence	2000-2008 Average (Million)	Victim 2009 (Million)	2000-2008 average (US$ bn)	Damage 2009 (US$ bn)
Floods, Landslide (Hydrological)	194	180	99.15	57.29	19.94	7.88
Cyclone, Storms (Meterological)	108	85	38.79	50.59	53.63	24.64
Drought, Heat-Cold (Climatological)	54	45	83.89	8.37	9.39	2.71
Earthquake (Geo-physical, Volcano)	37	25	9.03	3.27	19.67	6.06
Total	**393**	**335**	**230.86**	**119.52**	**102.63**	**41.28**

***Source**: Annual Disaster Statistical Review 2009: The Numbers and Trends, CRED 2010*

Although the number of reported climatological disasters (extreme temperature, heat and cold wave, drought, forest fire etc) in 2009 was higher than in 2008, the number remained below the annual average occurrence for the period 2000-2008. The human impact from climatological disasters (8.4 million victims) was particularly low in 2009, as were the reported economic damages from climatological disasters (US$ 2.7 billion). Although droughts and extreme temperature affected several countries in 2009, their impact remained relatively small compared to previous years, for example to 2002 when extended droughts in India and in China affected 360 million people, or to 2008 when extreme winter conditions affected 77 million people in China.

In 2009 only 25 geological disasters (earthquake, volcano, dry mass movements like landslide, rockfall etc) were reported, much less than the 2000-2008 annual average of 37. Eighteen out of these were earthquakes, 4 tsunamis, 2 volcanic eruptions and one landslide. The unusually low geophysical disaster occurrence in 2009 was reflected by a decrease in human and economic impacts from these disasters. In 2009, geophysical disasters accounted for 2.7% of natural disaster victims worldwide, which is below the annual average of 3.9% for the period 2000-2008. Likewise, economic damages from geophysical disasters accounted for 14.7% of global damages costs from natural disasters in 2009, which is below the annual average of 19.2% for the pe-

riod 2000-2008. The differences are even greater compared to 2008, when 21.7% of total natural disaster victims and 45.0% of total damage costs were caused by geophysical disasters, mainly due to the Sichuan earthquake in China.

Trends of Disasters

Looking beyond 2009 to the two decades of disasters since International Decade of Natural Disaster Reduction (IDNDR) a general trend of increasing disaster and of a broad correspondence between the number of incidents of natural disasters and the reported victims is clearly seen. There have been years when number of disaster events as also disaster victim declined, as the figures of 1992, 1997, 2001, 2006 and 2009, as compared to the proceeding years would indicate, but lean years have been followed by years of high disasters.

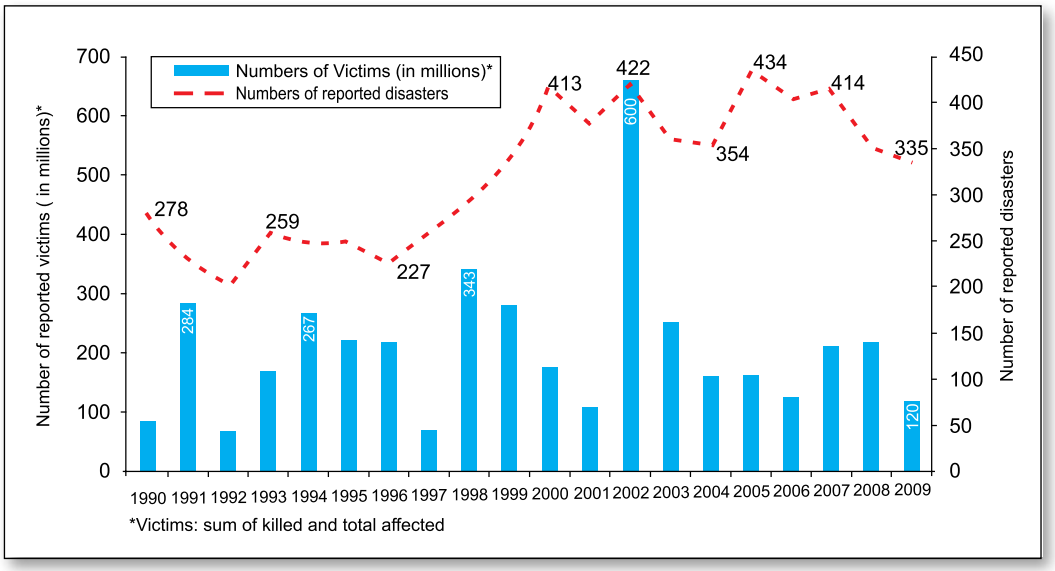


***Figure1.1**: Trend and occurrence of natural disasters in the world*
Source: Annual Disaster Statistical Review 2009: The Numbers and Trends, CRED 2010

A longer time series analysis for the period 1900-2009 shows a sharp upswing of natural disasters between 1970 and 2000; and a relative decline since 2000, which most analysts argue, may be too early to indicate any trend, although sustained global efforts for disaster reduction should ideally lead to such a decline.

Another important global trend of disasters is the consistently increasing number of hydro meteorological disasters in almost country and continent of the world. Incidents of geological disasters like earthquakes, landslides and volcanoes have remained more or less constant, even though the impact of these disasters in terms of loss and injuries of life and damages of buildings and infrastructures have worsened due largely to the rapid growth of population in the developing countries, unplanned settlements and unsafe building practices. The hydro meteorological disasters like flood, drought, windstorms, cyclones, tornadoes and other extreme climatic events, on the other hand have been continuously on the rise as would be evident from the following table.

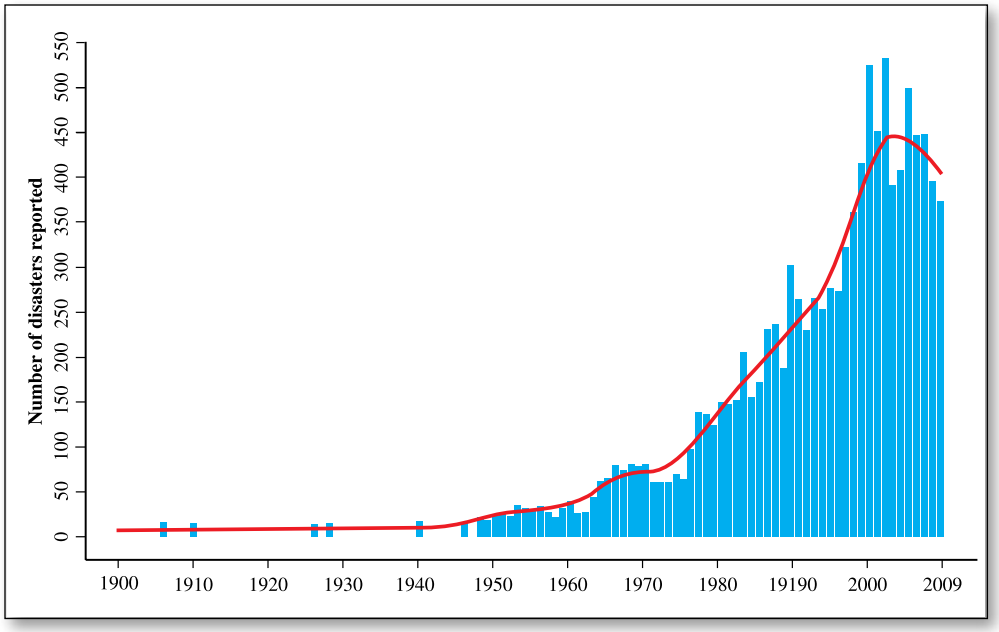


***Figure - 1.2**: Temporal Distribution of Natural Disaster (1900-2009) Source: www.emdat.be*

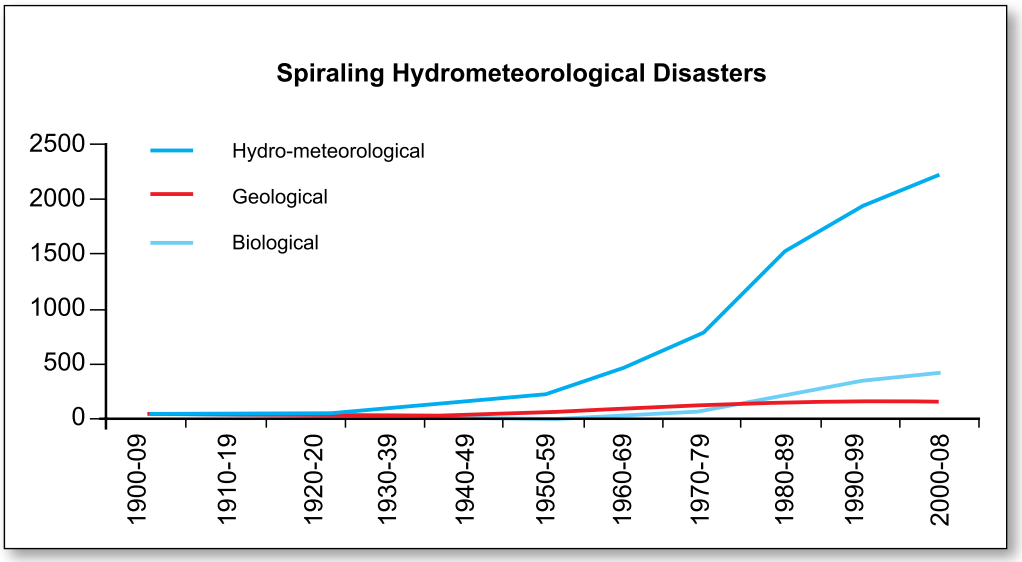
Another important global trend of disasters is the consistently increasing number of hydro meteorological disasters in almost country and continent of the world. Incidents of geological disasters like earthquakes, landslides and volcanoes have remained more or less constant, even though the impact of these disasters in terms of loss and injuries of life and damages of buildings and infrastructures have worsened due largely to the rapid growth of population in the developing countries, unplanned settlements and unsafe building practices. The hydro meteorological disasters like flood, drought, windstorms, cyclones, tornadoes and other extreme climatic events, on the other hand have been continuously on the rise as would be evident from the following table.

This trend gets sharper over a wider time frame as the following graph based on available data from 1900 onwards would indicate.

***Table -1.3**: Pattern of Hydro Meteorological and Geological Disasters 1974-2009*

Continents	Hydro Meteorological Disasters							Geological Disasters						
	1974-78	1979-83	1984-88	1989-93	1994-98	1999-03	2004-09	1974-78	1979-83	1984-88	1989-93	1994-98	1999-03	2004-09
Africa	84	109	120	97	145	322	472	4	4	8	10	4	11	8
America	85	162	229	284	285	436	1,873	14	37	26	35	35	39	37
Asia	183	276	294	408	387	612	2,853	37	60	59	74	62	114	87
Europe	33	82	124	128	123	271	1017	10	26	12	16	11	17	16
Oceania	43	52	50	53	57	66	376	4	4	7	11	7	9	10

***Source:** Centre for Research on the Epidemiology of Disasters (CRED), Leuven, Belgium*



Source: *Centre for Research on the Epidemiology of Disasters, Leuven*

Distribution of Disasters

From the 111 countries that were affected by natural disasters in 2009, 18 countries accounted for 79.0% of the deaths, 95.1% of the victims and 86.7% of the overall economic damages. This reflects the unequal distribution of the burden that natural disasters bring upon human society. As in the previous years, Asia once more took the largest share in natural disaster occurrence (40.3%), followed by the Americas (21.8%) and Africa (19.1%). 89.1% of global natural disasters victims in 2009 were in Asia, compared to 6.0% in Africa, 4.8% in the Americas, and 0.1% in both Europe and Oceania. The proportion of economic damages from natural disasters was also the highest in Asia (38.5%), followed by the Americas (32.1%) and Europe (24.8%).

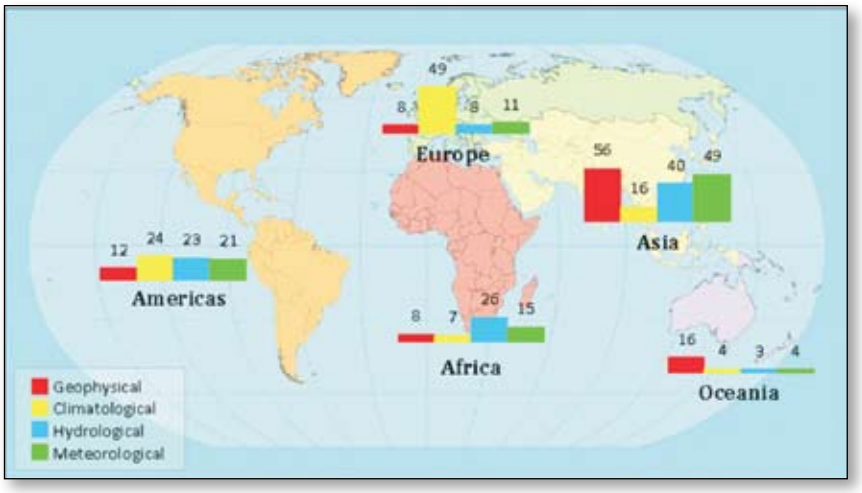
Table - 1.4*: Natural Disasters 2009: Continental Contrasts*

	Africa	Americas	Asia	Europe	Oceania	Global
Number of Disaster Events	64	94	158	61	16	392
Number of Victims (millions)	7.16	5.75	106.44	0.11	0.07	119.52
Economic Damages (billions)	0.17	13.23	15.91	10.24	1.73	41.28

Source: *Annual Disaster Statistical Review 2009: The Numbers and Trends, CRED 2010*

Of the top 10 countries in disasters during 2009, the majority again belonged to Asia, as in previous years. Philippines topped the list of disaster events (25), followed by China (24), USA (16), India (15) and Indonesia (12). India topped the list of number of disaster deaths (1806), followed by Indonesia (1407), Philippines (1334), Taiwan (630) and China (591). China topped the list of disaster victims followed by Philippines, India, Bangladesh and Sudan, while USA topped in economic damages due to disasters followed by China, France, India and Italy.

***Map - 1.1**: Percent Share of Disaster Sub-group and Continent in 2009*



***Source:** Annual Disaster Statistical Review 2009: The Numbers and Trends, CRED 2010*

***Table - 1.5**: Top 10 Countries Affected by Natural Disasters in 2009*

Disaster Events		Deaths		Victims		Economic Damages	
Countries	Numbers	Countries	Numbers	Countries	Millions	Countries	Billions
Philippines	25	India	1806	China	68.8	USA	10.8
China	24	Indonesia	1407	Philippines	13.4	China	5.2
USA	16	Philippines	1334	India	9.0	France	3.2
India	15	Taiwan	630	Bangladesh	4.6	India	2.7
Indonesia	12	China	591	Sudan	4.4	Italy	2.6
Brazil	9	Australia	535	Vietnam	3.7	Indonesia	2.4
Mexico	7	Peru	419	Indonesia	2.9	Spain	1.9
Australia	6	Vietnam	356	Guatemala	2.5	Australia	1.5
Bangladesh	6	Italy	335	Taiwan	2.3	Japan	1.4
Vietnam	6	El Salvador	275	Brazil	1.9	Vietnam	1.1
Total	**126**	**Total**	**7688**	**Total**	**113.5**	**Total**	**32.8**

***Source:** Annual Disaster Statistical Review 2009: The Numbers and Trends, CRED 2010*

Incidence of Disasters in South Asia

As per the EM-DAT global data base of disasters, 2009 witnessed 42 natural disasters in South Asia in which 10 or more persons got killed or 100 or more got injured. India topped the list with 17 disasters, followed by Bangladesh (6), Afghanistan and Nepal (5 each), Sri Lanka (4 each), Pakistan (3), Bhutan (2) and Maldives (0). This, contrary to the global and Asian trend, registers an increase of 50% over the recorded disasters of 2008, but a decline of 14.2% from 2007 and a decline of 23.3% from the average of 2000-08. Among the countries of South Asia, Afghanistan, Bangladesh, Bhutan, India and Nepal shows increase in number of disasters in 2009 as compared to 2008, Maldives and Sri Lanka maintains the same level whereas Pakistan registers a decline. The declining trend as compared to the average of 2000-08

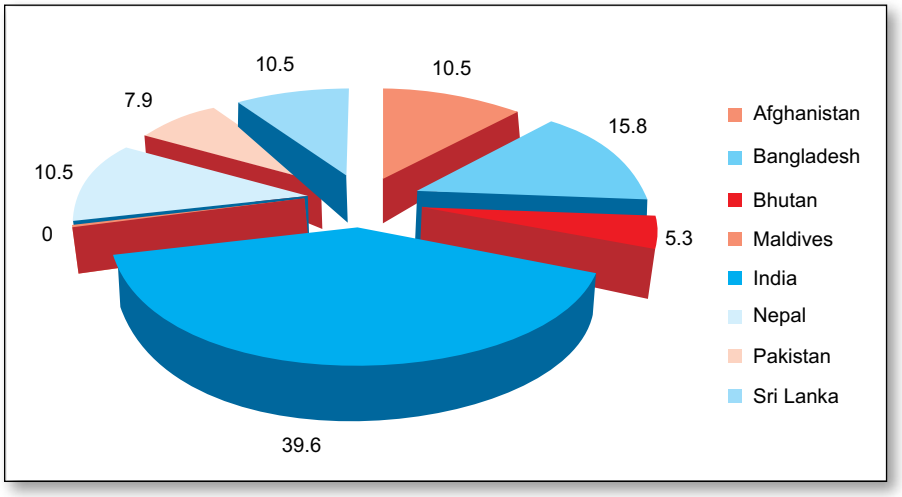


***Figure -1.3**: Percentage Distribution of Natural Disasters in South Asia in 2009*

***Table - 1.6**: Occurrence of Natural Disaster Events in South Asia (2000-2009)*

Country	2000-08			2007		2008		2009	
	Total	Average	%	Total	%	Total	%	Total	%
Afghanistan	79	9.9	18.0	7	14.3	4	14.3	5	11.9
Bangladesh	77	9.6	17.6	7	14.3	4	14.3	6	14.3
Bhutan	2	0.3	0.5	0	0.0	0	0.0	2	4.8
India	181	22.6	41.3	20	40.8	10	35.7	17	40.5
Maldives	2	0.3	0.5	1	2.0	0	0.0	0	0.0
Nepal	22	2.8	5.0	1	2.0	2	7.1	5	11.9
Pakistan	65	8.1	14.8	10	20.5	4	14.3	3	7.1
Sri Lanka	20	2.5	4.6	3	6.1	4	14.3	4	9.5
Total	**438**	**54.8**	**100.0**	**49**	**100.0**	**28**	**100.0**	**42**	**100.0**

***Source**: www.emdat.be*

***Table - 1.7**: Occurrence of Natural Disaster Events in South Asia (1974-2008)*

Country Name	1974-1978	1979-1983	1984-1988	1989-1993	1994-1998	1999-2003	2004-2008	Total 1974-08	Average 1974-08
Afghanistan	3	3	4	13	13	28	41	105	3.0
Bangladesh	16	18	22	37	40	41	41	215	6.1
Bhutan	0	0	0	0	2	2	1	5	0.1
India	30	51	54	51	45	72	89	392	11.2
Maldives	0	0	1	1	0	0	2	4	0.1
Nepal	3	7	13	7	8	8	10	56	1.6
Pakistan	5	13	7	19	18	30	38	130	3.7
Sri Lanka	6	9	7	10	7	10	6	55	1.6
Total	**63**	**101**	**108**	**138**	**133**	**191**	**228**	**962**	**27.5**

***Source**: Thirty Years of Natural Disasters 1974-2003: The Numbers, CRED, Leuven, Belgium, www.emdat.be*

is seen in all the countries except Bhutan, Nepal and Sri Lanka where disasters have increased during the period. A larger time frame of 35 years (1974 to 2008) would however present a more consistent picture of rise in disasters in all the countries of the region.

A total number of 3379 persons were killed in natural disasters in South Asia during 2009. India again topped the list with 2094 deaths followed by Nepal (440), Bangladesh (348), Sri Lanka (280), Pakistan (102), Afghanistan (91), Bhutan (24) and Maldives (0). The South Asian deaths in disasters constituted 31.7% of the total deaths in natural disasters globally (10655), although South Asia shared only 12.5% of the total disasters of the year (42 out of 335 total recorded disasters). The maximum number of deaths in disaster were due to flood (51.5%), followed by epidemics (26.6%), cyclone (12.67%), heat and cold wave (8%) and earthquake (1%).

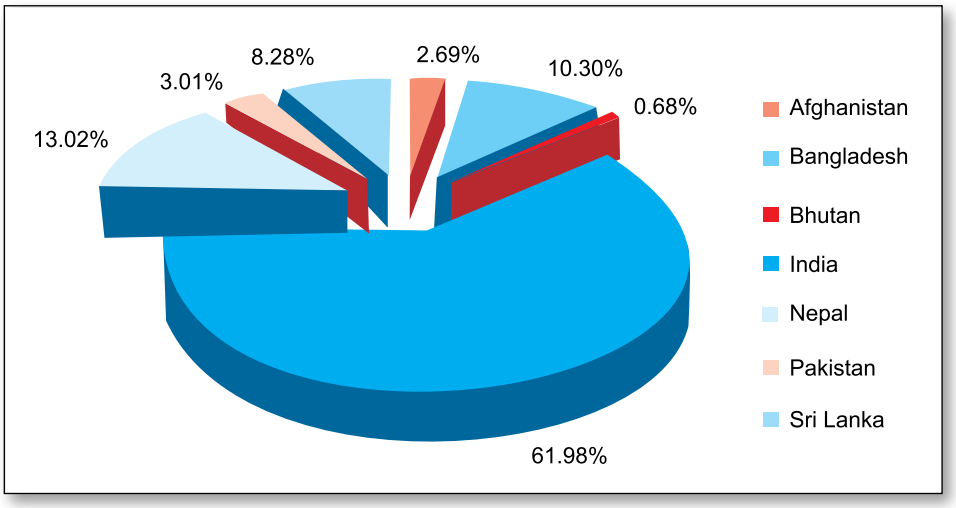


***Figure-1.4**: Distribution of Disaster Deaths in South Asia in 2009*

***Table - 1.8**: Pattern of Disaster Deaths in South Asia in 2009*

Countries	Cyclone	Earthquake	Drought	Avalanche	Flood	H&C Wave	Landslide	Epidemics	Total
Afghanistan	-	22	-	-	69	-	-	-	91
Bangladesh	197	-	-	-	16	135	-	-	348
Bhutan	12	12					-	-	24
India	218	-	-	-	1445	120	-	311	2094
Maldives	-	-	--	-	-	-	-	-	-
Nepal	-	-	-	-	108	18	-	314	440
Pakistan	-	-	-	-	102	-	-	-	102
Sri Lanka	-	-	-	-	3	-	-	277	280
Total	**427**	**34**	**-**	**-**	**1743**	**273**	**-**	**902**	**3379**

***Table - 1.9**: Number of People Affected by Natural Disasters in South Asia in 2009*

	Cyclone	Earthquake	Avalanche	Flood	H&C Wave	Epidemics	Total
Afghanistan	-	3309	32	62516	-	-	65857
Bangladesh	3954550	-	-	500000	50000	-	4504550
Bhutan	-	12	-	-	-	-	12
India	5109085			3886008	25	1521	8996639
Maldives	-	-	-	-	-	-	-
Nepal	-	-	-	175027		58874	233901
Pakistan	-	-	-	75080	-	-	75080
Sri Lanka	-	-	-	380000	-	33856	413856
Total	**9063635**	**3321**	**32**	**5078631**	**50025**	**94251**	**14289895**

As per EMDAT 14.2 million people of South Asia were affected by natural disasters during 2010. This constituted 11.8% of 119.52 million affected by natural disasters globally. Majority of them were hit by cyclone (9.06 million) followed by flood (4.5 million). India was the most affected country (8.9 million) followed by Bangladesh (4.5 million), Nepal (0.4 million) and Sri Lanka (0.2 million). It would be pertinent to note that EMDAT did not cover drought which affected large area and population of South Asia during 2009. EMDAT pegged the total economic damage caused by natural disasters in South Asia in 2009 to US$ 3.08 billion which again is an understatement as it covered only two natural disasters, namely cyclone and flood. The drought that had a creeping effect on rural economy of South Asia during the year was not included in this estimation.

***Table - 1.10**: Economic Damage (US$ 000) due to Disasters in South Asia in 2009*

Country	Cyclone	Flood	Total
Afghanistan	-	20000	20000
Bangladesh	270000	-	270000
Bhutan	-	-	-
India	300000	2434000	2734000
Maldives	-	-	-
Nepal	-	60000	60000
Pakistan	-	-	-
Sri Lanka	-	-	
Total	**570000**	**2514000**	**3084000**

Flood continued to remain the most common and perennial disaster in South Asia. It comprised 42.8% of the total disasters followed by cyclone (21.4%), landslide (9.5%), heat and cold wave and epidemics (7.1% each), earthquake and drought (4.7% each) and avalanche (2.3%).

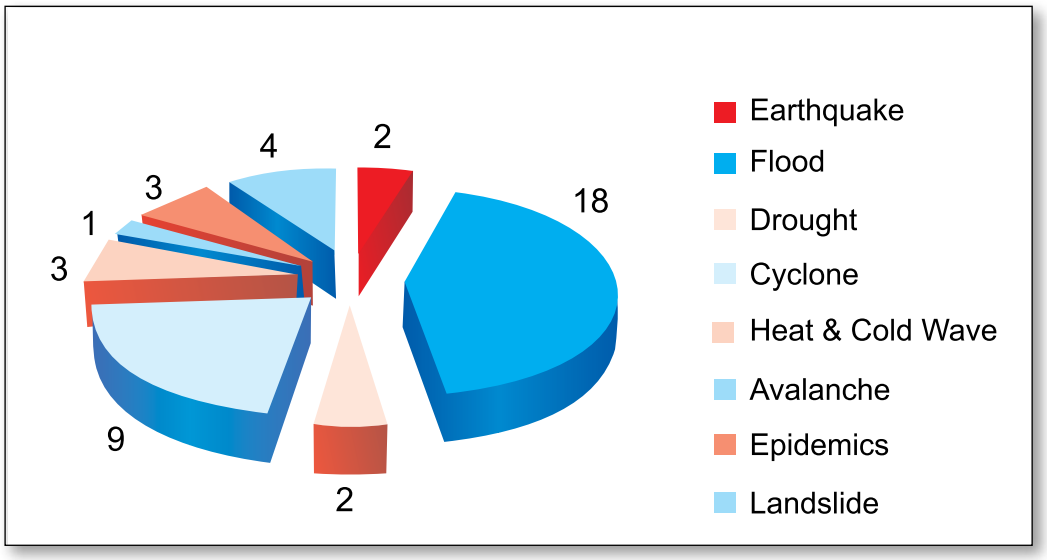


***Figure – 1.5**: Type and Incidence of Disasters in South Asia in 2009*

***Table – 1.11**: Spatial Distribution of Natural Disasters in South Asia in 2009*

Countries	Earthquake	Flood	Drought	Cyclone	H&C Wave	Avalanche	Landslide	Epidemics	Total
Afghanistan	1	3	-	-	-	1	-	-	5
Bangladesh	-	2	1	2	1	-	-	-	6
Bhutan	1	-	-	1	-	-	-	-	2
India	-	5	1	6	1	-	3	1	17
Maldives	-	-	-	-	-	-	-	-	-
Nepal	-	2	-	-	1	-	1	1	5
Pakistan	-	3	-	-	-	-	-	-	3
Sri Lanka	-	3	-	-	-	-	-	1	4
Total	**2**	**18**	**2**	**9**	**3**	**1**	**4**	**3**	**42**

Flood affected 5 out of 8 countries of South Asia; cyclone, heat & cold wave and epidemics affected three countries each; drought, earthquake and landslide affected two countries, while avalanche affected only one country, namely Afghanistan.

Although EMDAT does collect data on technological disasters, this covers only transport and industrial accidents of more severe magnitudes, but large number of small scale disasters happening all around are not captured in the global statistics. Even the EMDTAT data on natural disasters are seen as understatement of disaster situations, as many independent reports and media coverage of disasters do indicate that both the number and depth of disasters have been far more extensive than global data suggests. In this report therefore we have taken recourse to such independent reports to supplement the global data base, to provide a more comprehensive picture of disasters in the region, but for the purpose of both intra and inter-regional comparisons reliance has been placed on accepted global data base for uniform standards and acceptability.

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Chapter 2

Cyclone

An Overview

Cyclone is one of the most catastrophic hydro-meteorological disasters that use to cause a severe damage in South Asia. The frequency of storm surges is less in the Arabian Sea (AS) than in the Bay of Bengal (BoB), major destructive surges have occurred along the eastern coast of the AS as well, particularly the coast of Pakistan and India. Tropical cyclones generate quite strong wind fields and rainfall. Passage of tropical cyclones over a large surface of water (such as sea) gives rise to unusually large waves. The cyclone-generated winds cause sea water to pile up on the coast and lead to storm-surge (i.e., inundation and flooding of low-lying coastal regions). Most of the countries located along the periphery of the North Indian Ocean are threatened by storm surges associated with severe tropical cyclones. The destruction due to the storm surge flooding is a serious concern along the coastal regions of South Asia.

Cyclones are intense low pressure areas—the pressure increases from center towards the outer part. The amount of the pressure drop in the centre and the rate at which it increases outwards gives the cyclones, the intensity and the strength of winds[1]. Depending upon the pressure distribution in the atmospheric winds and its mode circulation in the Bay of Bengal and Arabian sea, South Asian countries experience all types of cyclones as described in Table 2.1 [World Meteorological Organisation (WMO)].

***Table 2.1**: Classification of Low Pressure Systems*

Types of disasters	Associated wind speed in the circulation
Low pressure area	Less than 17 knots (< 31 kmph)
Depression (D)	17 to 27 knots (31 to 49 kmph)
Deep depression (DD)	28 to 33 knots (50 to 61 kmph)
Cyclonic storm (CS)	34 to 47 knots (62 to 88 kmph)
Severe cyclonic storm (SCS)	48 to 63 knots (89 to 118 kmph)
Very severe cyclonic storm (VSCS)	64 to 119 knots (119 to 221 kmph)
Super cyclonic storm (SuCS)	120 knots and above (222 kmph and above)
(1 knot–1.85 kmph)	

***(Source:** http://en.wikipedia.org/wiki/Cyclone#Structure.)*

The cyclones experienced in the South Asian countries are typically Tropical cyclones, which are storm systems characterized by a low pressure center and numerous thunderstorms that produces strong winds and flooding rain. A tropical cyclone feeds on heat released when moist air rises, resulting in condensation of water vapour contained in the moist air2. Tropical cyclones can produce extremely powerful winds and torrential rain and they are also able to produce high waves and damaging storm surges. Initially developing over large bodies of warm water, they lose their strength as they move towards land. This is the reason coastal regions can receive significant damage from a tropical cyclone, while inland regions are relatively safe from receiving strong winds. Heavy rains, however, can produce significant flooding inland, and storm surges can produce extensive coastal flooding up to 40 km from the coastline[2].

Cyclones: the South Asian scenario

With a long coastline of more than 12,000 kilometers, most of it having very high population density, the South Asia has been perennially plundered by the fury of cyclones, most of which are tropical cyclones. More than 95% of the major cyclonic disasters experienced in the world have taken place in South Asia. The incidence of cyclones is more in the Bo B than in the AS. Cyclones form in the south and central BoB. Their initial course of movement is towards northwest, north and then they recurve towards northeast striking the Arakan coasts in April and Andhra–Orissa–West Bengal coasts of India and Bangladesh coasts in May. Most of the monsoon (June–September) storms develop in the central and northern Bay and moves west–north–westwards affecting Andhra–Orissa–West Bengal coasts of India. Post-monsoon (October–December) storms form mostly in the south and the central Bay, recurve between 150 and 180 N latitudes affecting Tamil Nadu–Andhra Orissa–West Bengal coasts of India and the coasts of Bangladesh.

In the AS, the cyclones form in southeast AS and adjoining central AS during the months of May, October, November and December and in east central AS during the month of June. Some of the cyclones that originate in the BoB travels across the peninsular India, weakens and emerges into the AS as low pressure areas. Some of these again intensify into cyclonic storms. Most of the storms in AS move in west–north–westerly direction towards Arabian coast during the month of May and in a northerly direction towards Gujarat Coast during the month of June. In other months, they generally move northwest, north and then recurve towards northeast affecting Gujarat–Maharashtra coasts; a few, however, also move west–north–westwards towards the Arabian coast. It has been generally observed that the pre- and post-monsoon storms/cyclones are more violent than the storms of the monsoon season. Life span of a severe cyclonic storm in the Indian seas averages about 4 days from the time it forms until the time it enters the land[3].

Cyclone activities in South Asia during the year 2009

Eight cyclonic disturbances were formed over the north Indian Ocean during the year 2009. Out of these eight disturbances, two had intensified upto deep depression (DD), three upto the stage of cyclonic storms (CS) and one upto severe cyclonic storm (SCS). The details about these disturbances are listed in the following Table.2.2 and Appendix-II.

Table 2.2. *: Cyclonic Disturbances in South Asia in the Year 2009.*

Sl. No.	Name of the disturbance/class of the disturbance	Area of the disturbance	Date
1.	Cyclonic Storm,' BIJLI'	Bay of Bengal	14–17 April
2.	Severe Cyclonic Storm,'AILA'	Bay of Bengal	23–26 May
3.	Depression	Arabian Sea	23–25 June
4.	Depression	Arabian Sea	25–26 June
5.	Deep depression	Bay of Bengal	20–21 July
6.	Deep depression	Bay of Bengal	05–07 September
7.	Cyclonic Storm,'PHYAN'	Arabian Sea	09–12 November
8.	Cyclonic Storm,'WARD'	Bay of Bengal	10–15 December

(Source: *http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf)*

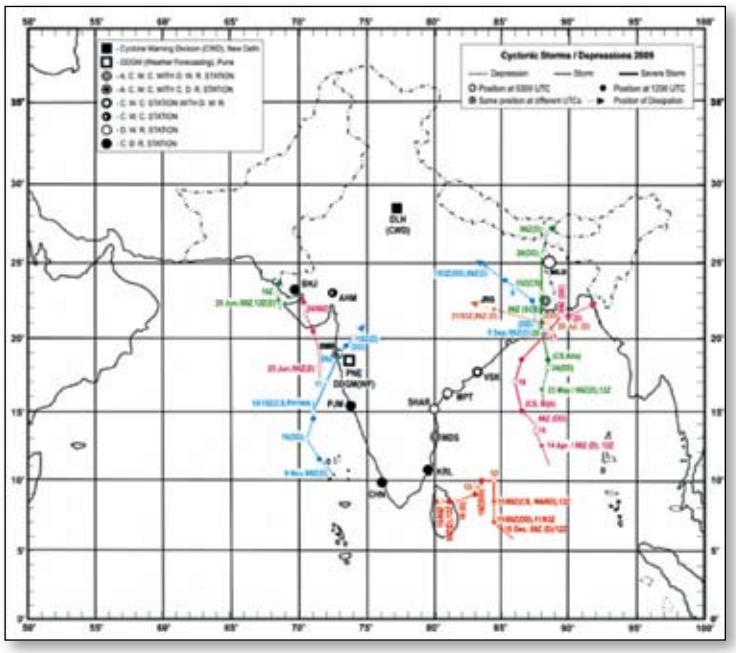


Figure 2 .1 *: Tracks of cyclonic disturbances formed over north Indian Ocean during the year 2009 (Source: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf).*

Tracks of the cyclonic disturbances formed over the north Indian Ocean during 2009 are shown in the following Figure 2.1.

The comparative analysis of the cyclonic disturbances for the period falling between 1997 and 2009 (13 years) shows a waxing and waning trend. There was an upward trend of cyclones in the north Indian Ocean during the years 1997 to 1999 followed by a lull during the years 2000–2003. The number of cyclonic disturbances again attained an increasing trend between 2004–07and during the following period during 2008–

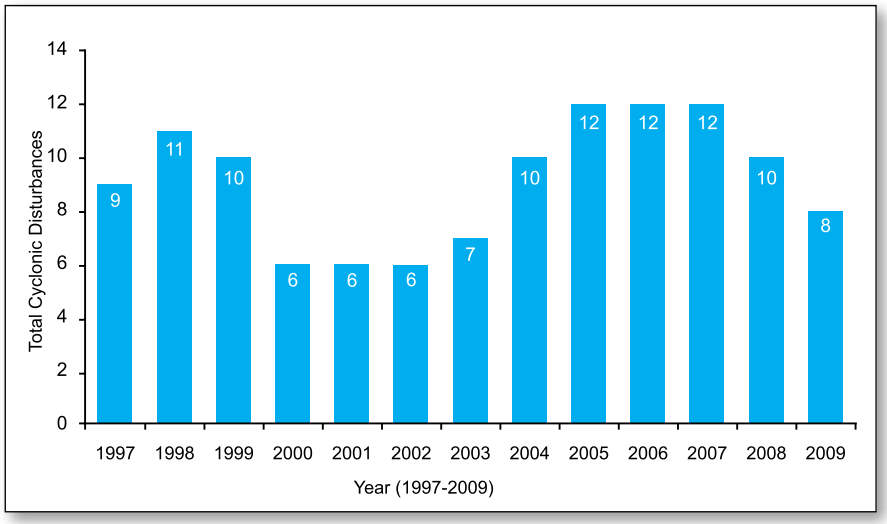


Figure2.2 *: Cyclonic disturbances formed over the north Indian Ocean and land areas of India during1997–2009 (Source: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf)*

09 the number of events show a declining trend (Figure2.2). During the monsoon season (June–September) four cyclonic disturbances were witnessed (Table 2.3). However, there was no disturbance during the month of August. Out of these eight disturbances five were in Bay of Bengal and three in Arabian Sea. The maximum life time of the events in a particular intensity stage was 6.75 days in DD and the lowest time was in SCS stage, 0.37 days[3] (Table 2.4).

Table 2.3 *: Monthly Frequency of Cyclonic Disturbances in South Asia during the Year 2009.*

Sl. No.	Type	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1.	D						*						
*													
2.	DD							*		*			
3.	CS				*							*	*
4.	SCS					*							
5.	VSCS												
6.	SuCS												

(Source*: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf)*

Table 2.4 *: Life-time of Cyclonic Disturbances During 2009 at Different Stages of Intensity*

Sl. No.	Type	Life time (in days)
1.	D	6.50
2.	DD	6.75
3.	CS	5.25
4.	SCS	0.37
5.	VSCS	--
6.	SuCS	--
Total life time in Days		**18.87**

(Source*: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf)*

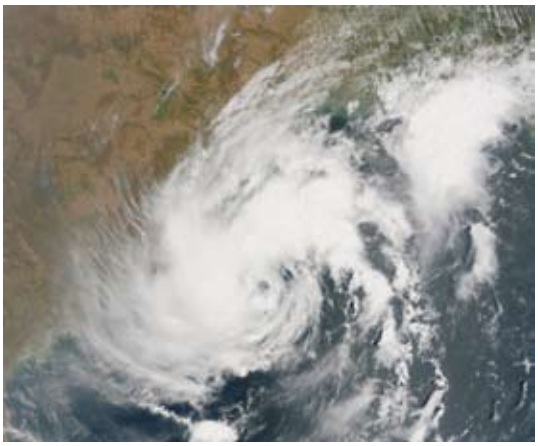
Incidence of 2009 Tropical Cyclone in Indian Ocean

The north Indian Ocean comprising of the AS to west Indian subcontinent and the BoB to east forms the north Indian basin which had experienced three major cyclone disturbances in 2009. The cyclonic events of the region are discussed below.

Cyclonic Storm Bijli, Bay of Bengal (14–17 April, 2009)

It had developed over the west central BoB during 14th to 17th April. This aspect is somewhat out of the convention climatologically, cyclogenesis during the first fortnight of April is rare and has been observed only on ten occasions during 1891–2008 (Figure 2.3). However, the track of this CS was according to convention as it had moved in a northwesterly direction and then recurved northeastwards towards Bangladesh coast. It gradually weakened and crossed Bangladesh coast near Chittagong 1600 UTC on 17th April. During the period of cyclogenesis there was no change in 24 hours in mean sea level pressure (MSLP) along the coast of India, Bangladesh and Myanmar as the system was away from these coasts. Upon reaching closer to the Indian coast after moving on a north–northwesterly course, the MSLP responded and maximum pressure fall

of 3.4 hPa was recorded over Gopalpur. The pressure kept on a downward spiral as the system attained a northeasterly course and a maximum fall of 5.8 hPa was recorded near Cox bazaar in Bangladesh. As the system moved north–northeastwards it did not cause any heavy rainfall along east coast of India. However, after the landfall, it caused isolated heavy rainfall over Mizoram with Lenpui reporting 7 cm rainfall in 24 hours. Squally winds of speed reaching 30–35 knots prevailed along Bangladesh coast at the time of landfall[3].



Cyclonic Storm Bijli
Formed - 14 April2009
Dissipated - 17April 2009
Highestwinds
75 km/h (45 mph) (3-minute sustained)
95 km/h (60 mph) (1-minute sustained)
Lowest pressure -996 mbar (hPa 29.41 inHg)
Fatalities 4 direct, 3 indirect
Damage Unknown
Area Affected Eastern India, Bangladesh, Myanmar

***Figure 2.3** : Image of the Cyclonic Storm "Bijli".*

Super Cyclonic Storm Aila, Bay of Bengal (23–26 May, 2009)

It had developed over the the BoB and crossed the Sagar Islands between 08.00 and 09.00 UTC on 25th May (Figure 2.4). The monsoon had set in the Andaman Sea and adjoining BoB on 20th June. A SCS, "AILA" crossed West Bengal coast near Sagar Island between 08.00 and 09.00 UTC of 25th May 2009. It caused loss of about 100 human lives and left several injured in West Bengal. It also caused about 175 human deaths and left several injured in adjoining Bangladesh. As the monsoon had set in, environmental factors were favourable for genesis and intensification of the system. The wind speed was relatively stronger in the southeast sector due to strong southerly surge of the monsoon current. The depression moved mainly in a northerly direction and intensified into a deep depression and lay centred at 03.00 UTC of 24th May near Lat 18.0°N/Long 88.5°E. It further intensified into a cyclonic storm, "ALIA" at 12.00 UTC of 24th May and lay centred near Lat 18.5°N/Long 88.5°E. It continued to move in northerly direction and intensified into a severe cyclonic storm at 06.00 UTC of 25th May and lay centred over northwest BoB near Lat 21.5°N/Long 88.0°E close to Sagar Island. The system crossed West Bengal coast close to the east of Sagar Island between 08.00 & 09.00 UTC as a severe cyclonic storm with wind speed of 100 to 110 kmph. The lowest estimated central pressure was about 967 hPa at the time of landfall. After the landfall, the system continued to move in a northerly direction, gradually weakened into a cyclonic storm and lay centred at 15.00 UTC of 25th May over Gangetic West Bengal, close to Kolkata. While it continued its northerly movement, it fur-

Severe Cyclonic Storm Aila

Category - 1Formed - 23 May 2009

Dissipated - 26 May 2009

Highestwinds

110 km/h (70 mph) (3-minute sustained)

120 km/h (75 mph) (1-minute sustained)

Lowest pressure - 968 mbar (hPa; 28.59 inHg)

Fatalities - 325 total, ~8,000 missing

Damage - USD552.6 million

Area Affected - India, Bangladesh

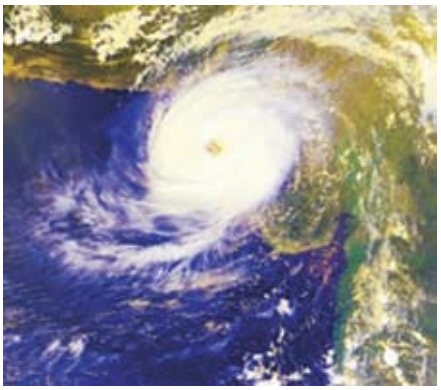


***Figure 2.4** : Image of the Severe Cyclonic Storm "Aila".*

ther weakened into a deep depression and lay centred at 03.00 UTC of 26th May over sub-Himalayan west Bengal & Sikkim, close to Malda. It weakened into a depression and lay centred at 06.00 UTC of 26th May over the same region close to Bagdogra. It further weakened and lay as a well marked low pressure area over sub-Himalayan West Bengal and neighbourhood at 09.00 UTC of 26th May and became less marked on 27th May. The track of Aila is shown in th figure 2.5.

The system could retain its intensity of cyclone for about 15 hours after the landfall, as it lay close to the BoB and lay centred over the Gangetic deltaic region for quite some time, thus ascertaining the availability of moisture. However, the system gradually weakened due to interaction with land surface.

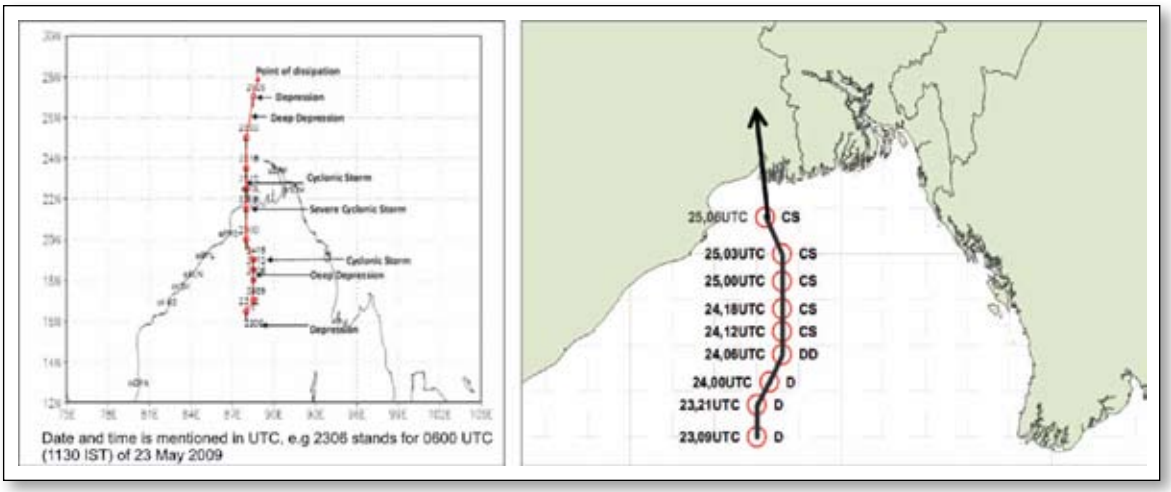


***Figure 2.5** : Track of the SCS "Aila".*

Widespread rain/thundershowers with scattered heavy to very heavy rainfall and isolated extremely heavy rainfall (≥25 cm) occurred over Orissa on 25th May, over West Bengal & Sikkim on 25th & 26th May (Table 2.5). Widespread rainfall with isolated heavy to very heavy rainfall also occurred over Assam & Meghalaya on 26th & 27th May. The significant amount of rainfall realised

over these regions are shown in Table 2.2.4. Apart from India and Bangladesh, Nepal also experienced heavy rain due to northward movement of the system. The following table summarizes the amount of rainfall experienced in the parts of India, Nepal and Bangladesh.

Table 2.5. Rainfall received (7 cms and above) in parts over the South Asian countries due to SCS, AILA (Modified after: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf.)

Table 2.5 *: Rainfall received (7 cms and above) in parts over the South Asian countries due to SCS, AILA*

Country	Met Sub-division	Date		
		25th May	26th May	27th May
India	Orissa	Paradip-26, Kakatpur-18, Chandbali, Alipingal-15, Neemapara, Patamundai-14, Rajkanika-10, Cuttack, Khuapada- 9, Bhubaneshwar, Soro, Gathgaon-8, Jajpur, Bangriposhi, Gop-7.		
	Gangatic West Bengal	Digha-7.	Panagarh A/F, Kalaikunda A/F, Sriniketan-17. Midnapur, Digha-14, barrackpur-12, Barampur-10, Barrackpur, Dumdum-9, Bankura, Krishnanagar-7.	
	Sub Himalayan West Bengal and Sikkim	Barobhisa-10.	Singlabazar-14, Malda-13, Gazoledobo-11, Khanitar-10, jalpaiguri-9, Domohani, Champasari- 8, Pushvihar, Alipurdwar-7,	Darjeeling-27, Sinlabazar,Lava-18, Bijanbari-15, Sukhiapokhri-11, Sevoke-10, Bagdogra-7.
	Arunachal Pradesh			Bhalukpong-7.
	Assam and Meghalaya		Cherrapunji-21, Shillong-12, Kokrajhar-9, Golpara-8, Bhalpur-7.	Manas NH-12, Cherrrapunji-9, Shillong-8, Beki Road Bridge-7.
	Nagaland, Manipur, Mizoram and Tripura		Dharmanagar, Paniagarh-8.	Belonia-13.
Bangladesh			Dinajpur-14, Sandwip, Feni-12, Cox's BAzar-9, M.Coat, Ranapur, Mogla-8.	Chittagong, Sandwip-13, Feni-10, M.Coat-7.
Nepal			Dang-8.	Biratnagar-12, Dharan-9, Daankuta-8.

(Modified after: *http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf.)*

Strong winds were associated with the SCS Aila. The wind speed experienced at various parts of the affected areas are: Kolkata 95 kmph, Panagarh 97 kmph, Kalaikunda 112 kmph, Barrackpore 102 kmph, Kakdwip, Sagar Island 75 kmph.

According to survey report of IMD, a storm surge of 3 m (10 ft) impacted eastern regions of Bangladesh, submerging numerous villages. The Sunderbans, was inundated with 6 m (20 ft) of water as per the media reports. Considering

the astronomical tidal wave at the time of landfall, which was about 4–5 meters, the maximum storm surge over Sunderban area may be estimated to be about 2 m[3].

The SCS AILA had caused considerable damage and destruction to India and Bangladesh. The major damages caused are as follows.

Bangladesh

More than three million people were hit by the cyclone. The death toll from cyclone AILA in Bangladesh was around 175. According to Bangladeshi authorities, over 5,400 people were injured and nearly 842,000 were forced to take refuge on rooftops and rafts. Several rivers broke through embankments, causing widespread inland flooding. An estimated 58,950 animals were killed by the storm[3]. Cyclone Aila ripped through the southern coast of Bangladesh late Monday (25th May 2009), killing over 190 people (source: AFP) and affecting over 3 million people, damaging many houses, crops, shrimp enclosures and roads in 14 districts. Many people including poor fisherman are still missing.

According to Government Sources about fourteen districts: Barisal, Bhola, Pirojpur, Patuakhali, Borguna, Jhalokathi, Khulna, Bagerhat, Satkhira, Chittagong, Cox's Bazar, Laxmipur, Feni and Noakhali were affected by Aila (Figure 2.6).

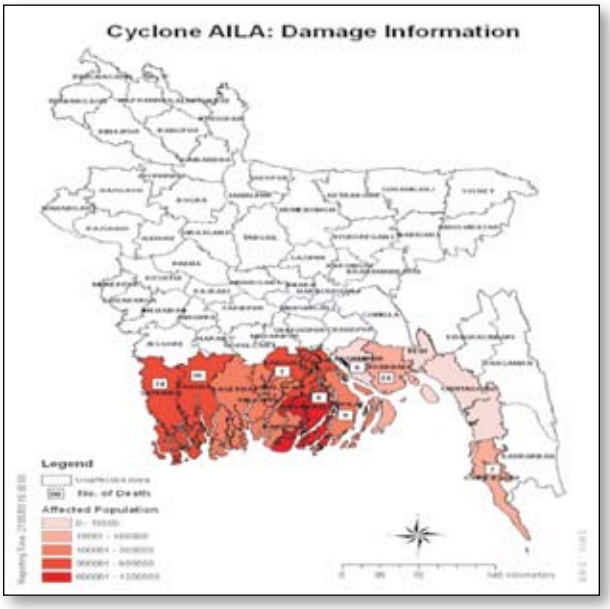


***Figure 2.6** : The part of Bangladesh affected by SCS Aila.*

***Figure 2.7 a&b.**: A woman displaced by Aila carries food distributed by NGO in Bangladesh (Source: Reuters/Andrew Biraj). b. Aerial view of a submerged village in The Sunderbans, India from IAF helicopter (Source: Reuters/Jayanta Shaw).*

***Figure 2.8 a&b** : Two Bangladeshi women whose relatives fell victim to Cyclone Aila mourn in Nil Dumoor village in Shatkhira, Bangladesh (Source: AP Photo/ Pavel Rahman). b. Villagers offer prayers near the body of a victim, unseen, of Cyclone Aila during a funeral service in Nil Dumoor village in Shatkhira, southwest of Dhaka, Bangladesh (Source: AP Photo/ Pavel Rahman).*

Damage Assessment

About seven thousand people had been injured and about 58,000 domestic animals drowned. Over 3,19,930 acres of cropland had been damaged, over 6,12,584 houses flattened and 259 km roads and 509 km embankment had been completely damaged by Aila in Bangladesh.

***Figure 2.9. a&b** : Villagers wade through waist deep water in search of drinking water in Bangladesh (Source: Munir Uz Zaman/AFP/Getty Images). b. A woman tries to retrieve her belongings from her house, wrecked by cyclone Aila Bangladesh (Source: REUTERS/Andrew Biraj).*

Response of Govt & international Agencies

The government and international organizations extended help to the cyclone-affected people . WHO had sent 686 medical teams to nine of the most affected areas. Government and other organizations provided relief and rehabilitation assistance to the affected and deployed to assist local administration and NGOs in rescue and relief operations.

***Figure 2.10 a&b** : Villagers stand in a queue as volunteers distribute relief material from a boat in Shatkhira, Bangladesh (Source: AP Photo/Pavel Rahman) b. Displaced villagers receive food aid packets in the Koyra area on the outskirts of Khulna, Bangladesh (Source: Munir Uz Zaman/AFP/Getty Images).*

Impact of Cyclone AILA in India

West Bengal: West Bengal was largely damaged due to severe cyclonic storm, AILA. According to State Government report, the number of storm-affected people was about 2.2 million. More than 61,000 houses collapsed and more than 132,000 houses were partially damaged. About 100 people died in the state due to AILA. It caused extensive damage to rice and other crops. In Sundarbans, heavy downpour raised river levels while the gushing waters of flooded mangroves burst mud embankments in the extensive delta region, destroying hundreds of houses. The Sunderbans mangrove forest area, home to the highly endangered Royal Bengal tiger, was fully inundated and high-speed winds destroyed all communication and transportation infrastructure. The entire Sunderbans biosphere reserve area of 9,600 square kilometers suffered extensive damage under the impact of cyclone AILA. It had also affected Sub-Himalayan West Bengal and Sikkim causing uprooting of trees due to strong wind and land slide and flood due to heavy rain.

Orissa: The outer bands of the storm also produced torrential rains and high winds in several parts of north coastal Orissa, with the heaviest

***Figure 2.11 a&b** : Villagers wave to an Indian Air Force helicopter delivering food packets in the mangrove-covered delta region the Sunderbans (Source: Deshkalyan Chowdhury/AFP/Getty Images) b. Flood-affected villagers collect food packets dropped from an IAF helicopter in the Cyclone-hit area of Patharpatima Island, India (Source: Reuters/Jayanta Shaw).*

rainfall being recorded at Paradip at 260 mm (10 inches) and winds peaked at 90 km/h (56 mph). Numerous trees were uprooted and power lines were down. High waves produced by the storm inundated coastal villages, forcing residents to evacuate to safer areas. However, there was no report of human death in the state. An estimated 1,000 acres of Orissa cropland were affected due to cyclone AILA.

Meghalaya: The remnants of cyclone AILA produced gusty winds and heavy rains in Meghalaya between 25th and 26th of May. Rainfall amounts peaked at 213.4 mm and winds reached 60 km/h. Several homes were damaged in the area and power was cut-off due to fallen trees and power lines. No injuries were reported in the state. Several streets were flooded and some homes were reported to have standing water.

Figure 2.12 a&b : *Houses damaged by cyclone Aila on the outskirts of Khulna (Source: Munir Uz Zaman/AFP/Getty Images) b. Villagers look over an eroded river embankment after heavy rainfall from Cyclone Aila in Namkhana village, India (Source: AP).*

Rehabilitation of cyclone affected in SCS Aila

The geographical location of the cyclone-affected in South Asia especially those affected by the SCS Aila have made the rehabilitation work very challenging. The worst affected part by Aila, the Sunderbans is a maze of intricate canals and rivers and communication to the affected people is a serious work for the relief and rehabilitation agencies. Various agencies like Oxfam India, Sundarban Social Development Centre and several agencies had rushed to the forefront in the wake of the devastating SCS Aila. The West Bengal state authorities had released a contingency relief fund of Rs 15,000,000 for the affected. 1,450 metric tonnes of rice was distributed, 1,75,000 tarpaulin sheets were distributed and 80 rescue boats were pressed into service. In addition to that the administration authorities along with the panchayat and UNDP Risk Management Programme volunteers tried to distribute aid into the interior parts of the devastated areas.

In Bangladesh BDRCS/International Federation mobilized non-food items including plastic sheets, water jerry cans and hygiene parcels from prepositioned stock and distributed them amongst the 10,000 households of the eight worst affected areas. In addition to the distribution of non-food items, the BDRCS/the International Federation collaborated with Save the Children and Oxfam, and provided 11,000 water jerry cans for the beneficiaries. The jerry cans allow beneficiaries to collect clean drinking water from the water purification plants set up by Save the Children and Oxfam in the affected areas.

Further assistance in the form of a standard supplementary food package for each of the 10,000 most affected family's in eight affected districts is in progress. The selection and registration process of beneficiaries has been initiated[4].

Depression over the Arabian Sea (23–24 June, 2009)

During the onset phase of monsoon, a depression formed over the AS and crossed Gujarat coast near Diu between 13.00 and 14.00 UTC of 23rd June. Under its influence, the southwest monsoon advanced over the country especially along west coast after a long hiatus during 08–22 June. Though it revived the monsoon, its significant impact on rainfall was confined to Saurashtra & Kutch and adjoining areas. The chief amounts of rainfall (≥5 cm) are given in table 2.6.

No major damages were reported due to this depression other than disrupted communication due to intensified rains.

***Table 2.6** : Rainfall received (7 cms and above) in Parts over the South Asian Countries due to SCS, AILA (Modified after: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf.)*

Country	Met Sub-division	Date		
		23th June	24th June	25th June
India	Gujarat region			
	Dharampur-7, Jhagadia and Vapi-5.			
	Saurashtra, Kutch and Diu	Maliya-5	Sutrapada and Veraval-17, Mangrol-15, Porbandar-7, Dwarka-6, Manavadar and Jamnagar-5.	Kalyanpur-16, Okha-15, mangrol-12, Bhavnad-10, Keshod, Ranavav, Lalpur-9, Sutrapada, Porbandar, Dwarka-8, Kutch Manvadi-6, Kodinar, Talala and Veraval-5.

Deep depression over the Bay of Bengal (20–21 July, 2009)

A deep depression formed over the north BoB at 03.00 UTC of 20th July and crossed north Orissa–West Bengal coast between Balasore and Digha during 16.00 and17.00 UTC of the same day. It caused good rainfall activity over central parts of country as it led to active monsoon condition. One of the main features of this system was that though it followed a climatological track moving in a west–northwesterly direction, its westward displacement was limited to the east of Long 800E. The system mainly caused floods due to the heavy to extremely heavy rainfall over Orissa, Madhya Pradesh, Maharashtra and Gujarat region. According to the report of the Revenue Department, Government of Orissa, Bhadrak, Cuttack, Ganjam, Kalahandi, Koraput, Keonjhar, Nayagarh and Sundergarh of Orissa state in India was submerged and experienced considerable damage. Nearly 43 people had died as result of this DD.

Cyclonic storm 'Phyan' over the Arabian Sea (09–12 November, 2009)

A cyclonic storm, 'Phyan' crossed Maharashtra coast between Alibag and Mumbai during 10.00 and 11.00 UTC of 11th November, 2009. Cyclone, 'Phyan' moved very fast prior to landfall. It moved about 450 km during 00.00 to 12.00 UTC of 11th November 2009. Though it crossed as a cyclonic storm, it slightly weakened before the landfall (Figure 2.13).

***Figure 2.13** : NASA's MODIS instrument on the Aqua satellite captured this stunning visual image of Tropical Cyclone "Phyan" making landfall north of Mumbai on November 11 at 0845 UTC (3:45 ET). Credit: MODIS*

The satellite imageries of the system at different stages of intensity are shown in the following figure 2.14.

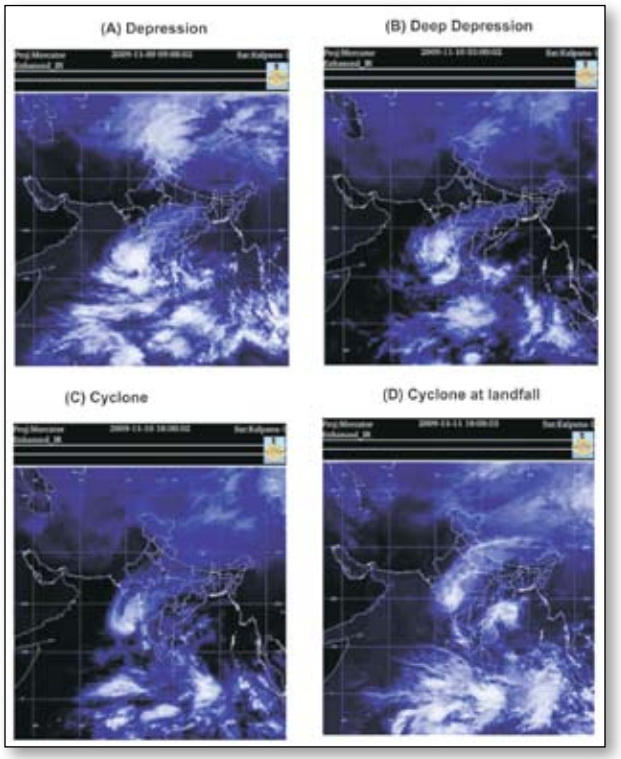


***Figure.2.14** : Stages of development of intensity of cyclone 'Phyan'. (Source: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf.*

The following figure 2.15 shows the track of the CS 'Phyan'.

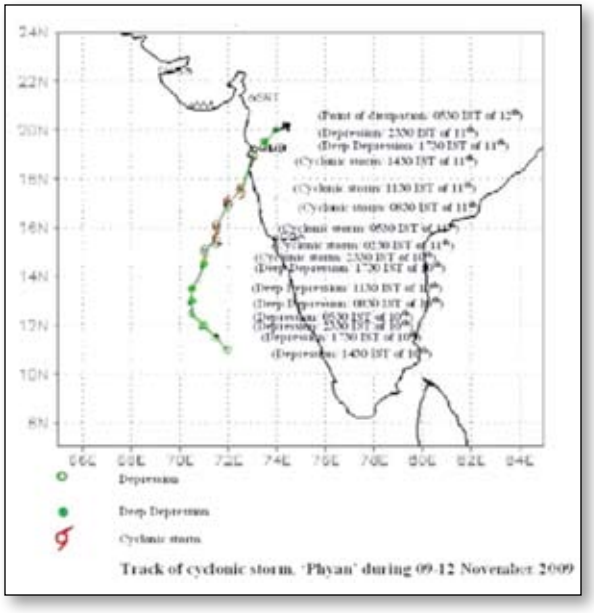


***Figure 2.15** : Track of Cyclonic Storm "Phyan".*

Widespread rainfall with isolated heavy to very heavy showers occurred over Goa, Konkan and madhya Maharashtra on 10th and 11th November. Fairly widespread rainfall also occurred over south Gujarat region due to the cyclone on 11 November. According to the state government Newspaper reports, the cyclone Phyan had caused damage to lives, crops and properties in Goa and Konkan coastal parts especially in Ratnagiri, Sindhudurg, Raigad and Thane districts. About 1,000 houses in these districts suffered damages. Seven persons died and about 44 fishermen missing due to cyclone[3].

***Figure 2.16. a, b** : Damages caused by the cyclone "Phyan" in the coastal parts of Maharashtra and Goa, India (Source: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf.).*

***Figure 2.17 . a** : Damages caused by the cyclone 'Phyan in the coastal parts of Maharashtra and Goa, India (Source: http://www.imd.gov.in/section/nhac/dynamic/rsmc.pdf.). b. Destruction caused due to cyclone Phyan (Source: http://www.zimbio.com/Tropical+cyclones/articles/123UgglbFBo/Mumbai+Rains+Today+Mumbai+Cyclone+Mumbai+Weather)*

Cyclonic Storm WARD over the Bay of Bengal (10–15 December, 2009)

A cyclonic storm, WARD (10–15 December) developed over the south BoB and crossed northeastern Sri Lankan coast, close to south of Trincomalee as a deep depression between 08.00 and 09.00 UTC of 14th December 2009. It weakened into a well marked low pressure area over north Sri Lanka at 03.00 UTC of 15th December. It then emerged into Gulf of Mannar and became insignificant on 16th December. It had followed a rare track, as it moved initially in a northernly di-

rection and then moved west–southwestwards across Sri Lanka. It was a slow moving system, as it travelled at an average rate of 200 km per day (8 km per hour). It had weakened into a deep depression over the sea before the landfall.

In association with the cyclone, the northeast monsoon was vigorous over coastal Tamil Nadu and Puducherry during 13–16 December 2009. Widespread rainfall with isolated heavy to very heavy rainfall occurred over this region during this period. As the system weakened and crossed north Sri Lankan coast as a deep depression, it did not cause any damage over the region other than disrupting normal life and causing inundation in some parts.

Cyclone mitigation measures: Towards a safer future

The cyclones are typical of the coastal areas and many of these areas have witnessed the fury of cyclones or disasters related to various low pressure systems. The first step in this direction is Preparedness. The impact of the damages caused by cyclones can be lessened to a considerable degree by taking coordinated programmes. The first step is the issue of warning to the potentially vulnerable areas. In India the Indian Meteorological Department (IMD) has developed a four stage warning system.

Stage1: This warning is about the possibility of a cyclone when a low pressure depression develops in oceans.

Stage 2: The Alert stage, warning given 48 hours prior to the time when a cyclone is expected to hit the land.

Stage 3: The Warning stage, when a cyclone is formed. The warning is given 24 hours before the anticipated time of arrival of a cyclone.

Stage 4: Cyclone arrival, issued 12 hours before a cyclone is due to hit the land. The warning gives information about cyclone and continues until the winds subside. In sea ports, danger signals are hoisted about the impending cyclone[5]. Preparedness should be developed into a continuous cycle of planning, organizing, training, equipping, exercising, evaluation and improvement activities to ensure effective coordination and the enhancement of capabilities to prevent, protect against, respond to, recover from, and mitigate against the disaster.

The step that follows Preparedness is the Response. The response phase includes the mobilization of the necessary emergency services and first responders in the disaster area. This is likely to include a first wave of core emergency services, such as firefighters, police and ambulance crews. They may be supported by a number of secondary emergency services, such as specialist rescue teams.

The final step in the cyclone rehabilitation is Recovery. The aim of the recovery phase is to restore the affected area to its previous state or in a realistic sense: as close as possible to the previous state. It differs from the response phase in its focus; recovery efforts are concerned with issues and decisions that must be made after immediate needs are addressed. Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment and the repair of other essential infrastructure. Efforts should be made to "build back better", aiming to reduce the pre-disaster risks inherent in the community and infrastructure.

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Chapter 3

Flood

An Overview

Floods are one of the deadliest natural disasters menacing human civilisation through ages. Modern trends of urbanisation and propensity for development with total disregard to the natural elements have made floods a big challenge to control. Every year floods claim thousands of lives in addition to leaving millions homeless and inflicting considerable loss to property and infrastructure. The term flood is a general or temporary condition of partial or complete inundation of normally dry land areas from overflow of inland or tidal waters or from the unusual and rapid accumulation or runoff of surface waters from any source. The causative factors can be several: riverine, estuarine (caused by a combination of sea tidal surges), coastal, catastrophic (due to dam breakage/failure) or other causes like accumulation of water over impermeable surfaces, thunderstorms etc[1]. The effects of floods are manifold. They damage essential infrastructure like bridges, buildings, road network, distributory canals etc. in addition to causing epidemics and waterborne diseases. Extensive loss of life, crops and vegetation are intrinsic threats associated with floods. These factors lead to escalation of food prices and costs of rebuilding damaged/destroyed infrastructure.

The countries belonging to SAARC are some of the worst flood-affected regions. The events were caused by both general and flash floods. During the year 2009 India experienced six flood events (Figs 3.1 and 3.2) followed in decreasing

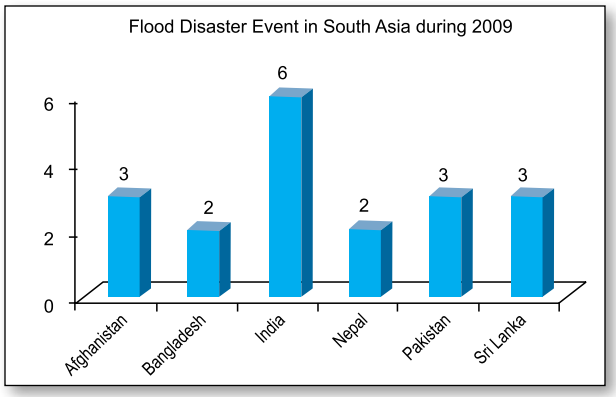

***Figure-3.1**: A plot showing number of flood disaster event during 2009*

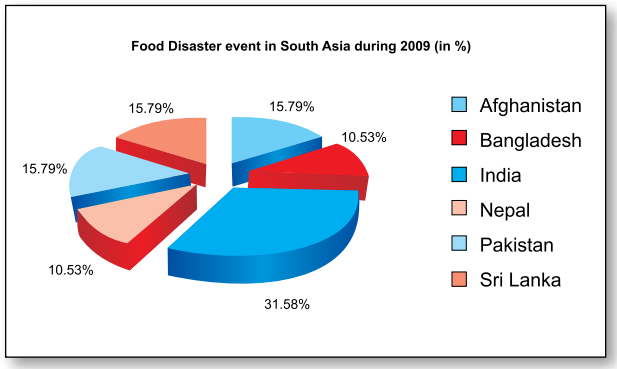

***Figure3.2**: Number of disaster event in percentage in South Asia during 2009*

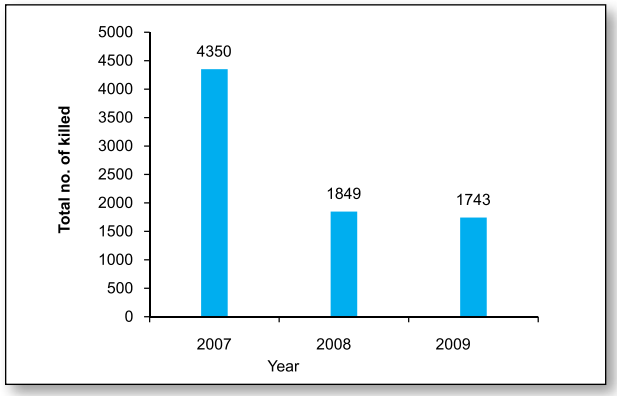

***Figure 3.3**: A plot showing people killed in SAARC countries during last three years (2007–2009).*

order by Afghanistan, Pakistan and Sri Lanka (3 each), and Bangladesh and Nepal (2 each). However, the number of people killed or affected in the South Asian countries shows a decreasing trend between years 2007 and 2009 (Fig. 3.3). The details of flood events are tabulated in Appendix-III.

Afghanistan

In 2009, Afghanistan had experienced two major flood waves in addition to few other ones. The first wave started in March due to heavy rain and uneven snowmelt run-off. Build up for flood scenario in Afghanistan had started during the third week of March. However, the major spell of flood wave starting from 3rd April, 2009 with monsoon rains caused severe damage. The northern parts of Afghanistan were most severely affected. Heavy flooding was observed over Kandahar, Herat and Badakhshan. At least 150 people were killed and hundreds of houses were damaged in 10 of Afghanistan's 34 provinces due to flash floods and heavy rain in the month of April. Heavy rains and flood had also badly damaged hundreds of hectares of agricultural land in districts of Kohsan, Gulran, Anjil and Guzara of Khandhar and Herat province. Afghanistan's National Disasters Management Authority reported that floods in Kandahar and Herat provinces 77 people were killed in which about 20,000 people were affected during on April–July 2009. Till 30th April, the casualties in the north-western part of Afghanistan had risen appreciably. According to different media report of the concerned country, it was found that about 2,000 families were affected by floods in Herat Province, nearly 800 families were affected in Badghis province and hundreds more were affected in several other provinces. Twenty three canals had been totally damaged and 4,546 partially damaged in addition to 112 bridges and 603 kilometres of roads have also been partially damaged (Figs. 3.4 and 3.5). The phenomenon continued for nearly three months with intermittent lull periods and came to an end on 2nd July, 2009.

***Figure-3.4** : Flood induced blocked, waterlogged streets in Afghanistan (Source: Ayub Farhat/IRIN)*

***Figure-3.5** : Spring floods killed dozens of people, destroyed hundreds of houses and damaged agriculture (Source: ootp.files.wordpress.com).*

The second wave of flash floods hit Afghanistan during the end of August. It claimed at least 11 lives and damaged dozens of houses in Alingar District, Laghman Province and eastern Afghanistan on 2nd September 2009. Flash floods also affected several areas in Nangarhar province on 31st August 2009. An Afghan Red Crescent Society led assessment, estimated a total of 4,000 people affected and 626 houses were destroyed mostly in Jalalabad city with damages also recorded in the Sorkhorood, Kuzkunar, Rodat,

Chaparhar and Behsood districts of Nangarhar (Figs. 3.6 and 3.7). A bridge connecting Jalalabad with Torkham on the Afghanistan–Pakistan border was also destroyed by floods.

***Figure-3.6** : One of the flood-affected families, rendered homeless by the floods in Afghanistan (Source: Golam Rasol Hasas/IRIN).*

***Figure-3.7** : A flood-affected family in Nangarhar Province, eastern Afghanistan (Source: Ayub Farhat/IRIN).*

However, according to CRED data sources, three major flood events had occurred as shown in (Appendix-III) in few province of Afghanistan during the month of April and September 2009. It was reported that 19 people were killed and 2,500 people affected in Kandahar and Herat provinces on 4th April 2009. While about 39 people were killed and 60,016 were affected, as was reported on 20th April 2009. In September 2009, 11 people were killed in Loghman and Alinagar province. According to CRED data sources, two major flood events were shown in (Appendix-III), few province of Afghanistan during the month of July 2009. It was further reported that 10 people were killed near Habanganj on 29th July 2009.

A system relief and recovery mechanism had set in motion immediately after the first wave of floods that had hit Afghanistan. Following a quick assessment of the damage caused by the flooding, the United Nations, a Jalalabad-based NGO-Youth in Action Association (YIAA) and the international military distributed food and water to hundreds of people affected by the flood. United Nations Office for the Coordination of Humanitarian Affairs (OCHA) has been coordinating relief for the affected population. However, the enormity of the events, size and spatial extent of areas affected, and inaccessible conditions to the interior parts of the flood affected areas had made the relief efforts very slow paced.

Bangladesh

The flood scenario in Bangladesh had become evident during the month of February 2009 due to the rise in water level in the river Jamuna. The continuous erosion by the river turned violent on 9th February and washed away large parts of the Islampur upzilas of Jamalpur district including schools, hospital quarters, post office, agriculture office, makeshift Union Parishad office in addition to 80 hectares of land, 450 houses and hundreds left under in hapless condition. The situation remained grave and took a severe turn on 24th February when the flood claimed a century old market, 450 dwelling houses and huge crops of land. Many of the affected families took shelter at their relatives' houses or were forced to pass a sub human life under the open sky on the highways[2].

On 1st March 2009, over 3,000 people were marooned as six villages in Gabura union under Shyamnagar upazila adjacent to the Sundarbans

were flooded following collapse of a damaged embankment at Khalsebunia point on Kabodak River. Following collapse of the 350 feet embankment, the sluice gate was also washed away due to heavy pressure of water from the river during the high tide. Over 500 bighas of crops were inundated in the area and over 120 shrimp enclosures were washed away as water entered the shrimp enclosures though the collapsed sluice gate. The marooned people are preparing to take shelter on the nearby high lands. Acute scarcity of safe drinking water is persisting in the affected areas as most of the tube-wells have gone under water, sources said. Local people were working there to reconstruct the collapsed embankment but the embankments collapsed by heavy pressure due to violent tide[3].

On 28th March 2009, about 400 metre stretch of Ranigram flood control embankment on the western bank of the Jamuna River near Sirajganj town collapsed. About 200 acres of croplands in five upazilas and 150 houses along the embankment had gone into the river. Due to massive erosion, many people of Kazipur, Sirajganj Sadar, Belkuchi, Shahzadpur and Chowhali upazilas of the district had shifted to safer places. According to the Water Development Board (WDB) sources Khokshabari, Shimla, Panchil, Bhatpiari and Ranigram in Sirajganj sadar upazila, Shuvogachha, Maizbari, Dhekuria and Simantabazar in Kazipur upazila, Randhunibari, Shohagpur and Enayetpur in Belkuchi upazila, Monakosha, Kaijuri, Ghudibari and Dattapara in Shahzadpur upazila and Khaskawlia, Jalalpur and Umorpur in Chowhali upazila were worst affected by the erosion[3].

On 10th April, two villages were inundated as the embankment on the bank of the River Kapotaksi breached at the Gazipara point of Koyra in Khulna the previous day. About 300 families, 100 bighas of boro field, 250 small shrimp enclosures and 20 ponds of Gazipara and Gabbunia went under water[2] (Fig. 3.8).

***Figure3.8**: Collapse of part of flood control embankment at Raniganj point near Sirajganj town due to erosion by the Jamuna River* ***(Source:** The Daily Star).*

On 29th May, monsoonal flash flood inundated low lying 19 villages of Sadar and Sundarganj upazilas. Onrush of waters from hilly areas across the border inflated the Teesta, Jamuna and Brahmaputra. Strong current has wiped out about 300 houses in nine villages in char areas during the last 24 hours ending 28th May. Flood embankment at Chandipur of Sundarganj upazila was badly affected due to strong currents. The worst affected villages during this spell of flood were Bhati Kapasia, Burai, Kamapsia, Lalchamar, Haripur and Tarardah in Sundarganj upazila. Villages facing extinction by river erosion included Goghat, Kanchipara, Kamarjani, and Bhabarpara. Senior officials visited some of the worst affected areas[4].

While about 6 people were killed and five lakh people were affected as was reported in Dhaka, Comilla and Rajshahi province, on 3rd July 2009.

Bhutan

The flood menace in Bhutan was initiated by a very heavy spell of rainfall during the last week

of May. According to the Thimpu Meterological Department, Bhutan received an average rainfall of 76 mm between 25th and 26th May, highest in past five years. The unexpected high rainfall was an after effect of the cyclone 'Aila' from Bay of Bengal that hit Bhutan on 24th May. The major rivers of Bhutan like Wangchu, Punatsangchu, Kurichu, Mangdechu, Chamkarchu and Parochu had either doubled in size or, in most cases, had swollen to a record 5–6 times their size. The sudden flood had claimed casualties of diverse kinds. Two students from Thimpu were killed when a bridge they were crossing at Semtokha was washed away by Olaronchu stream which had swollen by huge volume of water. In addition to this incident, a soldier was hit by a falling tree in Dewathang, and a road construction employee from India died in Takti while clearing a landslide area[5].

Large parts of Bhutan were subjected to floods as a result of heavy rainfall that had started on 6th September. The worst hit were the areas falling in southern Bhutan followed by western Bhutan. The rainfall recorded between 6th and 7th October was unusually high: 166.8 mm in Sipsu, 51.77 mm in Thimphu, 64.5 mm in Wangduephodrang and 59.22 mm in Zhemgang. The earthquake hit areas of Mongar and Trashigang had received 28 mm and 27.8 mm during this period. The rivers of these areas were on the swell and had reached the embankments in many cases. Though the floods did not claim lives, it took heavy toll on the livestock, agriculture, property and infrastructure like, roads. Six of the dzongkhag's 14 gewogs, Kana, Goshi, Trashiding, Tsendagang, Tsangkha and Drujeygang, were affected. In Goshi, Tsendagang and Trashiding gewogs, heavy rains formed small rivulets, which deposited sand and gravel on the fields. Irrigation channels were also washed away. Tsangkha, Drujeygang and Khebisa gewogs reported loss of maize crops and orange trees. In Drujeygang, paddy and maize fields, belonging to about 10 households, were destroyed. Dagana–Dagapela highway was blocked at three places[5] (Figs. 3.9 and 3.10).

***Figure3.9** : Ravages of floods in Bhutan during May 2009 floods (Source: Kuensel Newspaper).*

***Figure 3.10** : Bhutan hit by record rainfall and floods on 27th May 2009 (Source: Kuensel Newspaper).*

India

Every year life, property and crops worth millions of rupees are lost in India due to floods. India is the most flood-affected nation in the world after Bangladesh. It accounts for one fifth (1/5) of global deaths due to floods and on an average 30 million people are evacuated every year. Generally, the floods in India are caused by concentrated spells of heavy rains in the upper reaches of river during the monsoon months June–September.

The irregular and erratic distribution of rains in different parts of the country during monsoon is one of the prime reasons for the severe flood-induced negative impact on economy witnessed every year[6]. In the recent years the percentage of flood-related loss has increased manifold due to unrestrained urbanisation, encroachment of low lying areas and coastal areas blockage/reversal of natural gradient through unplanned developmental practices.

The northeastern states of India especially Assam was badly affected by floods during the year 2009. Every year the floods in Assam leave behind a trail of destruction, washing away villages, submerging paddy fields, drowning livestock and causing loss of human life and property. Heavy monsoonal rains had triggered flash floods. During the flood in Lakhimpur, Dhemaji, Jorhat and Nagaon districts of Assam the scenario became very grim. Nearly 350 villages of the region were inundated and an estimated 200,000 people were displaced. Most of the displaced people were lodged at makeshift shelters on raised embankments. There were several breaches in embankments in Dhakhukhana area in the eastern Lakhimpur district; besides at least two dikes were washed away in South Asia's biggest river island of Majuli in Jorhat district, about 320 km east of Assam's main city of Guwahati. The situation was critical. According to a Central Water Commission bulletin the main Brahmaputra River and its tributaries were flowing above the danger level in at least eight places and were in full spate. An Assam government statement said a total land area of 3,000 hectares was affected. Another flood wave in the Sivasagar district created havoc on 11th July by submerging over 60% of its area, including many arterial roads disrupting traffic in various areas[7](Fig. 3.11).

Figure 3.11*: People wade through a road flooded with Brahmaputra waters in Lakhimpur, Assam (Source: bengalnewz.blogspot.com).*

The state of Bihar, mostly occupying the low lying alluvial plains was severely affected by floods during the month of August. The flood water swollen Bagmati river had breached its embankments in the Sitamarhi district inundating vast areas. About 40 villages including 40,000 people were affected. However, unlike other years the breaching of the embankments was not due to rain and discharge of water in Nepal and not in Bihar[8].

On 23rd August 2009 the flood situation in the northern districts of Bihar declined sharply, inundating vast stretches of low lying areas and NH 105 affecting movement of traffic. Over 500,000 people were affected as Kishanganj, Saharsa, Supaul, Sitamarhi, Purnia, Darbhanga and Muzaffarpur districts with rivers Bagmati, Kosi, Kamala Balan, Mahananda and Adhwara group of rivers flowing above the danger mark. The floods claimed 11 lives with 6 deaths reported in Muzaffarpur alone while 1 person each had died in Sitamarhi and Supaul districts and 3 others in Kishanganj.

The overall flood situation in northern Bihar continued to remain grim as the rivers fed by heavy monsoonal rain kept on swelling. Around 1.5 million people were affected by the deluge in 11 north Bihar districts where floods have claimed a total of 52 lives. Relief distribution in

some of the flood-hit areas was suspended because of model code for polls coming into force in the light of the bye-elections in 18 Assembly constituencies in Bihar, State Disaster Management Department sources said. Standing crops in vast areas and houses worth several crores of rupees had been destroyed in the floods[7].

The unpredictability of flood was evidently demonstrated in the eastern state Jharkhand. Having been declared drought-affected, it received unexpected rainfall in the month of September due to the formation of a cyclonic depression. Many areas were flooded. The Damodar River had received huge volumes of water and the resulting deluge had submerged the famous temple of Chhinamastika at Rajrappa. The Patratu Thermal Power Plant Station at Ramgarh and Tenughat Vidyut Nigam Limited at Bokaro had opened their flood gates causing flooding of major parts of the state. Nearly 500,000 people were affected by this flood[10]. In Uttar Pradesh the floods had claimed 74 lives when the major rivers viz., Gomti, Yamuna, Sharda and Ghagra breached their banks and inundated vast parts affecting human life, livestock, standing crops, road network and houses[8,9].

The coastal state of Orissa witnessed flash flood menace between 14th and 20th July as heavy rains aided by low pressure hit Koraput, Nayagarh, Kandhmal, Malkangiri, Rayagada and Ganjam districts. The major rivers Mahanadi, Brahmani, Baitarani, Subarnarekha, Bansadhara and Rushikulya had breached their banks and flooded vast parts of Orissa. Twenty six people died in the flood and there was huge loss to property, crops and infrastructure[9]. Hundreds of villages remained marooned for several days and relief and rehabilitation work was severely affected owing to poor approachability[9,11](Fig. 3.12).

***Figure 3.12**: A resident bailing out water from his flooded house in Mathura Chatra area in Udupi (Source: The Hindu).*

The month of July brought about unprecedented plight and agony to the people of Karnataka as in the southern and coastal districts unprecedented torrential rains increased volume of water in the rivers and vast parts were submerged. Highways and arterial roads were cut-off, paddy fields and coconut plantation were destroyed, several houses collapsed and mobilisation of basic amenities to the people was largely affected. Twelve lives were claimed by the floods in Karnataka between 6th and 16th of July and thousands were rendered homeless[11]. One of the noticeable facts that came up during the floods in the state of Karnataka was that in some parts flooding was due to clogging of storm water drains and outlets mostly as a result of unplanned developmental practices.

The coastal state of Kerala also saw devastation due to heavy rains and resulting floods in many parts of the state. Flash floods in Thiruvananthapuram, Kozhikode, Mallapuram, Wayanad, Kasargod and Kannur claimed 18 lives, paralysed normal life to a halt and the total estimated crop loss due to the calamity was pegged at Rs 40 crores[11,12].

A later phase of heavy rain and rampaging flood spanning the last week of September to the first week of October had wreaked havoc in

Karnataka, Andhra Pradesh, Maharashtra and other state claiming 300 lives and displacing lakhs. Karnataka accounted for 168 fatalities and nearly 2,000,000 people were affected by the flood and estimated damage was reported to be USD 2,150 milion (Figs. 3.13 and 3.14) .

***Figure 3.13**: A car being driven through knee-deep water in Subhashnagar near Pandeshwar in Mangalore (Source: The Hindu).*

***Figure 3.14**: Children playing in the water that flooded Mangalore Kuloor area in Mangalore (Source: The Hindu).*

In Andhra Pradesh 37 and Maharashtra 25 as heavy downpour ravaged the three states flattening over two lakh homes, extensively damaging crops and uprooting lakhs of people (Figs. 3.15 and 3.16). Floods had also induced landslides in many parts of these states. Considering the severity of the flood scenario the army and military services were pressed into action for relief and rehabilitation work[9]. Estimated cost of property in the floods was projected to Rs 7 crores.

***Figure3.15**: Streets of Mumbai during monsoons (Source: toostep.com).*

***Figure3.16**: Floodwater breaching roads leading to snapped important links. (Source: travel.nytimes.com)*

***Figure 3.17**: A swollen Krishna River flowing a few feet below the railway track downstream of the Prakasam Barrage in Vijayawada, Andhra Pradesh. (source: whatslatest.com)*

Heavy rains in the Dharamsala region in Himachal Pradesh on 3rd September led to heavy destruction at Mahdher village in the Baijnath area. According to sources, heavy rains caused flash flood in Mahdher rivulet destroying about 11 cowsheds and killing 10 animals. It also damaged about 12 houses, gharats (water-run mills)

***Figure 3.18**: More than 1.22 lakh houses and over 13,000 huts were damaged, fully or partially, owing to the rain and floods in Raichur district, Karnataka (Source: The Hindu).*

***Figure3.17**: Flood waters from Krishna River submerging parts of Andhra Pradesh.*

***Figure3.18**: A woman cries on seeing her submerged house in Mahabubnagar district of Andhra Pradesh (Source: The Hindu).*

and other structures. According to the local authorities the loss due to flash flood was about Rs 5 crore[10].

According to CRED data sources, five severe flood events occurred. Most of the event were found to have occurred during July to November 2009. In month of July and September severe flood occurred, about 992 people lost their lives and 300 people also died during this period, about 19–20 lakhs were affected in this month in some parts of the country.

***Figure 3.19**: Residents of the Sunderbans moving to safer places in an overcrowded boat (Source: The Hindu).*

***Figure 3.20**: A boy rescuing his got from flooded water in a part of West Bengal. (Source : bengalnewz.blogspot.com)*

***Figure 3.21**: Collapsed scaffolding of the construction site of a bridge under construction across the Vahini River on the Hosur–Bagalur road in Bangalore (Source: The Hindu).*

***Figure 3.22**: The collapsed Nattankottai Panchayat Union Primary School, near Krishnagiri (Source: The Hindu).*

Maldives

The island nation of Maldives, comprising a cluster of atolls has been vulnerable to tidal and extreme rain-induced floods. The southern part of the country has usually been more prone to such attacks. What makes the islands more vulnerable is the fact that the highest elevation in the islands barely two meters above mean sea level.

Strong winds along with heavy rainfall had inflicted severe damage to the islands belonging to Addu atoll causing severe damage to life and property. On 8th July 2009 strong winds had blown away roofs of five houses in Hulhu Meedhoo and caused severe devastation including uprooting of over 150 trees from 30 houses of the Hulhu Meedhoo. Further a very big tree on the island's Big road and an area-nut tree near harbour area were also uprooted. The accompanying heavy rainfall had flooded all the islands of Addu atoll as flood water entered the houses. Viewing the gravity of the situation the Maldives National Defense Forces (MNDF) had been pressed into the rescue work of the affected people[13].

Nepal

Nepal receives heavy rains during the monsoon months beginning in July and as a result experienced heavy floods in many parts. Many parts were submerged cutting-off communication, mobilisation of basic amenities like food and medicines and inflicted considerable damage to the economy of the country.

The flood situation in Nepal became grave after 29th July and in duration of two weeks, the floods had caused severe damage in Nepal. The rivers Banganga, Jhuprakhola and Kanchaniya were on spate after heavy monsoonal rains and had overflown their banks inundating wide areas of Nepal. One person died after he was swept away by a flood while he was sleeping in a shed while another died after being swept away by the raging Kanchaniya river while crossing the river to fetch paddy seedlings[14]. Flood-induced landslides had blocked Siddhartha highway and Karmali highway. The Dang–Salyan section of the Rapti Highway at Tulsipur-1 was also blocked due to landslide. About 200 houses were badly damaged while some 575 others had been inundated. The villages severely affected were Khoriya, Kajarahawa, Dhanakauli, Hadadiyahawa and Tilauri. The fury of flood had destroyed thousands of hectares of crops and community infrastructure was badly damaged[15].

According to different Media sources of concerned countries, about 22 people lost their lives on 29th July 2009, and also about 17,000 were affected in general flood on 6th August 2009 (Figs. 3.23).

Another spell of floods trigged by continuous downpour had set in Nepal from 6th August. Several houses were badly damaged in Dharan16. Floods and subsequent landslides had left hundreds homeless or displaced and several people were found missing in Kuldevmandau, Kavra, Sunwal, Nawalparasi, Jhapa. Jhapa was one the worst affected areas as there the flood had displaced 183 families completely and 1,882 mo-

***Figure 3.23** : People in flood-affected parts of Nepal wading through flood water in search of safer grounds (Source: globalgiving.co.uk).*

mentarily. As many as 415 houses had been destroyed while 418 sustained minor damage.

Billions of rupees had been lost with the destruction of bridges, culverts and roads. Paddy planted in about 464 hectares of land was covered by sand while 660 hectares of land had been lost to erosion. The flood had left behind a trail of flood-related diseases and epidemics such as diarrhoea, high fever and headache. Lack of potable water and sanitation had compounded the already deteriorated problem. Two physicians arrived in the district from Kathmandu in view of a possible disease outbreak.

On 3rd September some 2,000 families at Prakashpur and Mahendranagar in Sunsari district faced displacement as the Koshi river once again changed its course and spiralling flood waters advanced towards human settlements.

Pakistan

Pakistan had witnessed flash floods and monsoonal floods in Dera Ismail Khan, Mardan and the port town of Karachi. Heavly rain and flood during the first week of April had destroyed the crops consisting of thousands of acres in Tehsil Kulachi and Tehsil Draban Kalaan. According to the sources, due to heavly rain and flood in the last week, Draban Kalaan , Gandi Aashiq the crops of wheat and grain were destroyed in most of the areas of Tehsil Kulachi , Draban Kalaan and Northern areas of Gandi Aashiq. Further, there was a huge loss of cattles and other animals too. Heavy rain and flood also affected many other areas crops like Gara Esaa Khan, Gara Mehmood, Gara Mastan, Kot Sultan, Gara Mddah, Zarkani, New Gara Khan, Gandi Esab, Kot Shah Nawaz, Maddi, Gara Ali, Gandi Umar Khan and Gara Rakhni[17].

The month of July saw unprecedented heavy rain in Karachi and surrounding areas. The result was heavy flood in these areas causing extensive damage to the agriculture and infrastructure sectors. At least 33 people were killed and over 70 injured in various accidents and mishaps as a result of the unprecedented catastrophic downpours in Karachi. Following heavy downpour, scores of residential areas including Bath Island, Defence, Jahangir Road and many other low-lying areas went under several feet deep water, flowing into the houses which made the residents' life miserable. KPT and Liaquatabad underpasses and many other roads, including busy I. I. Chundrigar Road, M. A. Jinnah Road and Aiwan-e-Saddar were flooded with water, where parked vehicles were seen floating. Power breakdown in the city further exacerbated the situation, as hundreds of KESC feeders had tripped with the first drop of rain. However, the restoration of power supply in phases started since Sunday morning, while most of the city including Baldia, old Sabzimandi, Model Colony, Federal B Area, Landhi, Garden and Jubilee had been without electricity for several days. Telephone lines of Karachi airport went dead following heavy rains in the city, which caused great hardships for the citizens. Mobile phone companies' services were also badly hit by the monsoon deluge, which had severed all communications in the city. Supply of potable water

had been also stopped for want of electricity at the pumping stations, while water scarcity kept on piling miseries to the people.

On 23rd July an under construction dam had broken near Barkhan district inundating thousands of acres of irrigated land destroying standing crops. This was an after effect of the heavy rains that had lashed Barkhan area. Eighty-eight millimetres of rain was recorded in the area. Thousands of acres of land were flooded and standing crops of cotton and chilly was destroyed. According to official sources more than 15,000 people were shifted to safer places prior to bursting of dam which was helpful in avoiding casualty or injury. However, several poorly constructed structures were badly damaged in the flood (Figs. 3.24 and 3.25).

***Figure 3.24**: Residents near the Nizamabad canal marooned as flood water encroach low-lying areas in Karachi (Source: http://media.nowpublic.net)*

***Figure 3.25**: The Army Men helping the people from flooded water near Karachi . (Source: www.candistar.com)*

Flash floods had claimed 36 lives and affected 75,000 others in the North Western frontier Province (NWFP) in a spell of heavy downpour on 17th August 2009 (CRED, data sources). There was widespread damage to homes, livestock and crops in Mardan and Swabi districts. Majority of the deaths were caused due to collapsing of the roofs and walls of poorly constructed houses[18].

Karachi, Hyderabad and the surrounding areas had again witnessed heavy rainfall and associated floods in the month of September and experienced loss to life and property. The low-lying areas were submerged in deluge and at least 10 people died in Karachi and 3 in Hyderabad.[17, 18] .

Sri Lanka

Sri Lanka is one of the countries of South Asia that has been prone to flooding. During the year 2009 the floods had hit Sri Lanka in two phases: during the month of August and a later phase of floods caused devastation in the months of November and December.

The first wave of floods hit Sri Lanka as a result of heavy rainfall and consequent alarming rate of rise in the water levels on 17th and 18th August in the rivers especially the Kalu Ganga river. Most parts of the country especially Galle, Matara, Kalutara and Ratnapura districts were badly affected. By August 18, nearly 700 persons were displaced and 100 houses in these districts had been damaged due to the floods. In Galle, the main road between Udugama and Thawalama was also completely flooded leading to disruption in communication and delay in sending relief and rescue initiatives to the affected[19]. Due to flash floods traffic on Deraniyagala Maliboda road was disrupted due to the damage caused to the bridge across Seethawaka Oya. Another major disruption in traffic movement was ob-

served on the Anhettigama–Panathura road due to a landslide covering the main culvert[20]. These torrential rain triggered flash floods had also wreaked havoc in the Menik Farm area of Vavuniya flooding the welfare centres that shelter the Internally Displaced Persons.

Flash floods had again caused extensive damage to the island nation of Sri Lanka in November and December. Between 21st and 22nd November 2009 flash floods had affected 600,000 people in Colombo and its suburbs. Batticaloa and Ampara were badly affected due to flash floods that had vented its fury between 14th and 16th December. Three people had died and nearly 30 lakh affected in these parts[21](Fig. 3.26).

***Figure 3.26** : Parts of Sri Lanka affected during the 17th August flash floods (Source: www. reliefweb.com)*

Relief, rescue and rehabilitation work in the flood affected areas

The fury unleashed by flood is a well known element of disaster in the South Asian countries is very well known. In view of this, the national governments and various agencies rushed to the affected people to provide the basic amenities.

Following a quick assessment of the damage caused by the flooding in August, the United Nations, a Jalalabad-based NGO—YIAA and the International Military distributed food and water to hundreds of people affected by the flood. United Nations OCHA had been instrumental in coordinating relief for the affected population. UN agencies such as the UN's Children Fund (UNICEF), the World Food Programme (WFP), the World Health Organisation (WHO) and OCHA, the Afghan Red Crescent Society, the Rural Rehabilitation and Development (RRD), the Afghan National Disaster Management Authority (ANDMA), the Public Health Department, the Department of Returnees and Repatriation (DORR) had worked tirelessly towards rehabilitation and providing relief to the flood affected people.

In India the vast geographical expanse of the country puts up a stiff challenge to the relief and rehabilitation agencies. However, these agencies have always done commendable job in the face of stiff adversities and come to the forefront to provide help to the millions affected. After the storms brought about by cyclone Aila that had left behind a trail of destruction in the Sunderbans in West Bengal, the region was under the threat of fresh inundation in areas which cannot ward off the tidal waves. Nearly 40,000 people were expected to be evacuated from parts of the Sunderbans following fears of fresh areas being submerged during high tide on the 6th June when water could gush in through the breaches of the embankments damaged in the cyclone. The State government remained on the alert and personnel and boats were kept ready to shift people to temporary shelters. At least 30% of the embankments breached during the

storms were till then to be restored. Temporary restoration reported to have been completed in the rest. A stretch of nearly 400 km of embankments was damaged in the two worst-affected districts of North and South 24 Parganas. The Army provided the civil authorities technical advice for the restoration of the embankments even as it continued to assist the local authorities in relief work. Ten medical teams were sent to the affected areas and another 10 were on the standby in the city, the total allocation for relief and restoration work by the State Government was increased to Rs 112 crore[11].

On 2nd August 2009 Central Government rushed 20 additional motorised boats and 100 water-rescue trained personnel of the National Disaster Response Force (NDRF) to flood affected Sitamarhi in the state of Bihar for relief and rescue operation. The authorities had distributed 3,000 plastic sheets, 150 quintals of beaten rice and jaggery among the flood-affected people in Sitamarhi district. The National Disaster Management Authority (NDMA) rushed the unit from Kolkata. Earlier, the NDMA had sent 32 motorised boats and NDRF units comprising 120 trained personnel from Begusarai and Bihta. NDRF comprising over 8,000 paramilitary personnel was constituted by the NDMA four years ago to deal with the aftermath of natural calamities.

The year 2009 had seen the Indian states of Andhra Pradesh and Karnataka suffer from the flood menace. The Central Government had dispatched trained personnel and motorised boats to Andhra Pradesh and Karnataka to help both states in rescue operations against the flash floods and torrential rains during the floods. Nearly 700 NDRF personnel with 173 inflatable motorised boats were sent to Kurnool Krishna and Mehboobnagar districts of Andhra Pradesh for assisting in rescue and relief operations. Besides these, a team of 19 personnel trained in water rescue operations and 20 inflatable boats were sent to Vijaywada (Krishna district). For Karnataka, the Indian Government had mobilised 249 NDRF water rescue personnel with 73 inflatable motorised boats to Bagalkote, Raichur, Gadag and Bijapur districts to help the State Government's rescue and relief efforts. The Central Government had also moved another contingent of 250 NDRF personnel and 60 inflatable boats from Gandhinagar to Delhi to be kept in readiness to be sent wherever additional personnel and motorboats were required. Meanwhile the army had also deployed seven columns (approx. 700 personnel) as well as three medical teams in Andhra Pradesh, while three army columns and one medical team assisted rescue and relief efforts in Karnataka. Twelve diving teams with special boats are aiding operations in Andhra Pradesh, of which four teams are deployed in Vijaywada. In Gadag and Karwar districts of Karnataka, four diving teams helped in relief operations while an additional 22-member contingent was also deployed in Karwar. Five naval helicopters were kept on standby in Vishakhapatnam to be deployed in Vijaywada. Two IL-76 aircraft, four AN-32 aircraft and 14 helicopters were pressed into service for rescue and relief operations in the affected areas of Andhra and Karnataka. The Central Government also released the first installment of Rs 156.83 crore from the Calamity Relief Fund to Andhra Pradesh. Karnataka received an aid of Rs 52.26 crore as the first installment of the central share of the fund and an equal amount was due in December[10]. Over 3.55 lakh people were accommodated in 1,200 relief camps and provided with food, clothing and medicines.

In Kerala several number of relief camps had been opened following heavy rain, flooding of homes and damage to them. New camps were opened in the Paravur and Aluva taluks. Steps had been taken to ensure supply of provisions for the people who had taken refuge in the relief camps and to prevent any outbreak of health problems related to the rainy season. Relief camps had also been opened at Vayalkkara, Kuttikkattukara, Karumalloor, Puthenvelikkara, North Kuthiathode, Elavoor, Vattaparampu and Desam.

During the floods in Nepal the Village Development Committees (VDC) were largely instrumental in providing relief to the affected people. The VDC office had informed that some seven families of Bane village had been given shelter in a local school while other 27 families of Kavra village had taken refuge in a nearby forest. The VDC office has distributed rice to the 60 flood-displaced families of Kuldevmandau VDC. In addition to this, the Red Cross division in the districts had played an important role in providing the displaced with shelter and food[16].

The Vavuniya district and Menik Farm in Sri Lanka wewre badly battered during the flash floods of 17th August 2009. Government authorities at Menik Farm had responded for resettlement of Internally Displaced Persons (IDPs) to the Mannar and Jaffna Districts in event of worsening weather conditions. The IDPs were directed to seek shelter in the Temporary Learning Centres.

South Asian countries have to take comprehensive preventive measures to curb the serious menace of frequent floods in the region. The damage caused by floods in South Asia is increasing, mainly due to rapid urbanization and the concentration of population in flood-prone areas. However, the destruction resulting can be controlled by adapting proper preventive measures by adopting following measures:

1. **Intense forestation programmes:** In the recent years there has been a sharp increasing trend in the rate of deforestation in the countries. Forests are very efficient absorbents in the event of heavy rain thus delaying the flow of water to the rivers and other water bodies. Moreover, when there are no roots of the trees to hold the soil, it is flushed into the rivers augmenting its sediments in the river channels. Consequently, the river water carrying capacity further decreases and makes it more prone to overflowing its banks. This is why the risk of flood increases in each monsoon in South Asia. Forestation programmes should be undertaken in the higher reaches of the catchment areas of the river basins to decrease the flood incidents.
2. **Construction of dams:** One of the most constructive ways of flood control is construction of dams. Japan, for example, has used dams for flood control and power generation by building a series of dams and reservoirs upstream and then connecting them to a power plant through a waterway channel. By this method the amount of downstream flow from the dams can be managed, thus stabilizing the river ecosystem.
3. **Embankment network:** To check flood, embankments along all the vulnerable river stretches should be made. Apart from this, human settlements in catchments areas should be discouraged and a forestation encouraged[22].
4. **Improved drainage efficiency:** The drainage efficiency can be improved by con-

struction of pumping stations, water gates, tunnels.

5. **Increase areas serving as retention basins:** In some of the existing water retention basins, although the capacity of draining water from the area is enough in normal circumstances, in time of excessive rainfall, it is necessary to allocate areas to be used as retention basins for detaining such amount of water to prevent flooding in low areas, road, and streets.
6. **Prevention of erecting structures on water courses:** Construction of bridges, fences or other permanent structures across watercourses or any other methods that can restrict the flow capacity within the channel should be prohibited. Nothing should be stored on the banks in such a place or way that it may be washed away or fall in. Watercourses must not be used to dispose of debris, even seemingly innocuous materials such as grass cuttings. Such debris may combine with wind blown debris, twigs, etc., to cause blockage of grills and thus a flooding incident[23].

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Chapter 4

Drought

An Overview

Droughts are normal, recurrent feature of climate, occurring in virtually all climatic regions. A climatic anomaly, drought is also characterized by deficient supply of moisture resulting either from sub-normal rainfall, erratic rainfall distribution, higher water need or a combination of all these factors. The escalating impacts of droughts have increasingly drawn the attention of scientists, planners, administrators and society. The vulnerability to drought in relation to the increasing needs of the growing population has become a point of great concern, especially on the food front. Unlike the other natural disasters like cyclones, earthquakes etc. the droughts have a slow onset and build up and more often than not it is difficult to establish the beginning and end of drought cycles since it is a slow, creeping disaster. But the impact of drought will be felt severely, since it affects the core sectors of economy. The duration of a drought is variable and the core area of a drought affected region may shift over a time thus needing continuous monitoring of the situation over a protracted period of time. The area under influence of a drought is also very large, thereby making the task of assessment and mobilization of response measures difficult. The quantification of the damage is also not easy as the impacts of drought are non-structural in nature. Moreover, the effects are much more drastic when the drought continues in a region from one season to another[1].

Droughts that frequently occurs in South Asia can be classified in to the following four types as meteorological, hydrological, agricultural and socio-economical droughts.

1. **Meteorological drought:** Simple absence/ deficit of rainfall from the normal. It is the least severe form of drought and is often identified by sunny days and hot weather.
2. **Hydrological drought:** Meteorological drought often leads to reduction of natural stream flows, groundwater levels or stored water supplies. This is reflected due to severe influence on the groundwater resource systems that leads to Hydrological drought.
3. **Agricultural drought:** This form of drought occurs when moisture level in soil is insufficient to maintain average crop yields. An extreme agricultural drought can lead to a famine, which is a prolonged shortage of food in a restricted region causing widespread disease and death from starvation.
4. **Socio-economic drought:** Socio-economic drought correlates the supply and demand of goods and services with the three above-mentioned types of drought. When the supply of some goods or services such as water and electricity are weather dependant then drought may cause shortages in supply of these economic goods[2].

The above types of drought have a tendency to shift from one to another in a sequential manner as shown in Figure 4.1.

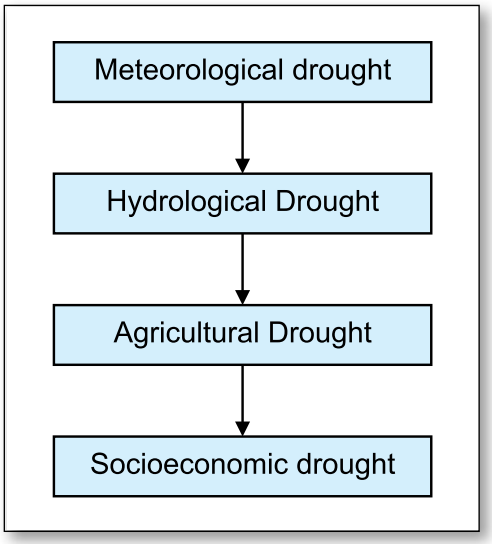

***Fig. 4.1** : Types of drought and their relation*
(Source: http://saarc-sdmc.nic.in/drought.asp)

Drought produces both direct and indirect impacts. The impact of drought could be felt even beyond the areas physically affected by it. In South Asia, drought has also demonstrated significant impacts on the ecosystems of drought-prone regions. Some of the consequences of drought are [2,3] as follows.

1. Diminished crop growth or yield.
2. Depletion of livestock percentage in the affected area.
3. Development of dust bowls, a sign of erosion, which further erodes the landscape.
4. Desertification.
5. Low-yield even in case of high-yielding varieties
6. Famine due to lack of water for irrigation and resulting crop shortage.
7. Damage to terrestrial and aquatic wildlife.
8. Malnutrition, dehydration and related diseases in the area.
9. Mass migration, resulting in internal displacement and coolant international refugees.
10. Reduced water flow through hydroelectric dams leading to power shortage.
11. Shortages of water for industrial users.
12. Creation of atmosphere of social disharmony due to unequal access to resources.

Drought : The South Asian Scenario

South Asia comprises some of the major drought affected countries of the world. Approximately 40% of the world's poor live in South Asia and the drought disasters that occur in this part of the world are of recurring type. Agriculture is the main source of livelihood for majority of population in these parts and failed monsoon or deficient rain often lead to drought. This adds to the existing problems of poverty in these countries and causes considerable strain on the natural resources. There is an acute need for long term assessment of the drought prone areas in these countries for formulation of drought mitigation programmes.

Afghanistan

Afghanistan has been one of the countries that has faced resource crisis over the years. The extreme poverty and under development in Afghanistan makes the population more susceptible during crisis and emergency. During the year 2009 the country had faced acute food shortage induced by drought in many parts of the country. Crop production was decimated and agricultural livelihood was severely affected and these cascaded a chain of adverse events like acute food grain supply, mass migration, conflict among the people and draining the economy that was already crippled. Low snowfall in 2008–09 caused the majority of the grain losses leading to a situation of alarm. Irrigated wheat production in Afghanistan accounts for roughly 70% of total output, and is nearly totally reliant on snowmelt and the resulting surface water flow through mountain streams and rivers.

In Afghanistan, harvesting activities generally happen between May and September every year. In 2009, because of prevailing drought situation, the summer wheat crops were badly affected (Figs. 4.2 & 4.3). Afghanistan normally produces 3.5–4.0 million tons of wheat annually which had come down significantly[4]. Losses in the grain production during the year 2009 were substantial and had serious ramifications for the domestic food market during the year 2009. According to the relief agency Oxfam, water shortage and rusting after effects pose a threat of severe food crisis and migration in Afghanistan. The hardest hit provinces were Nangarhar, Takhar and Laghman. The grain production was 36% less than the normal and many people in Afghanistan including women and children were in the threshold of serious danger of malnutrition[5].

***Fig. 4.2** : Drought affected barren land in Afghanistan (Source: crs-blog.org)*

***Fig. 4.3** : Drought affected barren land in Afghanistan (Source:http://www.unhcr.org/4b2910239.html)*

Bangladesh

The delayed monsoon in many parts of Bangladesh had posed severe threat of drought to Bangladesh (Fig. 4.4). Monsoon rains normally sweep Bangladesh from June to September and the country gets more than 75% of its annual rainfall during this period but a lack of rain had hampered crop potential. According to the government's weather department, rainfall during June was 37% below average while the first 19 days of July 2009 saw 23% lower precipitation than average for the period. Moreover, the monsoon rains in June were mainly concentrated in the northeastern and southeastern hilly areas triggering flash floods in those parts while the plains faced the threat of drought. Many experts were of the opinion that Bangladesh is one of the countries that is worst-affected by climatic changes and is likely to experience extreme weather conditions like, flood and drought in the future[6]. In Madhukhali, Alfadanga, Sadarpur upazilas, the people

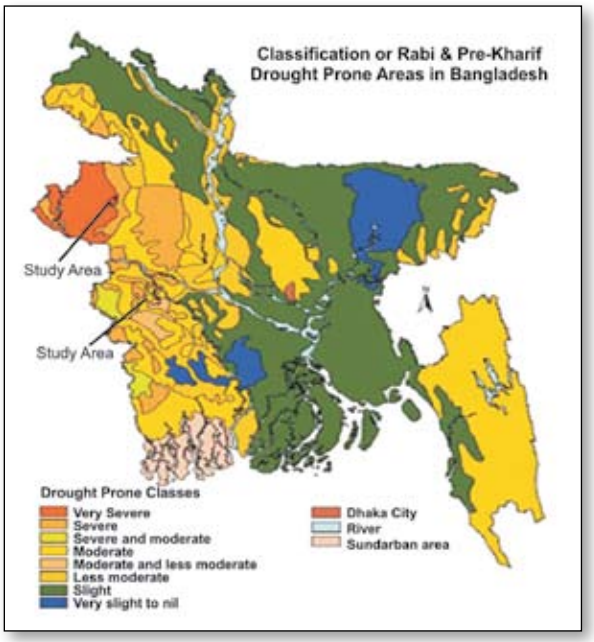

***Fig. 4.4** : Drought prone areas of Bangladesh (Source: http://gcmd.nasa.gov/records/GCMD_BANd0042_113.html)*

of these areas had to wait for rain, and a severe attack of drought on crops along with shortages of pure drinking water was experienced. Paddy withered due to shortage of surface water for irrigation[7].

The situation was reportedly worse in the northern and central region, seriously affecting rice–paddy plantations during the Aman season. The drought-like situation had been eased after light to heavy rainfall that was recorded over the country. The government had to step in and announce financial assistance to farmers, in particular free electricity for irrigation, to protect rice production in the sixteen-affected districts.

A general glance at the rabi and pre-kharif classified drought prone areas shows that the westernmost and easternmost parts are prone to drought while the menace is less manifested in the central part of the country.

India

The year 2009 experienced the worst drought situation in the country during the last 38 years. Temporal analysis of the most drastic drought years also shows that the year 2009 was one of the worst drought years in India, Witnessed by acute scarcity of water in the area (Fig. 4.5).

***Fig. 4.5** : Villagers trying to draw water from a well in drought-affected area[15]*

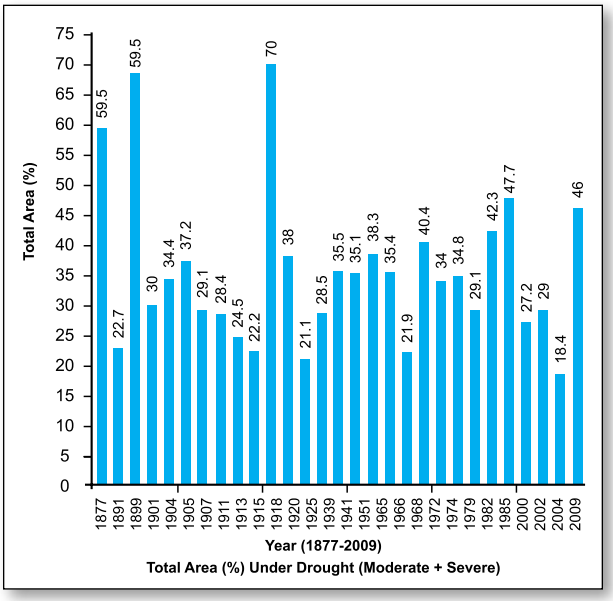

***Fig. 4.6** : Comparative graph showing percentage of area affected by drought in India. Important drought years have been used for the analysis. Data source: Drought Situations over India. Presented by (Jagvir Singh, G. R. Iyengar, T. N. Jha, B. P. Yadav and V. K. Jain(Ministry of Earth Sciences, National Centre for Medium Range Weather Forecasting(NCMRWF) www.ncmrwf.gov.in*

Nearly 46% of the country was affected by drought (moderate to severe). Also, in India, the frequency of drought has increased in past 9 years as the country has witnessed four episodes of moderate and severe magnitude (Fig. 4.6). One of the reasons of the recent spurt in the drought incidences is detrimental anthropogenic activities like over farming leading to depletion of soil fertility and nutrients, excessive irrigation practices leading to lowering of water table, widespread deforestation and construction and land use practices promoting soil erosion.

More than 30 million hectares of cropped area were damaged and around 120.53 million human population and 48 million animal population got affected by drought during 2009 (Fig. 4.7). To mitigate the impact of drought, the Government of India and all the concerned State Governments have monitored the drought indicators very closely right from the beginning of

***Fig. 4.7** : Vast stretches of drought stricken Agriculture land*[16]

the monsoon season and assessed the intensity and severity of the disaster. Three hundred fifty two districts in the states of Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Nagaland, Orissa, Rajasthan and Uttar Pradesh have been declared as drought-affected.

Large parts of the Peninsula received less than 750 mm rainfall and the rainfall is also erratic[10]. The report of the India Meteorological Department (IMD) shows that during the peak of the monsoon the deficiency in rainfall was very high (Figs. 4.8 & 4.9). At the waning phase of the monsoon cycle the scenario improved a bit but by then the drought had set in many parts of the country and already affected large sections of the population.

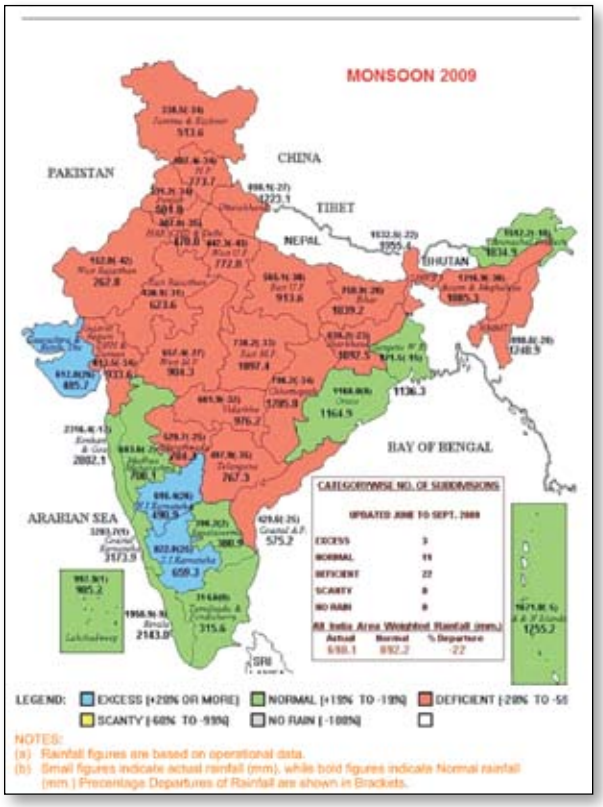

***Fig. 4.8** : Monsoon In India 2009*

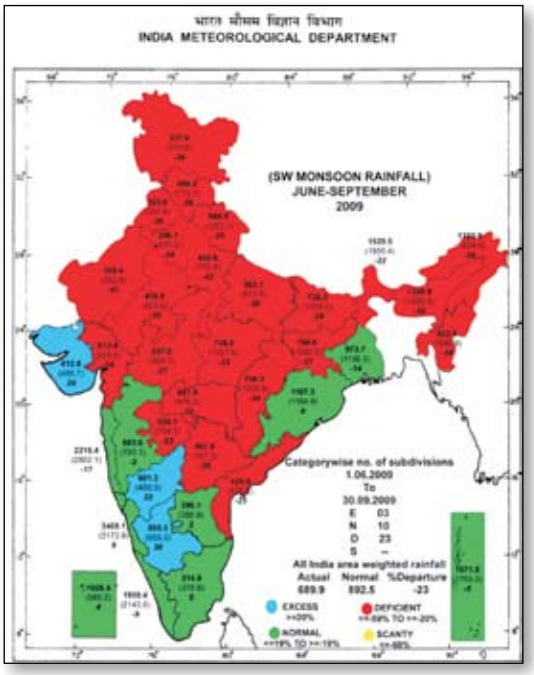

***Fig. 4.9** : Sub-divisionwise rainfall distribution over India during south-west monsoon season 2009*

The Monsoon performance in India in 2009 is summarized as follows.

- For the country as a whole, the rainfall for the season (June–September) was 77% of its long period average (LPA).
- Seasonal rainfall was 64% of its LPA over Northwest India, 80% of its LPA over Central

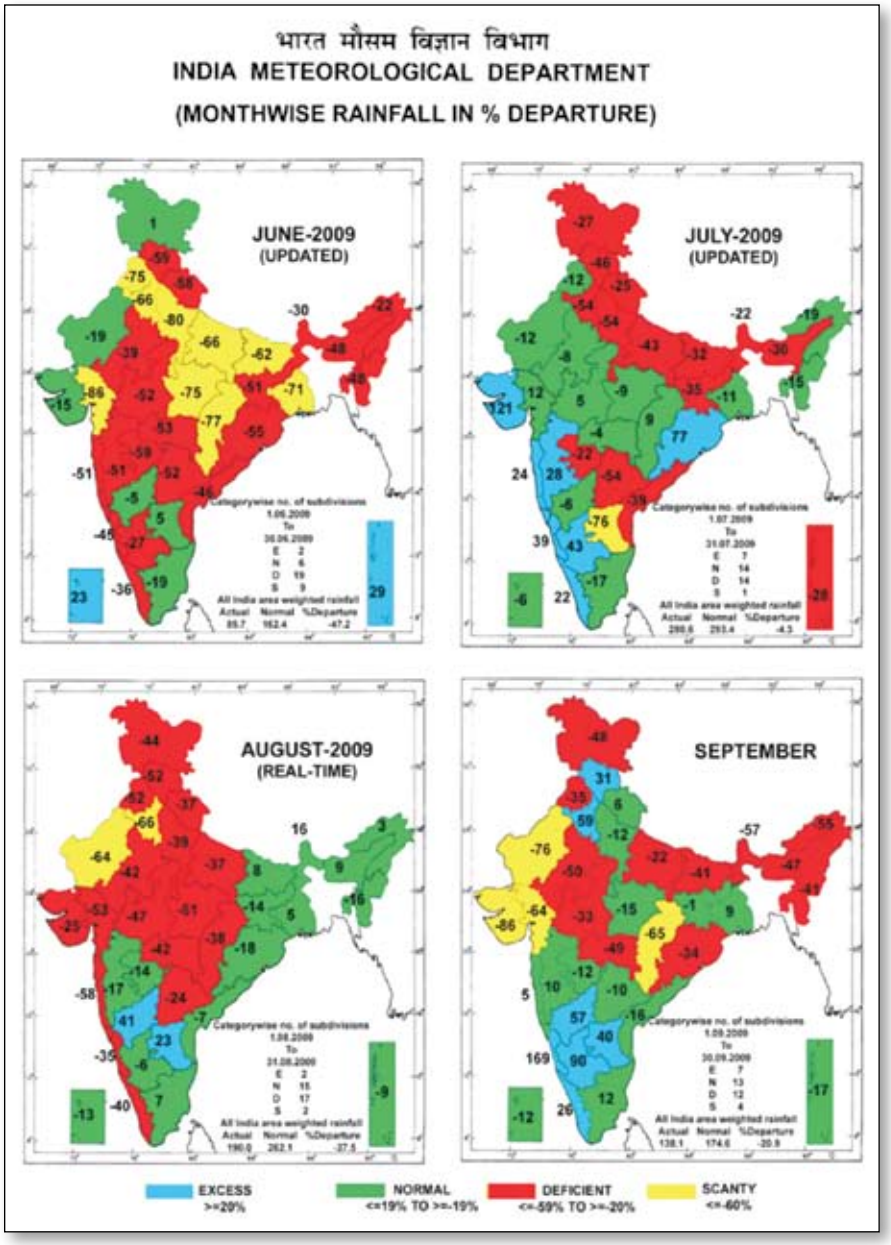

***Fig. 4.10** : Sub-divisionwise monthly rainfall distribution over India (June–Sept 2009)*

India, 96% of its LPA over south Peninsula and 73% of its LPA over Northeast (NE) India.

- Monthly rainfall was 53% of LPA in June, 96% of LPA in July, 73% of LPA in August and 79% of LPA in September (Fig. 4.10).
- The monsoon set in over Kerala on 23rd May, one week before its normal date of 1st June. During 8–20 June, there was hiatus in the advance of the monsoon. However, later the monsoon advanced rapidly and covered the entire country by 3rd July, compared to its normal date of 15th July. As in the previous two years, the withdrawal of monsoon from west Rajasthan was delayed and it

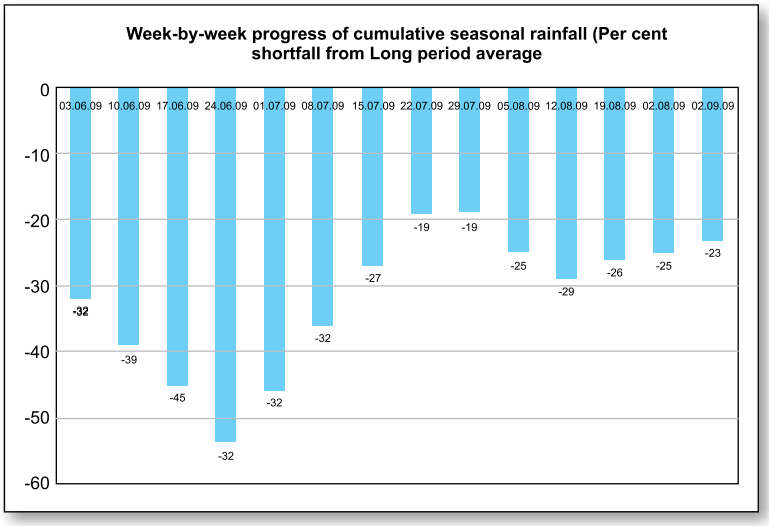

***Fig. 4.11** : Percentage shortfall in rain during monsoon period.*
(Source: http://beta.thehindu.com/business/Economy/article17783.ece)

commenced only on 25th September compared to its normal date of 1st September (Fig. 4.11).

- Out of 526 meteorological districts for which data are available, 215 districts (41) % of the meteorological districts received excess/normal rainfall and the remaining 311 districts (59%) received deficient/scanty rainfall during the season.
- The operational forecast for monsoon onset over Kerala for this year was correct, which is the fifth consecutive correct forecast for this event since issuing of forecast for the event which started in 2005.
- The operational long range forecast for the seasonal rainfall over the country as a whole and over four homogeneous regions except south peninsula have not been accurate. The forecast for August rainfall over the country as a whole has also not been accurate. All these forecasts were overestimate to the actual rainfall situation.
- However, the forecast for seasonal rainfall over south Peninsula and that for July rainfall over the country as a whole have been accurate.

On a regional basis, Northwest India registered a 42% deficiency in rainfall, followed by Northeast India which received 36% less rain; the Southern peninsula registered a 22% deficit while the Central region registered a 29% shortfall. India which is still a largely agricultural economy is a rain-dependent economy and is heavily dependent on rainfall as a source of irrigation. Deficient rains this year has destroyed some of the sugarcane crop leading to a rise in the prices of sugar. Further, a large amount of winter sown crops, including wheat, that were to be sown in train-fed fields had to depend on other forms of irrigation such as, ground water which was itself very scarce.

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The Northeastern states of India—Assam, Manipur and Nagaland were declared drought hit between June end and July following deficit monsoon rainfall (Table 4.1 & Fig. 4.12). In Assam, four districts were hit by flash floods that affected 3 lakh people; the remaining 23 districts reeled under drought (Figs. 4.13 & 4.14). 13 lakh hectares of cropland in the state was affected. Only 50% of the 3.9 million tonnes of rice needed to meet the demand in the state could be produced during the year. In neighbouring Nagaland, low rains had affected 15% of jhum cultivation (a type of cultivation where land is cleared by burning patches of forestland for cultivation) and 25% wet rice cultivation in terraced fields. The state of Manipur was also badly affected by drought[12]. The states of Tripura, Meghalaya, Mizoram and Arunachal Pradesh though received deficient rainfall, did not suffer to such an extent to be called drought-hit.

***Table 4.1**: Rainfall Deficit in the North-Eastern States of India in 2009*

State	Rainfall Deficit(%)
Assam	31
Arunachal Pradesh	35
Manipur	38
Mizoram	36
Nagaland	37.15
Tripura	21
Meghalaya	75

***Data source:** http://inwent-iij-lab.org/Weblog/2009/08/06/drought-hits-north-east-india-during-monsoon/*

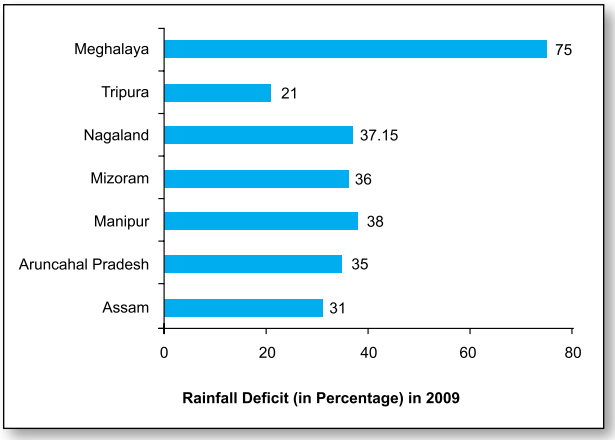

***Fig. 4.12**: Data source: http://inwent-iij-lab.org/Weblog/2009/08/06/drought-hits-north-east-india-during-monsoon/*

***Fig. 4.13**: Drought affected farmer in Assam (Source: www.nowpublic.com/world/drought-hampering..)*

***Fig. 4.14**: Drought affected farmer in Assam (Source: www.nowpublic.com/world/drought-hampering)*

The drought scenario was also very grim in the coastal state of Andhra Pradesh. In desperation, farmers in the state of Andhra Pradesh had resorted to taking their own lives—the toll was

said to be 20 farmers over a span of mere 40 days. Its parched districts had received only 153 mm of rain as against a monsoon normal, till mid-August, of 624 mm. An official with the state agriculture department had called the conditions the worst in 50 years. Some of the other states of India that had been affected by drought were Jharkhand, Andhra Pradesh, Maharashtra, Orissa. The state average rainfall for Orissa for the month of was just 92.7 mm as compared to the normal 206.1 mm. Kharif cultivation in the state suffered considerably. The total area under irrigation being limited to just 2%, most kharif cultivation in Orissa is rain fed. With the water bodies dried up and no rain received in June, all kharif cultivation in the state suffered[13].

The states of Gujarat, Rajasthan, Karnataka, Punjab, Uttar Pradesh and Madhya Pradesh during 2009 also experienced severe drought conditions and the farmers have suffered huge losses due to scanty rainfall or less rain fall. (Figs. 4.15 & 4.16) Due to scanty rainfall, the water levels in the reservoirs and dams had fallen down significantly. The farmers suffered due to shortage of electricity to run pump sets. The Governments have waved-off agricultural loans for the drought-affected farmers and also revised the procurement prices and food grains.

***Fig. 4.15** : Children in search of water in a dried up water body (Source: http://revista-amauta.org/wp-content/uploads/2009/08/india-sequia.jpg)*

***Fig. 4.16** : A farmer waits for the monsoons in a drought-hit Indian State (Source: beta.thehindu.com/sci-tech/article6088.ece)*

The administrative machinery was geared up towards taking the necessary pro-active measures to salvage the losses and sustain the economy and livelihood of the affected population. The Prime Minister of India has addressed the Chief Ministers and the Union Agriculture Minister followed up with a conference of Agriculture and Food Ministers of the states to review the position on drought in the states and to emphasize on the action required to be taken

The Government of India have provided a special package of Rs 800 crores for Punjab and Rs 400 crores for Haryana for taking the necessary measures to mitigate the impact of drought on the standing crops. Special package was also provided for drought relief and agricultural development of the Bundelkhand region alone that spans Uttar Pradesh and Madhya Pradesh, the region that has suffered a sustained drought for the past four years. The package will be implemented in seven districts of Uttar Pradesh and six districts of Madhya Pradesh. The prime mover of the package is optimization of water resources through rain water harvesting and through utilization of the river systems. Under the schemes, intensified and diversified agriculture will be promoted to improve productivity of crops and encourage a higher sowing area in the Kharif season. The emphasis was on watershed development and in-

crease in irrigation facilities to adequately equip the region in coping with the drought with resilience. Animal husbandry and dairy activities will also be expanded as an ancillary activity to enhance farmer's incomes to enable them to cope with the drought conditions.

Drought Management Strategies in India

In India, due to widespread area and a large number of people affected, drought management is always a complex operation, involving various organizations and institutions and government departments at the national, state, district and sub-district level. The Government of India has formulated various programmes and policies for effective management of drought. In November, 2009, the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India have issued a new and updated version of the Drought Management Manual, 2009, which focuses on the general/common elements of drought management in India and suggests a system for Drought Management policy and programmes to be followed by the Government of India and various State Governments. The manual enables the State Governments and other departments of the Government of India to undertake the specific activities, schemes and interventions for effective management of Drought and incorporate the necessary forecasting, monitoring, response and mitigation measures. The National Rainfed Area Authority (NRAA) under the ministry of Agriculture in India has come up with a detailed management strategy plan for fighting drought in India[14]. The plan is divided into two major sub groups: short term and middle/long term strategy planning. Some of the strategies suggested in the plan are enumerated below:

Short term strategies

1. Judicious use of surface and groundwater for drinking and irrigation.
2. Adoption of modified irrigation practices.
3. Improve water use efficiency and irrigation efficiency.
4. Livestock management including establishment of fodder/feed depots for ensuring availability of water and quality fodder to animals.
5. Selection of crops, cropping sequences and agronomic practices for drought-affected areas.
6. Promotion of subsidiary income and employment generating activities.
7. Deployment of Information technologies for collection, storage and dissemination on real-time basis.
8. Rescheduling of irrigation roasters.
9. Proper and optimum utilization of ground water for irrigation.
10. Use of water for irrigation, with a strict adherence to standardized water quality guidelines.
11. In situ rain water conservation.
12. Installation of tanks and farm ponds for ground water recharge.
13. Recharge dried up Open wells.
14. Follow crop rotation.
15. Application of contingent cropping.
16. Application of suitable fertilizers and micronutrients, intercropping, mixed cropping etc., for optimized use of water for irrigation.
17. Meticulous planning for Rabi and summer crops in case of failure of Kharif crops.

Middle/long term strategies

1. Judicious networking of rivers and other water bodies of high rainfall areas so that the

transferred water can be used for ground water recharging or filling up dried lakes, water bodies etc.

2. Ground water recharge in dry areas with introduced water, in situ and ex situ water harvesting.
3. Less exploitation of ground water by resorting to low water demanding crops and adoption of precision micro-irrigation techniques.
4. Formulation of strict guidelines for judicious use of water for domestic and industrial purpose in all drought-prone areas.
5. Recycling of used/waste waters after proper treatment and reclamation for agriculture, human and animal consumption.
6. Enhancement of perennial vegetation in arid and semi arid regions.
7. Development of fodder varieties of cultivated crops having tolerance for varying degrees of drought.
8. Resorting to programme for improved livestocking, breeding and management.
9. Upgradation and fine tuning of crops, cropping and farming systems.
10. Exploiting under exploited and under utilized plant resources.

Nepal

The 2009 winter season was one of the driest on record for Nepal with an average 50% decrease in the precipitations during the period of November 2008 to February 2009 (Fig. 4.17). Due to the extremely prolonged drought, farmers living in the mid and high hills districts of the mid-western and far western regions had incurred major crop losses and the depletion of food and seed stocks, resulting in decreased food intake and increased debt. It was estimated that the 2008–09 winter drought resulted in 14.5% and 17.3%

***Fig. 4.17** : Farmer of Nepal are battling a devastating Drought*[17]

country-wide decrease in barley and wheat production, respectively, as compared to the previous year. Despite the abundant 2008 summer harvest, yearly crop production for 2008–09 resulted in an average cereals' deficit production of 1,33,000(–2.5%) tonnes across Nepal with most of the shortfalls deriving from harvest losses in the hill and mountain areas of the mid- and far western regions. Locations characterized by high dependence on rainfall for their agricultural production were the most affected; hence, districts in the mid-western mountains faced a 50% average loss in wheat, far western mountains incurred an average 46% loss in wheat, while far western hills suffered from an average 36% reduction of the same cereal crop. The 2009 summer crops were severely impacted by the erratic and reduced precipitations during the 2008–09 winter and the delayed arrival of the 2009 monsoonal rains. Summer crops were planted much later than usual when temperatures are not ideal for germination, ultimately affecting yields. In most of the hilly districts where summer crop seeds were planted in due time, the absence of spring rains resulted in extremely low germination rates, which required replanting. The scarcity and unavailability of quality seeds did not always allow

for such practice to take place. The most affected summer crops were maize (in the hills) and rice (in the Terai)[9]. Out of the 75 districts of Nepal 40 were food-deficient as a result of drought.

Pakistan

Severe drought has occurred in the Thar Desert of Sindh arid zone. Failure of monsoon observed in all the talukas of district Tharparkar of Sindh compounded the existing food crisis caused by the drought-like situation during the previous year. Less than normal rainfall was received in these areas and the rain received too was either too little or too late to recover the crisis triggering acute shortage of food, fodder and water. Migration of population due to drought is a regular phenomena and in places like Nagarparkar it had escalated as high as 55% which was 10%–15% percent in normal years. Acute water shortage had resulted and there was severe shortage of drinking water. The wells in the area had dried up or the recharge period of them had increased considerably. Over a wide region including Veerawah, Pithapur and Nagarparkar severe depletion of ground water table had been observed.

In places like Tharparkar where the economy is largely dependent on livestock, the impact of drought was very harsh. The pastures had dried up and fodder availability was restricted, and in some extreme cases it was non-existent. Many of the livestock population had to subsist on toxic bushes which had made them vulnerable to diseases like, pest des petites, enterotoxaemia, diarrhoea and blood diarrhoea[8].

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Chapter 5

Glacial Lake Outburst Flood

An Overview

Glacial Lake Outburst Flood (GLOF) is a frequently occurring catastrophic event when the ice walls that contain a glacial lake break open and release the water from the lake into the surrounding rivers or valleys. The resulting flash-flood of ice cold water can result in an instant destruction as well as injury or death. The devastation due to GLOF is instantaneous and sudden and it rushes forward with tremendous speed giving very little time for preparedness to the affected region. Endemic to the regions situated at high altitudes, it is a cause of major concern in the countries like Nepal and Bhutan and to some extent in the northern parts of India. A direct consequence of global climate change, it's effects have become more pronounced in past few decades. There has been a general increase in the number of warmer days and nights in comparison to colder days and nights. According to available data, the global average temperature has increased by approximately 0.75°C in past three decades and average annual mean temperatures have been increasing in Nepal by 0.06°C between 1977 and 2000. These increase in temperature are more pronounced at higher altitudes and in winters. As a result of this the Himalayan glaciers situated at high altitudes are melting and retreating at an unprecedented rate, leaving in their place the highest and most unstable lakes of the world. For example, between 1970 and 2000, nearly 6% of the glacier area in Tamor and Dudh Koshi subbasins of Nepal has decreased. Reduction in the size of glaciers and reduced snow in the Himalayas has resulted in less water flowing into rivers and formation of glacial lakes. Due to continuous warming these glacial lakes keep growing in volume and pose threat of GLOFs to already fragile ecosystem.

Glacial lake outburst floods have long been known to occur in the Himalaya–Hindu Kush region of South Asia. In the past, though there have been several disastrous events of GLOF in the region, precise location, frequency and actual scale of their effects are not adequately known or documented. The northern region of Bhutan, India, Nepal and Pakistan are vulnerable to GLOF. The GLOFs in China can directly affect the southern lowland of South Asia causing catastrophic flood to most of the antecedent rivers of the Himalaya region as observed in 11 July 1981 events. Past records show that at least one catastrophic GLOF event had occurred at an interval of 3 to 10 years in the Himalayan region. Nepal has experienced 22 catastrophic GLOFs including 10 GLOFs in Tibet/China that also affected Nepal. The GLOF not only brings casualties, it also damages settlements, roads, farmlands, forests, bridges and hydro-powers in addition to effecting changes to the wildlife habitat and ecology. The settlements that were not damaged during the GLOF are now exposed to active landslides and erosions scars making them high-risk areas[1,2].

The inventory studies carried out by ICIMOD in Himalaya–Hindu Kush region has revealed that there are 15,003 glaciers, covering an area

of about 33,344 sq km, and 8,790 glacial lakes, of which 203 were identified as potentially dangerous or 204 with the addition of Thorthormi glacial lake in Bhutan3. This data does not cover the Himalayan areas of Arunachal Pradesh and Jammu and Kashmir in India, Afghanistan; thus the numbers for the whole of the Hindu Kush–Himalayan region will be higher. A brief note on the glacial lake in South Asian countries is given below.

Bhutan

In Bhutan, the glacial lake inventory survey was undertaken in 200. Using 1:50,000 scale topographical maps published between 1950 and 1970 by the Survey of India and Land Observation Satellite (LANDSAT) and Thematic Mapper (TM) images on a scale comparable to the topographical maps a total of 677 individual glaciers were identified (total area approximately 1,317 sq km), and 2,674 glacial lakes, of which 24 were classified as potentially dangerous (Fig. 5.1 and Table 5.1). The great majority of lakes were very small in Bhutan.

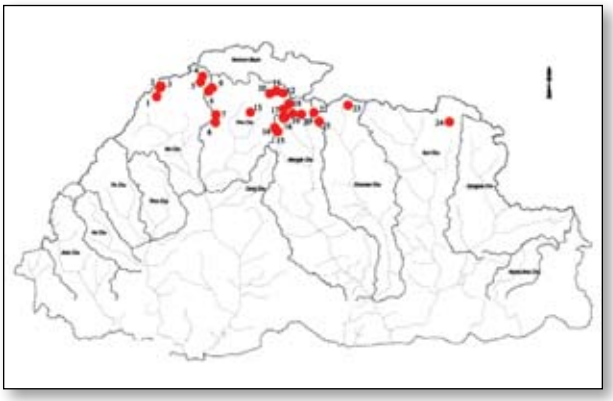

***Figure 5.1**: Distribution of potentially dangerous lake in Bhutan.*

An updated inventory of major glacial lakes and assessment of GLOF potential in Bhutan and their level of potentially unstable glacial lakes were carried out in 1998 during the Japan–Bhutan joint research. Thirty glacial lakes were recorded and full inventory sheets were prepared during the project; among them 24 glacial lakes are identified as potentially dangerous.

***Table 5.1**: The Glaciers, Glacial lakes and Lakes Identified as Potentially Dangerous in Bhutan*

River Basin	Glaciers			Glacial Lakes		
	Number	Area (sq km)	Ice Reserves (cu km)	Number	Area (sq km)	Potentially dangerous
Amo Chu	0	0	0.00	71	1.83	0
Wang Chu	36	49	3.55	221	6.47	0
Pusa Tsang Chu	272	503	43.27	980	35.08	13
Manas Chu	310	377	28.77	1383	55.51	11
Nyere Ama Chu	0	0	0.00	9	0.07	0
Northern Basins	59	388	51.72	10	7.81	0
Total	**677**	**1317**	**127.31**	**2674**	**106.77**	**24**

In the year 2009 there was no major report of GLOF from Bhutan. However, Bhutan had witnessed a crisis situation in the Tshojo glacier (Fig. 5.2) during the month of April. Tshojo glacier had been identified as one of the potential glaciers to give rise to GLOF. On 30th April at 03:30 AM in the Tshojo glacier area rise in water level in Pho Chhu river was noticed. Alerts were issued and news had reached Punakha around 09:30 AM causing panic among the local people and they had initi-

***Figure5.2**: Tshojo glacier, Bhutan(Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)*

ated the proceedings for moving to a safer place (Fig. 5.3). However, the rising level of Pho Chhu river rose by nearly 2.1 metres and then stabilised. After keeping a close vigil on the situation the emergency was called off at 12:15 PM.

***Figure5.3**: People in panic of GLOF, Punakha (Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)*

India

The northern parts of India i.e., Sikkim, Uttaranchal and Himachal Pradesh harbours the major glacier and glacial lakes in India. To date altogether 549 glacial lakes were identified in India (Table 5.2). In Himachal Pradesh, there are 2,554 glaciers with a total area 4,161 sq km. Using remote sensing techniques, 156 glacial lakes were

***Table 5.2**: The Glaciers, Glacial lakes and Lakes Identified as Potentially Dangerous in India*

River Basin	Glaciers			Glacial Lakes		
	Number	Area (sq km)	Ice Reserves (cu km)	Number	Area (sq km)	Potentially dangerous
Himachal Pradesh						
Beas	358	758	76.40	59	236.20	5
Ravi	198	235	16.88	17	9.16	1
Chenab	681	1,705	187.66	33	3.22	5
Satluj	945	1,218	94.45	40	136.46	3
Sub-basins	372	245	11.96	7	0.18	2
Total	2,554	4,161	387.35	156	385.22	16
Uttaranchal						
Yamuna	124	173	17.88	20	0.17	0
Bhagirathi	393	1,034	143.41	32	0.44	0
Alaknanda	540	1,675	191.36	54	1.37	0
Kali	382	1,178	122.78	21	0.51	0
Total	1,439	4,060	475.43	127	2.49	0
Tista river basin (Total)	**285**	**577**	**64.78**	**266**	**20.20**	**14**

identified with a total area of 385 sq km, of which 16 were considered potentially dangerous. Similarly, for Uttaranchal, 439 glaciers with a total area of 4,060 sq.km, and 127 glacial lakes with a total area of approximately 2.5 sq km. were identified. Most of them were very small and none of them were identified as potentially dangerous. The Tista river basin has 285 glaciers with a total area of 577 sq km altogether and 266 glacial lakes, 14 of which were rated as potentially unstable.

Nepal

Among the South Asian countries Nepal is a treasure house of glaciers. It hosts 3252 glaciers with

***Table 5.3**: The glaciers, glacial lakes, and lakes identified as potentially dangerous in Nepal*

River Basin	Glaciers			Glacial Lakes		
	Number	Area (sq km)	Ice Reserves (cu km)	Number	Area (sq km)	Potentially dangerous
Koshi river	779	1,410	152.06	1,062	25.09	16
Gandaki river	1,025	2,030	191.39	338	12.50	4
Karnali river	1,361	1,740	127.81	907	37.67	0
Mahakali iver	87	143	10.06	16	0.38	0
Total	**3,252**	**5,324**	**481.32**	**2,323**	**75.64**	**20**

area of 5,324 sq km and 2,323 glacial lakes having 75.64 sq km^3 (Table 5.3).

Among these nearly 20 glaciers are identified as potentially dangerous and susceptible to the danger of GLOFs (Fig. 5.2). However, out of these 20, 2 have been taken off the list as their areas have drastically reduced due to outburst. The gravity of the phenomenon of global warming and its adverse effect on the glaciers of Nepal can be understood from the fact that after 2000, 50

***Table 5.4**: The Glaciers, Glacial lakes and Lakes Identified as Potentially Dangerous in Nepal*

River Basin	Glaciers			Glacial Lakes		
	Number	Area (sq km)	Ice Reserves (cu km)	Number	Area (sq km)	Potentially dangerous
Indus River Basin						
Swat	233	224	12.22	255	15.86	2
Chitral	542	1,904	258.82	187	9.36	1
Gilgit	585	968	83.34	614	39.17	8
Hunza	1,050	4,677	808.79	110	3.21	1
Shigar	194	2,240	581.27	54	1.09	0
Shyok	372	3,548	891.80	66	2.68	6
Indus	1,098	688	46.38	574	26.06	15
Shingo	172	37	1.01	238	11.59	5
Astor	588	607	47.93	126	5.52	9
Jhelum	384	148	6.94	196	11.78	5
Total	5,218	15,041	2,738.50	2,420	126.32	52

lakes are growing in size and 22 new lakes have emerged[3].

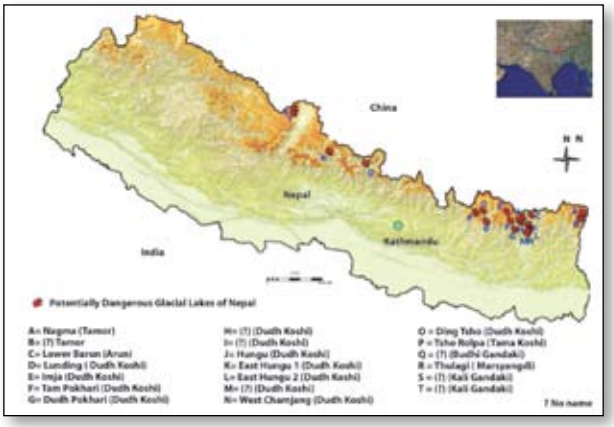

***Figure5.2**: Distribution of potentially dangerous glacial lakes in Nepal (**Source**: http://geoportal.icimod.org/Publication/Files/15bf260e-8f19-46dc-95df-df523ce3916b.pdf).*

Pakistan

The Water Resources Research Institute (WRRI) of the Pakistan Agricultural Research Council (PARC) and ICIMOD jointly carried out an inventory survey of glaciers and glacial lakes in the Indus basin in Pakistan in 2005. The study identified a total of 5,218 glaciers with an area of 15,041 sq km and 2,420 glacial lakes. They have identified 52 glacial lakes as potentially dangerous (Table 5.4).

GLOF: Mitigation Measures

The best way to combat GLOF threat is to take recourse to well planned long-time mitigation measures. These include monitoring, development of early warning system and community awareness.

1. Near real-time monitoring

   In the recent decades glaciers have been retreating at a fast rate and the lakes associated with the glaciers are rapidly increasing in size and number. In such a scenario creation of up-to-date database of the glaciers and glacial lakes are of utmost importance to understand theiractivities, which is only possible through the study of remotely sensed datasets. For example, since 2007, ICIMOD is monitoring the growth of Imja Tsho with support from European Space Agency (ESA), Synthetic Aperture Radar (SAR) and Advanced Synthetic Aperture Radar (ASAR) data to monitor the growth of Imja Tsho and its vicinity (Fig. 5.5).

***Figure5.5**: Monitoring growth of Imja Tsho through satellite data (Source: Bajracharya 2009).*

2. Real-time monitoring

   This includes collection of data like lake water level, total weather station data and photographs collected from web camera, transmits their synthesis and analysis for monitoring of potentially dangerous glacial lakes.
3. Installation of Early Warning System for GLOF monitoring (Fig. 5.6)
4. Controlled breaching of lakes
5. Construction of channel and moraine dams (Fig. 5.7)

***Figure5.6**: Installation of early warning system (Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf*

***Figure5.7**: Channel and moraine dam built in reducing impact of GLOFs. (Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)*

***Figure5.8**: Channel for creating outlet form glacial lakes (Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)*

***Figure5.9**: Installation of siphons for diverting water from glacial lakes (Source: http://hmg.npolar.no/opencms/export/sites/hmg/en/documents/topic-2/reynolds2_topic2.pdf)*

***Figure5.10**: Khumbu Festival, 2009 (Source: http://www.meteotrentino.it/clima /convegno2010/1_Ang_Tshering_Sherpa.pdf*

***Figure5.11**: Runners at the starting point of GLOF Action Run 2009,Imja Lake- Source: The Nepal News*

6. Outlet control structures (Fig. 5.8)
7. Pumping or siphoning from the lakes (Fig. 5.9)
8. Boring tunnel through moraine barrier or under ice dams
9. Informing people about alternative livelihood options
10. Preparation and implementation of community level action plans like medical facilities, medical evacuation, evacuation plans, land exchange programmes in potentially dangerous areas
11. Assimilation of indigenous information of local people with modern technology for contingency planning
12. Sharing risk information with public through model results like maps
13. Creating public awareness through group activities and festivals

    One of the most effective ways of GLOF mitigation is to create awareness among the local people and also the world at large about the gravity of the situation. In this regard in 2009 GLOF Action Run 2009 and Khumbu festival was organised (Fig. 5.10). The idea was to create great international and local concern on the risks posed by GLOFs, to demonstrate that even the fastest runner will not be able to outrun the fury of GLOF and create an opportunity where local residents are the focal point2 (Figure 5.11).

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Chapter 6

Avalanches

An Overview

Avalanches are rapid movement of snow down the slope or flanks of mountains and can be triggered by natural factors or human activity. Typically occurring in mountainous terrain, an avalanche can mix air and water with the descending snow. Composed of flowing snow, avalanches are among the most serious objective hazards to life and property in mountainous stretches of the globe. The ability of the avalanches to carry enormous masses of snow and associated debris makes them one of the most destructive elements of nature. The type of an avalanche though may vary from case to case; all of them have a few things in common: a triggering factor, a zone of initiation or origin, a run out where the avalanche comes to rest and finally the part where the avalanche comes to rest in form a debris deposit[1]. Among the SAARC countries Afghanistan, Bhutan, India, Nepal and Pakistan are vulnerable to avalanches. The following table and Appendix-VIB enlist the occurrence of important avalanches in SAARC region (Table 6.1).

***Table 6.1**: Important Avalanche Incidents in SAARC Region During the Year 2009*

Country	Date of incident	Location	Casualties
Afghanistan	16 January 2009	Near Salang tunnel	10 people killed, vehicles and machinery destroyed.
	16 February 2009	Herat and Ghor provinces	12 lives including 6 children in addition to severe damage to the property and livestock.
	28 February 2009	Takhar province	Nearly 2,000 livestock killed and 18 homes destroyed.
India	12 January 2009	Chotali village near Uri	3 people buried.
	14 April 2009	Jammu and Kashmir	7 soldiers killed.
Pakistan	6 February 2009	Kupwara	4 people killed.
	16 February 2009	Chitral District	4 people killed.
	6 April 2009	Near Lowari Tunnel	5 people killed.

***Source**: UN and other International, National agencies and Media reports*

Avalanches in Afghanistan during 2009

The mountainous stretch of Hindukush ranges falling in Afghanistan has a recurring history of avalanches. An avalanche hit the Salang tunnel, the lifeline linking southern and northern Afghanistan on 16 January 2009. At least 10 people were killed and 12 vehicles and machinery used to clear the road of snow were swept away when the avalanche struck a highway[2] (Figures 6.1 and 6.2). Forty people were rescued, 11 of whom were injured by the avalanches. The 12 February 2009 snow avalanche triggered by heavy snowfall in the Herat and Ghor provinces of Afghanistan had claimed at least 12 lives including 6 children in addition to severe damage to the property and livestock[3]. Ghor province has been

***Figure 6.1**: Members of Afghan army trying to remove snow from an overturned vehicle (Source: Sky News).*

***Figure 6.2** : Rescue team clearing blocked pass in Afghanistan (Source: Sky News).*

frequently visited by the avalanche menace and had witnessed another major avalanche on 17 March 2009.

On 28 February 2009 two heavy avalanches in northern Takhar province killed nearly 2,000 livestock and destroyed 18 homes[4]. An avalanche incident in Shorakh village of Warsaj district resulted in killing 2,000 sheeps, destroying 10 homes, 2 power producing dams and 2 grain mills. Another avalanche in Mushtaq village of Farkhar district killed nearly a 100 livestock and buried 8 houses. All the roads linking the village to the district had been closed due to heavy movement of snow along the slopes. The stranded people were in desperate need of emergency supplies. A team comprising provincial officials of Afghanistan National Disaster Management Authority (ANDMA) and Rural Rehabilitation Department reached to the affected area. Here the incidents of avalanches have often been resulted into deadly incidents. Almost a week back, an avalanche killed 3 people in Daikondi province. Similarly, another avalanche incident in Badakhshan had also destroyed 1,500 livestock and killed a woman and injured 3 others and left the infrastructure of the province badly damaged. The avalanche event had also damaged the infrastructure of the province.

Avalanches in India during 2009

The part of India along the snow clad peaks of the Himalayas along the northern fringes of India has always been vulnerable to avalanche menace. It has led to a huge loss to life and property to the people of that region. During the year 2009 2 major incidents of avalanche was witnessed by the state of Jammu and Kashmir.

On 12 January 2009 an avalanche struck Chotali village near the border town of Uri, around 85 km from Srinagar. Three persons were buried under the avalanche. Rescue teams of the police and army had immediately rushed to the spot and due to their intense efforts it was possible to rescue 1 person[5].

Fifteen soldiers of Indian army were trapped when an avalanche buried an army post in the Shamsbari mountain range of Jammu and Kashmir's Kupwara district on 14 April 2009. Seven soldiers were killed and 8 soldiers could be rescued by the relief and rescue teams.

Avalanches in Pakistan during 2009

Like Afghanistan and India, the northern fringe of Pakistan is also vulnerable to avalanche hazard. On 6 February 2009 4 persons, were killed in an avalanche in Kupwara district[6]. Six persons were buried at Khoni Nallah in Zed Gali of Machil

area of the district. However, rescuers succeeded in saving 2 persons. Consequent upon the avalanche attack, the authorities had issued an avalanche alert for the higher reaches of the valley asking people of Tangdhar, Kupwara, Baramula, Sopore, Islamabad, Kargil, Doda, Gurez, Naugam, Banihal, Uri and Rajouri areas to exercise extreme caution which was helpful in avoiding further damage in the area.

On 16 February 2009 4 persons belonging to the same family were killed when a snow avalanche hit them while travelling from Dabargar area of Yarkhond, district Chitral to Mastoj[4]. Due to land-slide and avalanche after snowfall in the Chitral district, all the major roads linking the area with other parts of the country had been blocked resulting in acute shortage of medicines and food supplies to the area. In another incident, 2 persons were killed when another avalanche hit them at Shamaran Fhandar village, Ghizer valley. These 2 persons along with other residents of the area were busy in clearing the snow from Shamaran power house to help restore power supply when a big snow mass fell upon them.

On 6 April 2009 at least 5 people were killed when a snow-slide tumbled over 2 vehicles near Lowari tunnel in Dir Bala area[6]. The police and local people had launched rescue operation immediately after the incident. 7 people were onboard in the 2 vehicles when the snow avalanche triggered along the mountain slopes. Five dead bodies could be recovered from the debris.

Avalanch: Mitigation Measures

Several methods are employed to prevent or lessen the impact of avalanches in the avalanche prone areas. In the areas of high snowfall, small explosive charges can be triggered to avoid building up of heavy snow masses. Construction of snow fences, posts, walls and erection of snow nets are other effective methods for preventing snow build up and consequent probability of avalanche initiation. These practices aid in breaking up the wind intensity and thus change the way the snow accumulates. In many parts of the globe increasing vegetation density or reforestation is resorted to increase slope stability and create natural snow barriers. In areas with very high snowfall and unstable slope conditions stronger barriers are constructed of concrete, rock or earth. The usual practice is to construct them over the structures they are meant to protect; though sometimes they are also constructed to divert snow flow in safer directions. Apart from these, focused studies are being carried out by various organisations like Snow and Avalanche Study Establishment (SASE), India and Indian Space Research Organisation (ISRO), India for avalanche related hazard study and analysis.

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Chapter 7

Heat and Cold Waves

An overview

Heat waves are extreme events associated with particularly hot sustained temperatures known to produce notable impacts on human mortality, regional economies and ecosystems[1]. However, the definition recommended by the World Meteorological Organisation is that when the daily maximum temperature of five consecutive days exceeds the average maximum temperature by 5°C or 9°F[2]. Two well-documented examples are the Chicago heat wave of 1995 and the Paris heat wave of 2003. Global research has shown that the incidence of hot waves is likely to increase due to the effect of global warming. Based on preliminary data, the globally averaged combined land and sea surface temperature was the second warmest on record for June and the January–June year-to-date tied with 2004 as the fifth warmest on record. Large portions of each inhabited continent were substantially warmer than average during June 2009. The warmest anomalies were most notable in parts of Africa and most of Eurasia[3,4] (Fig. 7.1).

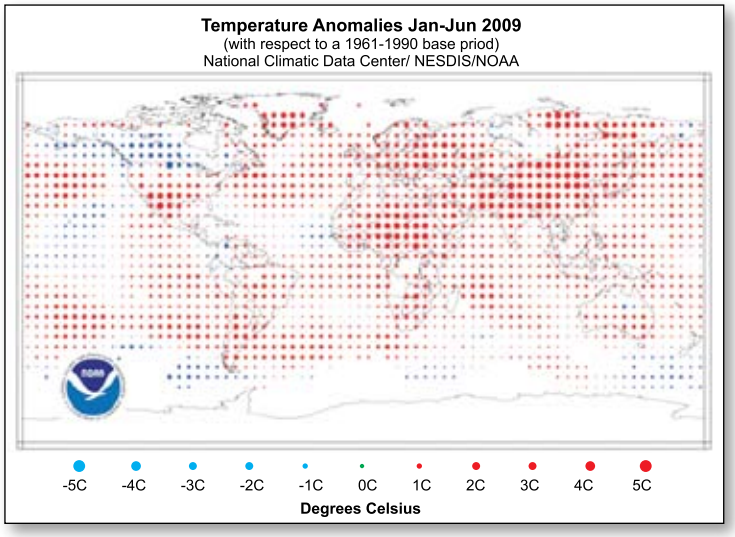

Figure7.1: *Global temperature anamoly for the period of January–June 2009.*
(Source : http://www.ncdc.noaa.gov/img/climate/research/2009/jun/map-blended-mntp-200901-200906-pg.gif

Cold waves on the other hand are rapid fall in the temperature within a period of 24 hours requiring increased protection to agriculture, industry, commerce and social activities. The precise criterion for a cold wave is determined by the rate at which the temperature falls and the minimum to which it falls, depending on the geographical location and time of the year. The effects of cold waves on the community are manifold: death and injury to humans, livestock and wildlife; freezing of water pipelines; increased demand for electricity to name a few.

Heat waves in south asia during the year 2009

Parts of South Asia witnessed heat wave conditions during 2009. The countries most affected during the year were Bangladesh, India and Pakistan. The heat wave conditions in these countries were unlike witnessed during earlier years and had taken heavy toll on the humans, livestock and ecosystem. The details of events are listed in Appendix-IV.

Bangladesh

Bangladesh had witnessed heat wave conditions in the early part of the year. Many parts of Bangladesh were reported to be reeling under the scorching sun causing distress to the human and livestock. Places like Khulna, Rajshahi, Iswardi, Bogra and Dhaka were affected as early as the second week of April. Among the highest temperatures recorded during this period were: Tangail 36.7°C, Faridpur 39.1°C, Madaripur 36.2°C, Chandpur 35.5°C, Rajshahi 40.7°C, Iswardi 39.6°C, Bogra 36.7°C, Khulna 38.6°C, Satkhira 39°C and Chaudanga 40.7°C[5]. The temperature of the capital city Dhaka had reached 42.2°C during the last week of April, highest in 14 years. Severe water crisis, power cuts and cases of diarrhoea had compounded the problem. According the officials of International Centre for Diarrhoeal Disease Research, Dhaka, they had treated the highest number of patients in the pre-monsoon season during our 45 years. Sixteen people had died of diarrhoea-related illnesses and the hospital has treated more than 40,000 patients since the beginning of March[6]. Student attendance in the educational institutions declined sharply and farmers also faced problems as it was impossible to spend long hours in the field during such heat wave.

India

During the year 2009 India too witnessed unprecedented heat wave conditions throughout the country. However, the increase in summer temperature and area of spread of heat waves in India increased sharply during 1991–2000 in comparison to the earlier two decades, according to a study by the India Meteorological Department (IMD). The average increase in temperature for India is 0.55°C/100 yrs (Fig. 7.2). Their study

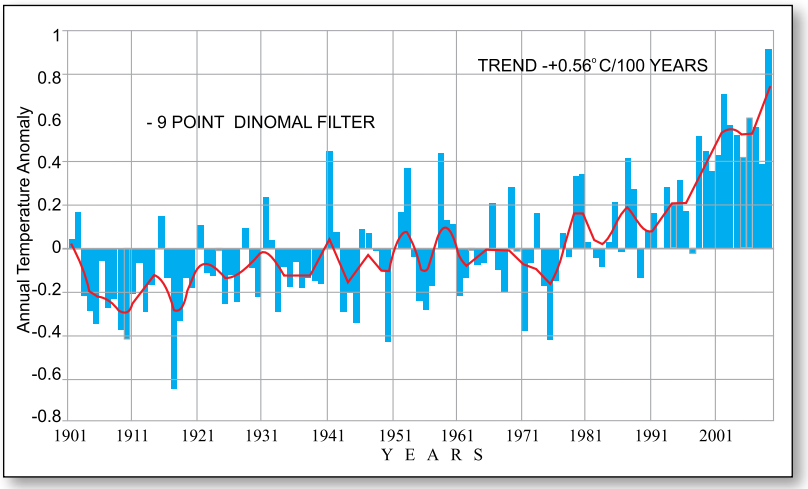

Figure7.2: *Annual temperature anomaly for the period between 1901 and 2001 (Source: http://www.imd.gov.in/doc/warm2009.pdf).*

has shown that between 1991 and 2000 an average of 22.7 subdivisions in the country were hit by heat waves per year, while between 1971 and 1980 an average of 9.9 subdivisions were hit by heat waves per year. During 1981–1990 the average was 7.3 subdivisions. Twenty-five subdivisions went through more than 15 spells of heat waves in 1991–2000. While in the previous two decades 2subdivisions received more than 15 spells of heat waves. In 2009, annual mean temperature averaged over the country as a whole was +0.913°C which was above the 1961–1990 average. The annual average temperature for the country is 24.64°C. The year 2009 was the warmest year on record since 1901. The other warmer years on record in order are 2002(0.708°C), 2006(0.6°C), 2003(0.560°C), 2007(0.553°C), 2004(0.515°C), 1998(0.514°C), 1941(0.448°C), 1999 (0.445°C), 1958(0.435°C), 2001(0.429°C), 1987(0.413°C) and 2005(0.410°C)[7].

Similarly, spatial pattern of trends in mean annual temperature anomalies suggests significant positive (increasing) trend over most parts of the country except over some parts of Rajasthan, Gujarat and Bihar, where significant negative (decreasing) trends were observed (Fig. 7.3). The mean monthly temperature for the year 2009 also shows an increase in temperature for the months June to September[7](Fig. 7.4).

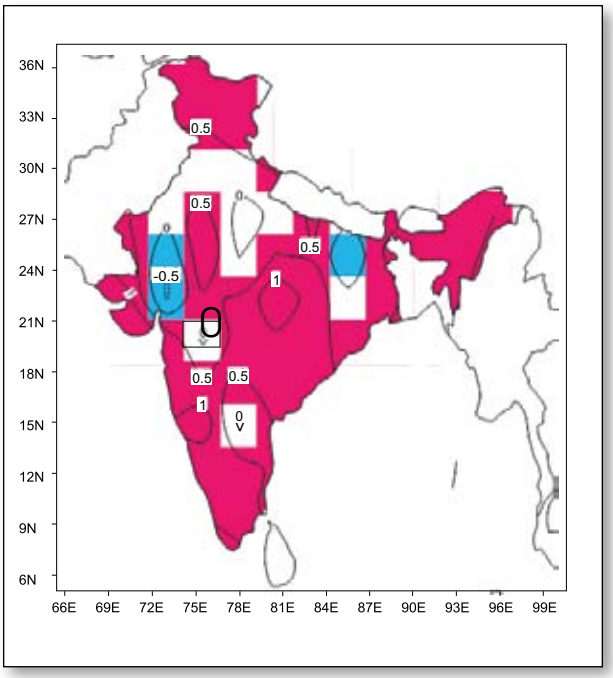

***Figure7.3**: Annual mean temperature trend for the period 1901–2009 (Source: http://www.imd.gov.in/doc/warm2009.pdf).*

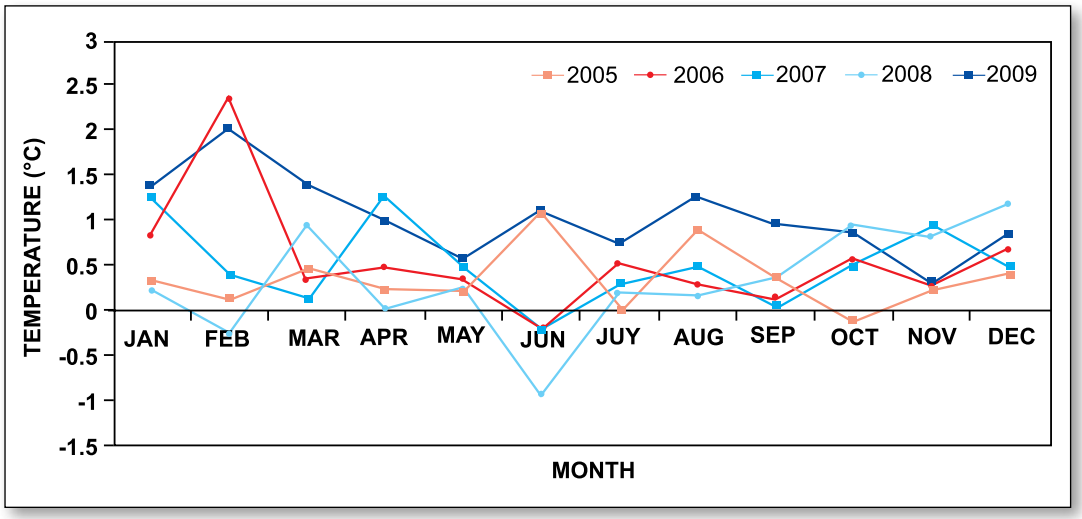

***Figure7.4**: Mean monthly temperature anomaly for the period 2005–2009 (Source: http://www.imd.gov.in/doc/warm2009.pdf).*

The entire north India was under severe heat wave conditions as early as the last week of April/ first week of May. Highest temperatures during this period were: Delhi 44°C (+5°C), Hisar 45°C (+6°C), Jaipur 44°C (+6°C), Pilani 47.1°C, Khandwa 47.5°C, Bundelkhand 48°C , Ganganagar 46.8°C[8, 9]. Other places experiencing heat wave conditions and unusually high temperature conditions were, Ahmedabad 44.4°C (+3°C), Deesa 42.9°C, Idar 42.3°C, Gandhinagar 42.8°C and Bhavnagar 43°C. Even the hill station Shimla had witnessed very high temperature conditions in April/May[10].

The eastern states of West Bengal, Orissa and Bihar were badly affected by heat wave conditions in the year 2009. The phenomenon was attributed to a cyclonic storm called "Bijli" that formed in the Bay of Bengal around April 15. As it moved towards Bangladesh it intersected and cut-off cool easterly winds blowing from the Bay of Bengal to Orissa and West Bengal. The easterly winds keep the eastern coast cool, but in their absence north-western desert winds blowing from Rajasthan prevailed, heating the coastal states. On the other hand, the development of an anti-cyclone with its centre over Rajasthan was a contributory factor for the heat wave in northern part of India as it sent warm wind from northwest to central and western India. The reason for lesser number of western disturbances which help in warding off heat wave has been attributed by some to the abnormal heating of the Tibetan plateau which was warmer than normal by 2°C during February. When a plateau heats up, winds over it move horizontally unlike upwards in the plains. This creates a high pressure over the plateau, which then shoves away winds[11]. People in India were badly affected by the heat wave especially in the northern region (Figs. 7.5 and 7.6).

***Figure7.5**: Pilgrims on their way to Ajmer Sharif shrine in New Delhi, India, take a break from the heat under their bus on Friday.*
***(Source**: Saurabh Das/AP)*

***Figure7.6**: A hand cart puller taking rest to escape from intense heat wave*
***(Source**: http://www.ndtv.com/news/specials/heat_wave.php*

Pakistan

At least, 18 people were killed in the heat wave across Pakistan and 16-year-old heat record was broken in different parts of Sindh during the summer of 2009. Due to severe hot weather, 9 people were killed and dozens of others fainted in Sindh. A severe heat wave engulfed parts of interior Sindh, including Ghotki, Sukkur, Jacobabad, Shikarpur, Khairpur, Dadu, Badin, Nawab Shah and Sangarh, which killed Rozina, Manzoor, Gul Sher, Akbari, Maula Bux, Ameena, Ali Hassan and Muhammad Randwani. According to media reports, 3 people lost their lives in Larkana. 54°C temperature was recorded in Mohenjodaro, 52°C in Larkana, Nawabshah, Jacobabad and Sibi, 48°C

in Turbat, Multan and Bahawalnagar, 47°C in Dera Ismail Khan and Bahawalpur while Bannu, Gujranwala, Lahore, Sargodha and Sialkot witnessed 46°C temperature[12].

Cold waves in south asia during the year 2009

Bangladesh

The northern and south-western parts of Bangladesh experienced severe cold wave conditions during December 2009. The cold wave associated with dense fog had adverse impact on the agriculture and fisheries and the life of normal people. There was a significant rise in the case of respiratory diseases and in many cases death. More than 100 people lost their lives in the cold wave conditions. More than 9,500 families were affected[13].

India

Entire north India and many parts of eastern India were heavily influenced by cold wave conditions especially during the month of December (Fig. 7.7 to 7.9). In the states of Jammu and Kashmir, Himachal Pradseh and Uttarakhand heavy snowfall had intensified cold wave conditions. It had disrupted road, train and air-traffic movements in these parts. Many places like Leh, Kargil, Amritsar had experienced sub zero temperatures. Among the eastern states, parts of Bihar, Jharkhand and Orissa were reported to be reeling under harsh cold wave conditions. Nearly 300 people lost their lives in the cold wave conditions[14, 15].

***Figure7.7**: People affected by cold wave conditions (Source: http://drop.ndtv.com/albums/NEWS/coldindia/cold4.jpg*

***Figure7.8**: Poor visibility conditions due to foggy weather (Source: http://media.sacbee.com/static/weblogs/photos/images/2010/jan10/weather_sm/weather16.jpg*

***Figure7.9**: A snap showing poor visibility during the fog (Source: http://nimg.sulekha.com/business/original700/india-weather-2010-1-2-5-10-2.jpg)*

Nepal

The terai region of Nepal bordering India had experienced very severe cold wave conditions towards the end of the year 2009. Places like Siraha were badly affected and had witnessed several deaths due to cold. It had affected normal life,

***Figure7.10**: People warming their hands over fire to relieve from cold (Source: blog.com.np/tag/nepal-photos/).*

***Figure7.11**: Livestock insulated against cold wave (**Source**: blog.com.np/tag/nepal-photos/).*

agricultural activities, road and air traffic and had continued for a prolonged period. The commercial activities had also been affected and had a toll on local economy. The most vulnerable population is poor, children and elderly people (Fig. 7.10). During the cold waves farmers usually insulated their livestoc by using woolen blankets and jute sheets (Fig. 7.11).

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Chapter 8

Forest Fire

An overview

Forest fire, also sometimes referred to as Wildfire, is an uncontrolled intense fire that breaks out in the forest areas due to reasons ranging from natural to man-made. They constitute the most common hazard in the forested areas and the communities located in the proximity of the forests. They pose a threat not only to the forest wealth but also to the floral and faunal regime thus seriously damaging the ecological balance and environment of a region. During the summer months when there is no rain and the base of the trees are rich in dry leaves and twigs, the slightest of the sparks can start a fire that can spread widely in no time. Many countries in the world are affected by the menace of forest fires.

The causes of forest fire can be both natural and human influenced. Among the natural causes the major ones are lightning, volcanic eruption, spontaneous combustion etc. and the human influenced fire can be due a variety of causes. Acts of arson, camp fires, discarded cigarettes, sparks from instruments, power line arcs have been known to be the cause of forest fires in recent times. The most common cause of wildfires varies throughout the world. In the United States, Canada and Northwest China, for example, lightning is the major source of ignition. In other parts of the world, human involvement is a major contributor. In Mexico, Central America, South America, Africa, Southeast Asia, Fiji and New Zealand, wildfires can be attributed to human activities such as animal husbandry, agriculture and land-conversion burning. Human carelessness is a major cause of wildfires in China and in the Mediterranean basin. In Australia, the source of wildfires can be traced to both lightning strikes and human activities such as machinery sparks and cast-away cigarette butts[1, 2, 3.]

The South Asian scenario

Among the South Asian countries Bangladesh, Bhutan, India and Nepal are specifically susceptible to the forest fires. The stretch falling in the Himalayan ranges has a long history of this disaster. The forests of western Himalayas are more prone to forest fire than the eastern part as the forests of the eastern Himalayas grow in high rain density. The pine forests of Himalayas are very susceptible to fire as the pine debris accumulating at the base of the trees take a long time to decompose and the intervening period is the one of very high risk. The deciduous forests of India in the Western Ghats have also been exposed to the forest fires[4]. Here the trees begin shedding their leaves very early and by the end of April the area is littered with dry leaves, an ideal recipe for forest fire with the slightest of the natural causes or human negligence. In 2009, forest fires were reported from Nepal, Bhutan, Bangladesh and India. Pre-monsoon dryness was found to be main causes of forest fires in South Asia. Beside this, prevailing winds assisted in dragging the nearby fires. The human casualties though were less in these fire events; they destroyed thousands of hectares of forest land.

Bangladesh

In March 2009, a devastating fire gutted about 30,000 trees of Telmachhara forest range in Habiganj. As a result the animals escaped deep into the forest due to tremendous heat. Nevertheless, the wildlife and valuable trees at the nearby Satchhari Jatiya Udyan remained unharmed. Fire fighters from Habiganj district with the help of locals controlled the spreading fire. A burning cigarette was suspected as fire triggering factor which spread to the Chhan plantation of the Telmachhara forest.

Bhutan

Forest fire in Bhutan during dry winter and pre-monsoon season is common. In 2009 forest fire was reported from many forest locations (Table 8.1). The forest fire that began on the evening of 16 January 2009 lasted 3 days destroying about hundreds of hectares of forests in Bhutan. It was suspected that a fire lit to prepare lunch by some villagers passing through that area was the cause of the fire (Figure 8.1). In March, forest fire were reported from Hongtsho, Genekha Janadingkha Ihakhang, Sajbotay, Khalingtar, Sibsu Gola and Tendu, Tshangkha gewog, Samdrup jongkhar, Limbukha and Mendrelgang. In May 2009, the forest fire, which started damaged about 300 acres of chirpine forest in the Gewog. Fanned by wind, the fire, which started from a rocky cliff between Gorujurey and Tinchuley villages, lasted almost 3 days[5].

***Table 8.1**: Details of Forest Fire in Bhutan During 2009.*

Location	Destroyed area (in acres)	Cause
Hongtsho	500	Fire lit by villagers
Genekha	400	
Janadingkha Ihakhang	40	
Sajbotay, Khalingtar, Sibsu Gola and Tendu	400	
Tshangkha gewog	300	
Samdrup jongkhar	200	
Limbukha and Mendrelgang	50	
Gewog	300	Fire blown by wind

***Figure8.1-Kanglung under a blanket of smoke resulting from forest fire (Source**: Kuensel Newspaper).*

Nepal

The dry season during March and May saw a spurt in the report of forest fire in Nepal. In early March forest fire claimed 5 human lives in the forests to the southwest of Annapurna. The event was very well picked up by the Moderate Reso-

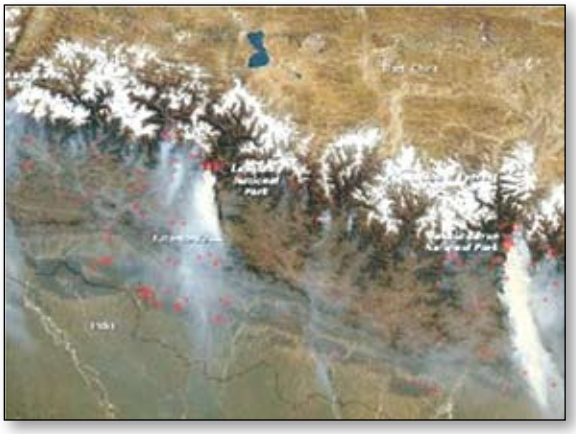

***Figure8.2** :MODIS image showing the forest fire affected area of Nepal (Source: http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=37518)*

lution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite which shows large scale forest fires in the Himalayan ranges of Nepal (Figure 8.2). The ecosystem of several national parks and conservation areas was badly affected in the fire.

In another incident at least 13 Nepalese soldiers were killed while trying to put out a forest fire in Ramechaap district in central Nepal. The soldiers who died were part of a 130-member team deployed to put out the massive blaze in a pine forest in the Srikandanda hills close to the town of Ramechaap Bazar. The cause of the fire was suspected to be a cigarette thrown by people venturing into the forest or from a market organized in the town close to the forest[6].

During the last week of April 6 persons were killed and 2 injured in a forest fire that broke out in gulmi and Bara districts in Nepal. The fire was reported to be due to an explosion in a transformer[6]. According to the Department of Forests, different places in 31 districts, including Chitwan (5,000 hectares), Rautahat (5,000 hectares), Sindhuli (4,600 hectares), Tanahun (3,000 hectares), Gulmi (1,600 hectares), Parbat (1,500 hectares), Parsa (760 hectares) and Bajura (300 hectares) have been hit by wildfire. Up to 5.5 million hectares of land is covered by forests in Nepal. The department of National Park and Wildlife Conservation said 520 hectares of land in 6 National Parks had been affected by the wildfire. Huge loss to the flora and fauna was incurred including the birds, reptiles, medicinal herbs and coniferous forests. The period being the nesting period of the birds, it had adversely affected their numbers.

India

India experienced several instances of forest fire during the year 2009 in which vast stretches of forest and agriculture land were destroyed. Table 8.2 enlists the major forest fires in India during the year 2009.

The period between February to May, peak of the dry season in India witnessed a number of forest fires throughout the country. The affected areas included Gujarat, Manipur, Karnataka, Andhra Pradesh, Punjab and Maharashtra.

***Table8.2**: Major Forest Fires in India in 2009.*

Location	Destroyed area (in acres)	Cause
Gir Forest, Gujarat	70–80	Not known.
Bhagavati-Donakanal	Not reported.	By firewood collectors.
Sesang	Not reported.	Not known.
Adilabad	Not reported	Through the activity of tendu leaf collectors.
Tadoba Reserve Forest	50	Not known.
Chamundi Hills	20	Accidental/carelessness of people.
Bhadson Beer	2 sq km	Fire from nearby wheat fields.
Waynad	424	Not known.

The Gir Reserve Forest in Gujarat, only lion sanctuary in India was engulfed in forest fire during February 2009 and spread over nearly 70–80 acres of the area. In the same month the Nagarahole National Park in Karnataka saw a major fire in which nearly 900 acres of shrubland was devastated and reduced to cinders. The affected areas also included Metikuppe, Veerahosana-

halli Muttigodu, Agarasasuli and parts of Antharasanthe in Mysore district and the adjoining Kodagu district. The dry leaves, which formed a carpet, were instrumental in the spread of the fire which engulfed the dry vegetation.

The only floating National Park in the world, Keibul Lamjao National Park with an area of over 2,160 hectares in the northeastern state of Manipur was in flames on last week of February 2009, posing a threat to animals and other endangered species. The fire soon engulfed dry plants and spread in three directions before fading in the evening. This National Park is home to the rare Brow Antlered Deer, locally called Sangai and according to the locals many of them were observed running helter-skelter to escape the flames. Fire also broke out on Punyagiri hills in the Eastern Ghats in S.Kota mandal on last week of February 2009 where the devotees had thronged to offer prayers to presiding deity Sri Uma Koti Lingeswara Swamy on the occasion of Maha Sivaratri. According to the local fire officer dried teakwood leaves caught fire and spread fast in about an acre of the plantation on the hills reportedly due to callous smoking. The month of February also saw reports of forest fire from the part of Western Ghats in Kerala.

Fifty-eight hectares under the North Wayanad forest division, 250 hectares under the South Wayanad forest division and 116 hectares under the Wayanad Wildlife Sanctuary had been destroyed in forest fire. According to the divisional forest officer, Mananthavadi forest division, presence of dry bamboo groves had worsened the situation.

During the month of March, a large number of trees were destroyed in a fire that broke in a forest in the Bhagavati–Donakanal area. Two cattle sheds belonging to the Gowli community were destroyed in the fire. These cattle sheds were situated on the border of the forest area. There was no loss of life reported in the fire accident. But fodder stored for cattle was destroyed. According to Forest Department, the loss due to the fire was heavy. Some rare trees and bamboos and saplings were completely destroyed in the fire. According to range forest officer fire could have been due to cigarette stub discarded by miscreants or those who entered the forests to collect firewood[7]. In 2009 summer forest fires have caused large scale destruction of trees and animal habitats in Adilabad district of Andhra Pradesh (Figure 8.3). Man-made fires damaged vegetation and wildlife in Adilabad forests in the second week of March. The fire was reported to be due to the careless "beedi contractors" who had set fire to tendu plants for leaves[7].

During the second week of March another major forest fire was reported from the famous Tadoba Tiger Reserves in Chandrapur district, some 180 kms from Nagpur in Maharashtra. At least 50 sq km area of the forest of shrub land has been devastated and was reduced to ashes. The fire was first noticed in the buffer zone of the reserve forest and soon it had engulfed the protected forest areas. The areas that badly affected were: Pandhar-Pauni, Khaparda, Bamni and Parasgaon jungle of Tadoba-Andhari Tiger Reserves[8].

In a major fire in the Chamundi hills of Karnataka around 20 acres of forest land was ravaged that included large tracts of shrub jungles and ground vegetation (Figure 8.4). It was suspected that a few devotees who had come to participate in a jatre which commenced at Uttanahalli may have started the fire by accident. Personnel from the forest department and other volunteers rushed to the spot and sought the assistance of the fire department and together they were able

to control the fire but by then huge devastation had already been inflicted8[7].

In the month of April when the dry season is at the peak, a major wildfire broke out in the Bhadson "Beer" (Mini jungle area) of Punjab. The fire broke out in the jungle and suddenly, it spread to other areas also. The fire spread to nearly 2 sq km of the forest and destroyed a large patch of forest land. At least 6fire brigade vehicles were engaged to douse the fire. Fire tenders from Patiala, Nabha, Mohali, Ludhiana and Khanna were called to control the flames. The district officials mentioned that though the exact cause of the fire was yet to be known, but it seemed that the fire from nearby wheat fields reached the forest area due to the strong winds[8].

***Figure8.3** : A burnt tree in Indhanpalli range of Jannaram Forest Division is the tell-tale mark of wanton destruction of forests in Adilabad (Source: The Hindu).*

***Figure8.4** :Volunteers trying to put out the fire that broke out at Chamundi Hills (Source: The Hindu).*

Pakistan

Forest fires raged across western side of the Murree Hills in Pakistan, destroying trees and vegetation on 60 per cent of the area, nearly 500 acres. The blaze damaged precious trees of pine, deodar and cedar, besides destroying thousands of saplings in the forests of Angoori, Samly, Plassy, Khajut, Saine, Mora Seyadan. Flora and fauna were also hit by the fires around the famous hill resort of the Punjab. As the fire broke out simultaneously in many forests and it was almost impossible for the limited staff of the forest department to control the fire. Forest fire in the Kalachitta mountain of Pakistan had damaged the forest covering as many as 1,500 acres of land in the month of July. The fire destroyed plants near the villages, including Akhori, Humak, Boota, Mahoora and Akhori.

Sri Lanka

The country of Sri Lanka was also a witness to a few episodes of forest fire during the year 2009. In July, nearly 30 acres of land in Kalugala, Ududumbara in the Knuckles Range, one of Sri Lanka's forest reserves in the central hill country was destroyed by raging bush fires. Several teams had been deployed to control the fire, without any success due to the prevailing dry weather conditions in the area. Another major fire broke out at a forest reserve in Ettalapitiya, Bandarawela destroying nearly 400 acres. Controlling the fire had become difficult as the hilly area was inaccessible to the fire trucks[9].

Preparedness and Mitigation Measures

To minimize the devastating effects of forest fires it is imperative to adopt reducing the risk of fires and lessening its severity and spread. As human

activity plays a role in forest fires, the prevention policies must consider limiting their involvement. In India there has been attempts of controlling forest fire since British times who had the practice of controlling fire in the summer months through removal of forest litter all along the forest boundary which was called the "Forest Fire Line". This line used to prevent fire breaking into the forest from one compartment to another. Following steps can be undertaken to prevent or reduce the risk of fire in forested areas:

1. To keep the source of fire or source of ignition separated from combustible and inflammable material.
2. To keep the source of fire under watch and control.
3. Not allow combustible or inflammable material to pile up unnecessarily and to stock the same as per procedure recommended for safe storage of such combustible or inflammable material.
4. To adopt safe practices in areas near forests viz. factories, coalmines, oil stores, chemical plants and even in household kitchens.
5. For fire reduction,fire fighting techniques and equipment to be incorporated while planning a building or coal-mining operation.
6. Formation of fire fighting teams and volunteer crops with instructions to be readiness during target periods.
7. Use of flame resistant materials in forest fire prone areas.
8. Removal of dry litter through controlled burns under strict observation.
9. Creation and maintenance of a defensible space through clearing of flammable material within a prescribed distance.

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Chapter 9

Earthquake

An Overview

The South Asian region is located in one of the most tectonically active belts of the world that has history of catastrophic earthquakes in terms of human causalities and property loss (Fig. 9.1). Particularly, the Himalayan-Hindu Kush belt of the region is widely considered as the most earthquake prone area due to ongoing tectonic activities. The region has already been rocked by destructive past earthquakes, e.g., Bihar–Nepal, 1934; Quetta, 1935; Assam, 1950; Kangra, 1905; Bhuj, 2001; Sumatra, 2004; Kashmir, 2005. Recently, occurrence of the 2009 Assam–Bhutan earthquake created panic among the people of India and Bhutan border because of strong shaking in the region. Several lines of evidence have pointed out the area between west of Kathmandu and east of Dehradun, termed as "Central Seismic Gap", has not witnessed major earthquakes since 1505 and is believed that the devastating earthquake is overdue in this part of the Himalaya. Because of high population density, unplanned urbanization and rapid increase in non-engineered construction practices in SAARC member countries, the risk of earthquake in the region has been increasing continuously, which may further accelerate if our efforts lack risk mitigating steps.

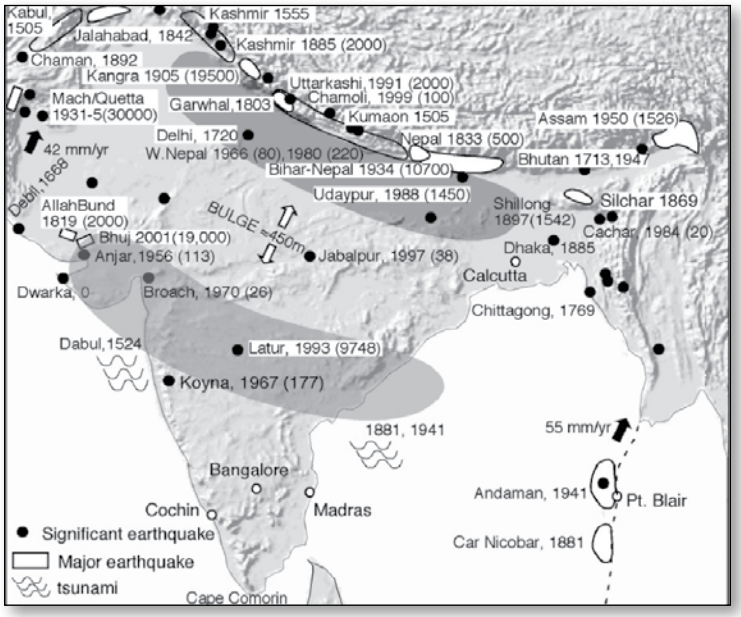


***Figure 9.1**: Historical earthquakes in South Asia. Locations and dates of important earthquakes are shown with number of fatalities in parenthesis where known*[1].

Seismotectonics of the South Asia

The South Asian region is characterized by the collision tectonics between the Indian and Eurasian plates that has initiated since 50 Ma. This collision resulted in the world's youngest mountain chain, the Himalaya that encompasses the six SAARC nations out of eight, among which are: Afganistan, Bangladesh, Bhutan, India, Nepal and Pakistan. As said above, these countries witnessed major devastating earthquakes and many are expected to be overdue in the seismic gaps of the region. However, Sri Lanka and Maldives are vulnerable to earthquake induced disaster like tsunamis as witnessed in 2004, which killed over 225,000 in southeast and South Asia.

Geo-tectonically, the entire Himalaya is ruptured in east-west direction by the series of thrust faults, namely, from south to north, Main Frontal Thrust (MFT), Main Boundary Thrust (MBT) and Main Central Thrust (MCT) separating the region in several rock packages having unique characteristics (Fig. 9.2). These all fault are merged with the basal decollèment beneath the Himalaya called Main Himalayan Thrust (MHT), a plate boundary fault between Indian and Eurasian plates. MFT is the southern expression of MHT. Most of the crustal level earthquakes that occurred in the Himalayan region are due to release of elastic strain accumulated along the ramp of MHT just beneath the higher Himalaya. Similarly, the Indo–Burma region is another seismically active zone in South Asia. This zone is characterized by the collision tectonics between Indian plate and Burmese micro-plate and generates several earthquakes in the Andaman and Nicobar region.

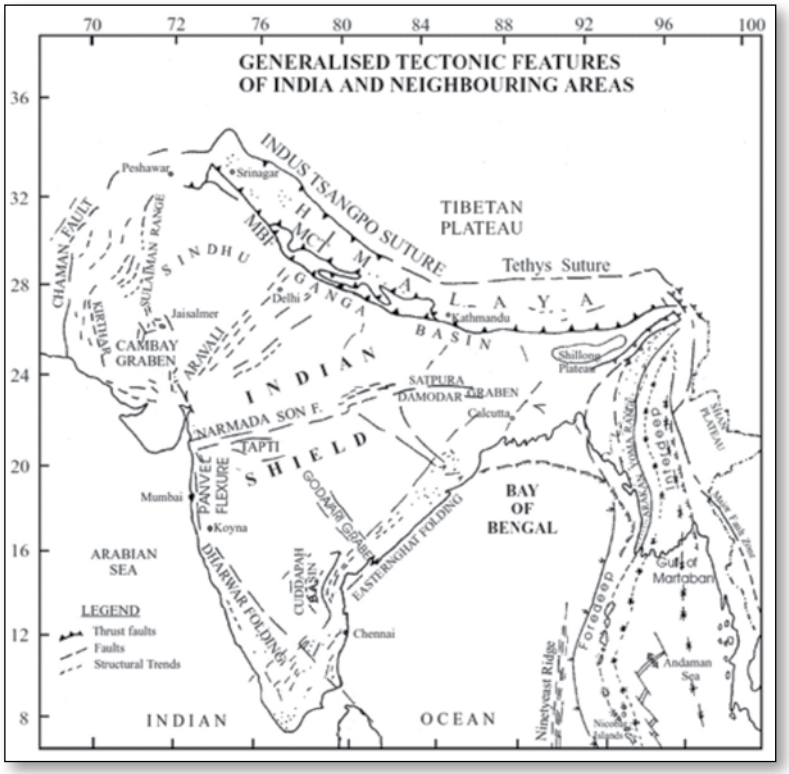


***Figure 9.2**: Generalized tectonic map of Indian sub-continent[2].*

The spatial distribution of earthquakes in South Asia region generally follows plate boundary between Indian, Eurasian plates and Burmese micro-plate. For simplicity, distribution can be described as four distinct zones although sub-zone can also be identified therein, first, the Andaman–Nicobar zone, which covers southern part of the Indo–Burmese collision zone, second Arakan Yoma range, third the entire Himalayan range that extends from NEFA to Afghanistan and the fourth one is Sulaiman range including Chaman Fault. These all zones have been struck by the earthquakes with magnitude greater than 8.0 in Richter scale in the past. However, in terms of loss of life and damages, Himalayan earthquakes (e.g., Kashmir, 2005; Bihar–Nepal, 1934; Kangra, 1905; Assam, 1950) were the most devastating. Comparatively, southern belt of the South Asia, (e.g., Sri Lanka and Maldives) has not witnessed major earthquakes till date, however, recently few seismic events have been recorded in Sri Lanka (Fig. 9.3).

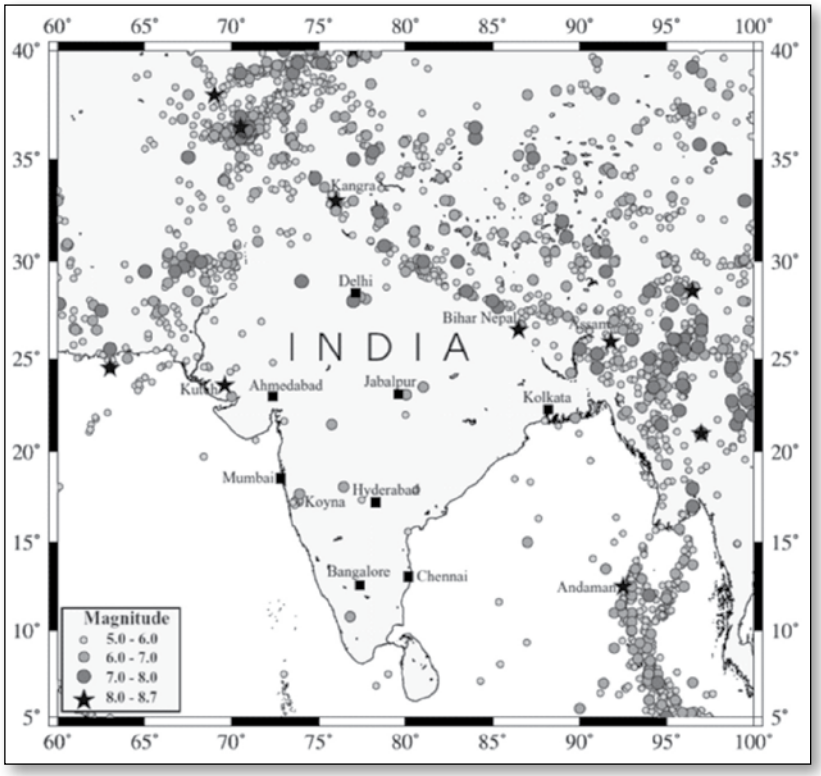


***Figure 9.3**: Seismicity map of the Indian subcontinent showing the spatial distribution of earthquakes[3].*

South Asian Seismicity in 2009

According to United States Geological Survey (USGS), in 2009 there were 142 events of magnitude 6–6.9, 16 events of magnitude 7–7.9 and 1 event of magnitude greater than 8.0 worldwide. Overall 17 earthquakes reached a magnitude of 7.0 or higher and one broke a magnitude of 8.0. These statistics are higher than those of 2008, which experienced only 12 earthquakes over magnitude 7.0 and none over 8.0.

At least 1783 deaths worldwide resulted from earthquake activity in 2009. USGS reported southern Sumatra earthquake as the deadliest earthquake of the year that killed approximate-

ly 1,117 people in Indonesia on September 30. These fatalities were further confirmed by the United Nations Office for Coordination of Humanitarian Affairs (OCHA). This number of earthquake-related fatalities in 2009 was far less than the 2008 count of over 88,000 caused by magnitude 7.9 earthquake that occurred in Sichuan, China on May 12. The Samoa Island earthquake of 8.1 was the strongest earthquake in 2009 that occurred on 29th September. The earthquake-induced tsunami killed 192 people in the region. Similarly, the medieval city of L'Aquila in central Italy was also hit by the earthquake of magnitude 6.3 killing 295 people on April 6.

Overall, earthquakes caused fatalities or damage in 15 countries during 2009, including Afghanistan, Bhutan, China, Costa Rica, Greece, Indonesia, Italy, Kazakhstan, Honduras, Japan, Malawi, Samoa, South Africa and Tonga, as well as the U.S. territory of American Samoa.

In South Asia, a total 100 earthquake events are recorded which are of magnitude 3.0 and above. Among them Indian and its adjacent region witnessed 56 events, followed by Nepal 18, Afghanistan 10, Pakistan 5, Bhutan 3, Bangladesh 1 and Sri Lanka 1. It is fortunate that the SAARC member countries have not suffered any major earthquake disaster. The earthquake data recorded by USGS, IMD and National Seismological Centre, Nepal is presented in Appendix-VA, B and C. Since this study has been carried out on the basis of data available in different earthquake monitoring and research centres and media reports, there may be chances of unreported earthquake events.

A total number of 34 fatalities have taken place due to earthquakes during the year (Fig. 9.4). In Afghanistan, 22 people were killed due to an earthquake of magnitude of 5.5 and 5.1 on Richter scale that occurred in the Nangarhar Province on 17 April 2009. Another earthquake of 6.3 magnitude jolted eastern Bhutan on 21 September 2009 causing 12 human fatalities and damaging property worth US $55 million. Although Bhutan lies in highly seismic Himalayan belt, this is the first well documented devastating earthquake in the recent times. This earthquake has badly shaken the country and the government is proactively thinking of seismic risk evaluation and mitigation in the country. These two earthquake events are discussed in detail in the forthcoming section.

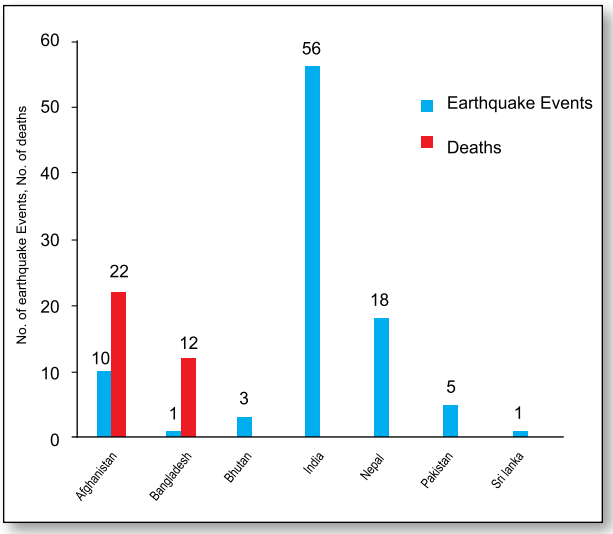


Figure 9.4: *Earthquake events and deaths during 2009 in South Asia (Source: USGS, EM-DAT, Media reports).*

Afghanistan

The seismotectonics of Afghanistan is mainly governed by three major faults namely Hari Rud (RD), Chaman (CH) and Central Badakhshan (CB) (Fig. 9.5). These three faults meet to the north of Kabul in Hindu-Kush region. The east-striking HR fault marks the boundary between the north Afghan platform to the north and the accreted arcs and fragments to the south. Similarly, CH and CB faults separate the eastern block and acts a

transpressional plate boundry. In the Hindu-Kush region, the Indian plate is subducting with the Eurasian plate at a rate of about 3.9 cm/yr. This subduction of the Indian plate drives the active faults and generates earthquakes in Afghanistan and other regions to the north, east and south, resulting in a significant seismic hazard. The cluster of seismic events is mainly in the north eastern part of the Afghanistan and most of the major earthquakes are aligned along the CB fault and associated active faults (Fig. 9.6). Except micro-seismic event, in 2009, single event of 17th April killed 22 people in east of Kabul injuring 3,309.

Two moderate earthquakes have hit eastern Afghanistan (Fig. 9.7) on 17th April 2009, killing at least 22 people and destroying about 200 houses4. As per the US Geological Survey a 5.5 magnitude earthquake followed by a 5.1 magnitude aftershock two hours later struck the Nangarhar province, about 80 km east of Kabul near the Pakistan border. Detail of the earthquake is given in Table 9.1.

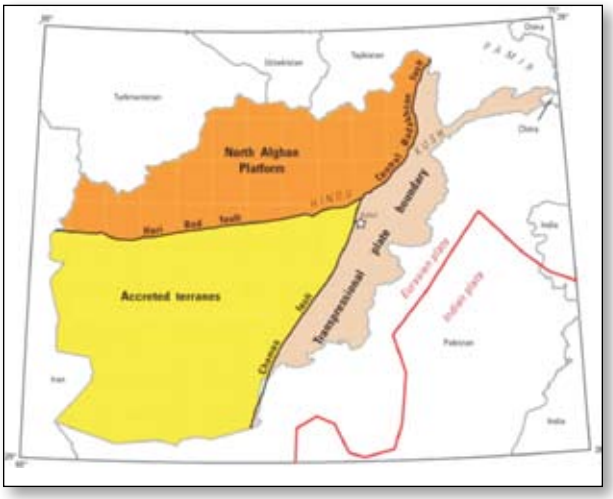


***Figure 9.5**: Seismo-tectonic map of Afghanistan (Source: USGS)*

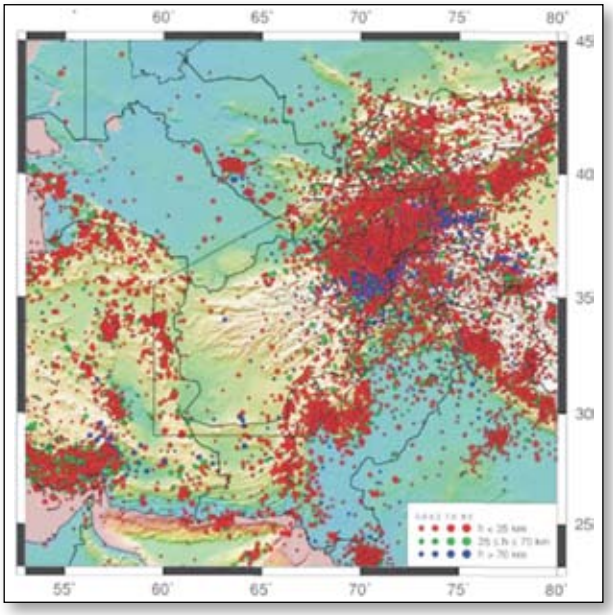


***Figure 9.6**: Seismicity map of Afghanistan (Source USGS)*

M5.5 Nangarhar Earthquake, 17th April 2009

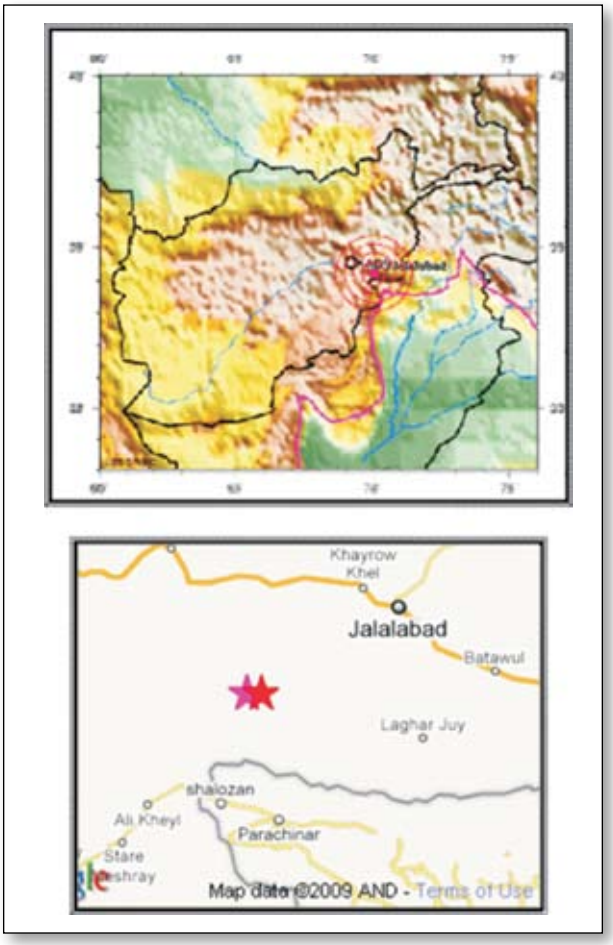


***Figure 9.7**: Location of the Earthquake*

***Table 9.1**: Detail of Nangarhar Earthquake, 17th April 2009*

Magnitude:	5.1
Date-Time:	April 17, 2009 at 04:12:52 AM at epicentre
Location:	34.203°N, 70.021°E
Depth:	3.2 km (2.0 miles) (poorly constrained)
Region:	Hindu-Kush Region, Afghanistan
Distances:	45 km WSW of Jalalabad, Afghanistan

***(Source**: USGS)*

Damage and fatalities

ANDMA's figures show 22 people were killed, 59 wounded and some 500 families have been affected by the quake. No disruption in essential services—such as electricity, tap water, healthcare and telecommunications—in either of the remote districts has been reported though hundreds of homes were totally destroyed and many more made uninhabitable, according to ANDMA (Fig. 9.8). The livelihood of tens of thousands of people has been harmed because livestock have been lost and agricultural land has been damaged.

***Figure 9.8**: Damaged house by the 17th April earthquake (Source: IRIN News)*

Relief and rescue

Four villages have suffered serious damages. As per the provincial office in Jalalabad at least 30 people were injured. Rescuers had been sent to the scene to retrieve bodies and help those hurt. Following the earthquake the survivors in the affected remote corners of eastern Afghanistan spent cold nights in the rain outside the remains of their homes because government help did not reach them[5]. The quakes shook an area several dozen km west of the city of Jalalabad.

Provincial authorities said cash assistance was provided to most affected families though several local people feel little or no meaningful assistance had reached them. In the village local authorities distributed around 5 million Afghanis (USD100,000) to the families of the victims. The government declared it would compensate families 30,000 Afghanis (about USD600) for every death and about USD200 for every house damaged in the quake, as per the information of ANDMA.

Aid agencies have launched needs assessments in order to ensure a coordinated humanitarian response and the UN World Food Programme (WFP) conducted an oversight flight of the area to examine the extent of the damage. Initial reports indicated that there is sufficient civilian humanitarian assistance and response capability in country as indicated by UN OCHA. Food and non-food items have also been distributed by Afghan and international military forces in Nangarhar.

Seismic hazard in Afghanistan

Earthquakes in Afghanistan are most abundant in and near the northeastern part of the country where the effects of the plate collision between India and Eurasia are most pronounced. In this region, tectonic forces have created the mountains of the Hindu-Kush and Pamirs along with frequent moderate to large earthquakes. Historical accounts show that the damaging earthquakes have also occurred elsewhere, even in the seismically less active parts of the country (Fig. 9.6).

Parts of eastern, northeastern and southeastern Afghanistan are prone to seismic activity and this natural vulnerability has been exacerbated by the prevalent illegal and substandard construction of houses, weak essential infrastructure and widespread lack of awareness on the risks of earthquakes and other natural disasters. According to USGS map northern part of the Afghanistan, i.e., Mazar-e-sharif, and Kandahar including capital city Kabul are located in the high seismic hazard zone (Fig. 9.9) and part of western Afghanistan (e.g., Herat and Rudbar) shows low hazard. However, southwestern and northwestern part of the country lies in low hazard zone. The most recent major earthquake the country suffered was on 4th February 1998 when a 6.1 magnitude quake killed some 3,650 people, destroyed thousands of houses and displaced tens of thousands of people in the north eastern province of Takhar.

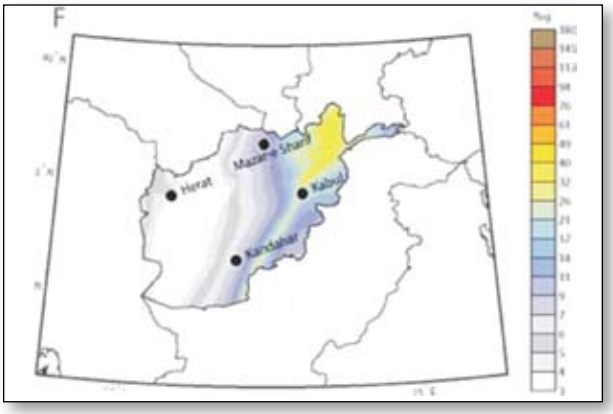
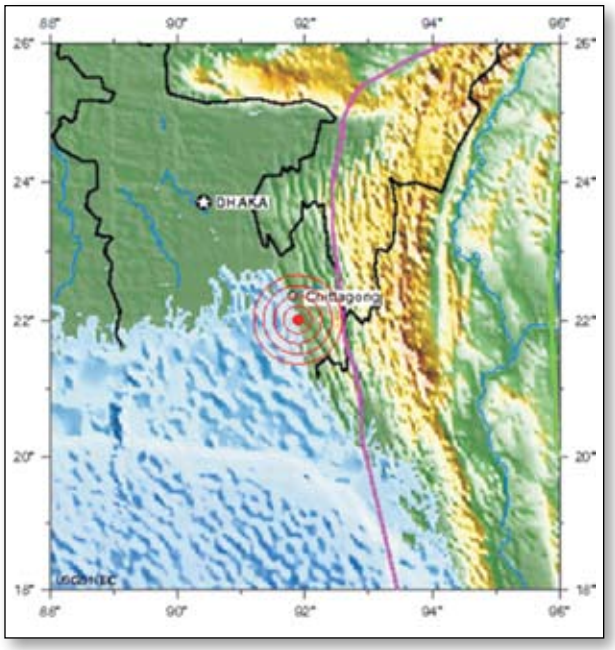


***Figure 9.9**: Seismic hazard map of Afghanistan (Source: USGS)*

Bangladesh

M3.7 Bandarban district earthquake, 11th December 2009

A mild tremor, measuring 3.7 on the Richter scale, jolted different areas of Bandarban District on 11th December 2009 at about 23 hours 22 minutes 31.26 seconds (BST). It was about 365 kms southeast of Dhaka Seismic Observatory (Fig. 9.10). Being panicked, local people of Bandarban came out of their houses during the tremor that lasted for a few seconds. There was, fortunately, no report of casualty or damage to property.



***igure 9.10**: Location of epicentre of 11th December earthquake (Source: USGS)*

Another mild earthquake, measuring 5.1 on the Richter scale, jolted the port city Chittagong and Bandarban on 13th December 2009 9:41pm. The epicenter of the tremor was 245 km away from Agargaon Seismic Centre in Dhaka to the southeast. There was no report of damage or casualties due to this quake. It, however, created panic among the people of the two districts.

Bhutan

M6.1 Bhutan earthquake, 21st September 2009

An earthquake of magnitude 6.1 occurred in Mongar dzongkhag of eastern Bhutan on 21st September 2009 at 02:53:05 PM at epicentre (Fig. 9.11). It had a magnitude of 6.1 and was strongly

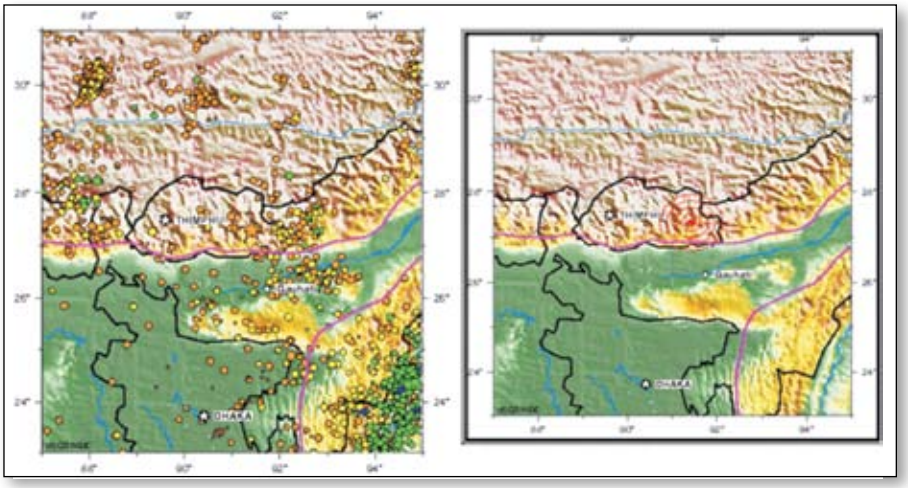


***Figure 9.11**: Seismicity map of Bhutan and adjacent area showing the location of 21st September earthquake (Source: USGS NEIC)*

felt in eastern Bhutan. Tremor also felt in Thimphu, Mongar and Tashigang of Bhutan. In India, tremor was felt in Guwahati, Calcutta, Bidhannagar, Dispur, Kalimpong, Mussoorie, Nagaon, Nalbari, North Dum Dum, Patna, Shillong, Silchar and Tezpur. The quake was felt as far away as Bangladesh and Tibet. Seven more tremors were felt in Trashigang after the main shock, with the first few tremors occurring every half an hour. The shaking intensity of the earthquake was in between IV to VI (Fig. 9.12). Detail of the earthquake is shown below Table 9.2.

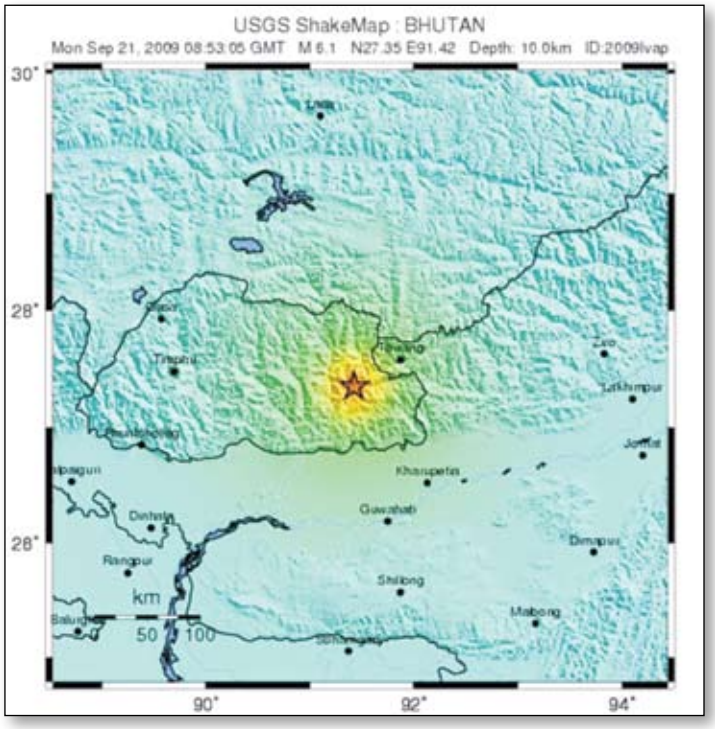


***Figure 9.12**: Shake map showing instrumental intensity of 21st September earthquake (Source: USGS)*

***Table 9.2**: Detail of Bhutan earthquake, 21st September 2009*

Date-Time	Monday, September 21, 2009 at 02:53:05 PM at epicenter
Location	27.351°N, 91.425°E
Depth	10 km (6.2 miles) set by location program
Region	Bhutan
Distances	135 km (85 miles) NNW of Gauhati, Assam, India 180 km (110 miles) E of Thimpu, Bhutan 610 km (380 miles) NNE of Kolkata (Calcutta), West Bengal, India 1,410 km (870 miles) E of New Delhi, Delhi, India

***(Source**: USGS)*

Damage and fatalities

Thousands of people in the eastern dzongkhags (districts) spent the night out in the open after the powerful earthquake, damaged homes, government offices, historical monuments, blocked roads and killed at least 12 people6. The first tremor of the earthquake measuring 6.1 on the Richter scale, with its epicentre in Mongar dzongkhag (district), was felt around 2:53 pm and made the surrounding hills look like they were throwing up dust, according to a person driving along the Trashigang–Riju road. The road was suddenly filled with boulders and mud. Five people were killed in Mongar. A 31-year-old woman and her 2-year-old son were killed after their traditional wood and mud house collapsed in Narang gewog, the worst hit area in Mongar. Two women, aged 49 and 80, were also killed in Narang. A 42-year-old woman, a road worker, was found buried under debris in Kurichhu, Mongar. Six students and one farmer were injured. In Trashigang's Yangneer gewog, two men in their 60s were killed after their house collapsed. A 7-year-old boy was also found dead in his home in Jomtshang village, Udzorong. Five people, including two children, were injured. In an area seven kilometres away from Samdrupjongkhar town, four Dantak labourers, three women and one man, clearing the road after the first tremor, were killed by falling boulders.

Most houses in the Lhakhang area have collapsed. Many monuments, monasteries, chortens, houses and schools in eastern Bhutan have been damaged. There were heavy cracks on Trashigang dzong and Lhuentse Singye dzong. Dzongkhag officials in Pemagatsel also reported that there was a major damage to Yongla Goenpa. Most of the collapsed houses are stone masonry building built with mud mortar (Figs. 9.13 and 9.14). The sertho of Trongsa dzong had also tilted, while parts of the Tshemey lhakhang in Yangneer, Trashigang, collapsed, injuring four people, including two monks. Roadblocks in many parts of Mongar and Trashigang were also reported. Almost 50 houses and seven chortens have been damaged in Yangneer gewog. In Narang gewog alone, more than 30 houses have been damaged. In other gewogs of Trashigang and Mongar, more than 100 houses, 19 chortens and 7 lhakhangs have been destroyed. Buildings of four schools in Mongar were damaged by the eathquake. The students were practising dance in one of the school buildings when the ceiling fell. All the students rushed out of the room and no one was hurt. In Trashiyangtse, about 45 to 50 houses have been partially damaged, while three schools were similarly affected in Lhuentse. At least 15 people were injured in the eastern dzongkhags. No damages were reported in the central, western and southern region of Bhutan. Thimphu residents came to know about the earthquake through relatives calling them from the eastern dzongkhags.

***Figure 9.13**: Damage to buildings the 21st September earthquake (Source: SQCA Bhutan).*

***Figure 9.14**: Damage to buildings during 21st September earthquake (Source: SQCA Bhutan).*

***Figure 9.15**: Undamaged Ekra structure (Source: SQCA Bhutan)*

More than 1,100 homes have been damaged in the six eastern dzongkhags by the earthquake, compelling thousands of people to spend many nights out in the open[6]. Out of 234 traditional wood and mud houses in the gewog, 56 have collapsed and the rest have been partially damaged. However, no damage was found on most of the Ekra structures (Fig. 9.15). People were scared and they were afraid to step inside their homes. About eight tremors were felt in villages of Mongar and Trashigang after the first tremor hit the region at 2.53 pm. Since the quake's epicentre was in Mongar, the worst hit areas were Narang, Drametse and Thangrong gewogs. Yangneer gewog in Trashigang, which shares a boundary with the three gewogs in Mongar, was also among the worst hit areas. In Trashigang alone, about 405 homes were damaged. It wasn't only the magnitude on the Richter scale but also the intensity of the earthquake. This is one of the biggest disasters seen in recent times in Bhutan.

According to the latest reports from the Disaster Management Department, at least 3,747 houses have been affected by the quake. Of which, about 1,183 have been reported as non-repairable. The damage was such that the houses have to be demolished and rebuilt. The earthquake was also felt in Gasa, where 23 houses have been partially damaged and could be repaired. The summary of fatalities and damages is shown in Table 9.3.

***Table 9.3**: Summary of Fatalities and Damages*

Households affected	3,747
Dead	12
Injured	35
Chortens	326
Lhakhangs	219
Dzongs	5
Schools/Institutes	89
Health centres	29
Offices	90
Others (Road blocks, etc)	2

Rescue and relief

Education minister visited the affected areas and gave Nu 10,000 as semso to all bereaved families on behalf of the Royal Bhutan Government. Local leaders and dzongkhag officials were also under a lot of pressure, visiting remote areas to update the figures of the damages done. Despite roadblocks in the region were relief items like tents, tarpaulins and food have reached the villages. As immediate relief, army personnel have built temporary shelters, made of tarpaulin and bamboo mats, in most of the affected areas. Emergency goods and supplies, such as rice, salt, cooking oil, clothes, tea leaves, biscuits, flour, noodle snacks, sugar and blankets were provided to the victims of the quake. Following a Royal command, the Royal Bhutan Army and Office of the Gyalpoi Zimpoen were also in the field, carrying out relief work and delivering essential commodities to the people affected by the quake.

Government formed a team of Bhutanese engineers to assess the damage and to delineate the fault line that caused the earthquake. Prime Minister, who returned with the technical team and other officials from the six eastern dzongkhags, said that the technical report would have several recommendations on the mapping of seismic hazardous zones within Bhutan. Narang gewog in Mongar may be located on a major seismic fault line. Officials from the Department of Geology and Mines, Standard and Quality Control Division and Ministry of Works and Human Settlement also provided recommendations on setting safety standards to build houses.

Similarly, Prime Minister briefed representatives of international agencies in Bhutan on the aftermath of the 21st September earthquake, which killed 12 people, injured 35 and damaged at least 3,747 homes and 89 schools. It is an enormous figure for Bhutan and this disaster has struck the rural parts of the country6. A six-member team from the UN and the World Bank assessed the damage of the earthquake in the six eastern dzongkhags.

The office of the Gyalpoi Zimpon has received about Nu 3 million in cash from Bhutanese people and agencies, as well as a few foreigners, for the 21st September 21 earthquake-affected victims, which according to the Royal Office for Media, went to His Majesty's People's Welfare Fund (kidu fund)6. The Bhutan Chamber of Commerce and Industry (BCCI) met representatives of associations like handicrafts and hotels to mobilise contributions. An association formed by the graduates, youth voluntary, have also presented about Nu 500,000 and other essentials like clothes, blankets, mattresses to the Gyalpoi Zimpon office, collected from ministries, agencies, shopkeepers and residents of Thimphu, Paro and Phuentsholing (Fig. 9.16). Thimphu residents have also organised dance parties to raise funds.

Figure 9.16: *Graduates with their contributions collected for earthquake victims*

The German Government, through the federal foreign office's humanitarian emergency aid programme, provided 50,000 Euros to UNICEF for earthquake relief operations in Bhutan[6]. The fund was for procurement and distribution of relief

material for people affected by the earthquake that hit eastern Bhutan.

Damage Assessment and Recovery

The 21st September earthquake has cost the government Nu 2.5 billion and could delay programmes in the 10th Plan, which is already short by Nu 4.8 billion for the second year (2009–2010) of the plan period[6]. The government estimated budget of Nu 2,192 million for early recovery, reconstruction and disaster risk reduction, according to the final cost assessment report. The amount was almost 70% of the annual net revenue of Tala, the country's biggest hydropower project.

UNDP and UNICEF have committed USD 400,000 and USD 140,000 respectively as immediate assistance. The Government of Kuwait has also committed USD 2 million and the Government of Turkey has pledged USD 100,000 as immediate assistance. The cost of early recovery activities alone has been estimated at Nu 87 million and Nu 50 million for disaster risk reduction. The damage/loss assessment due to earthquake is shown in Table 9.4.

***Table 9.4**: Final damage/loss Assessment*

Total losses:	Nu 2,501 million
Cost of recovery:	Nu 2,192 million
Rebuilding cost :	Nu 2,005 million
Early recovery cost :	Nu 87 million
Disaster risk reduction :	Nu 50 million
Implementation :	Nu 50 million

More than Nu 38 million has already been disbursed to ten gewogs in Trashigang as insurance claims, according to the Royal Insurance Corporation of Bhutan (RICBL)6. The damaged houses were divided into four categories, the highest receiving Nu 100,000 and the lowest Nu 1,000. More than Nu 12.9 million was paid to villagers in Udzorang gewog alone. The Joint Rapid Assessment team estimated the cost of early recovery, reconstruction, and disaster risk reduction at Nu 2,192 million (approximately USD 45.6 million). The recovery and reconstruction strategy of the government was approved by the cabinet in December 2009. A resource mobilisation group and a technical working group have been set up to deal with resource and technical aspects of reconstruction. The resource mobilisation group, headed by the finance secretary, would be responsible for taking stock of resources mobilised and modalities of utilising resources. The technical group, headed by the SQCA Director, would be providing earthquake resilient building techniques, codes, standards and guidelines. The main coordinating body for the reconstruction phase would be the steering committee headed by the Home Minister.

Mb5.5 Earthquake of 31st December 2009

On 31st December 2009, another earthquake of magnitude 5.5 on Richter scale has rocked Bhutan. A detail of the earthquake is given in Table 9.5.

***Table 9.5**: Detail of 31st December Earthquake*

Magnitude	5.5 Mb
Date-Time	31 Dec 2009 15:57:30 near epicenter
Location	27.332N /91.411E
Depth:	10 km
Distances	165 km (103 miles) E (97 degrees) of Thimphu, Bhutan

***(Source**: USGS)*

A total of 640 houses in Trashigang dzongkhag have suffered damages. Khaling gewog has the highest number, with 190 houses, mostly with minor cracks. The Khaling goenpa, three

lhakhangs, three chortens and two outreach clinics have also suffered cracks. In Bidung gewog, all the 135 houses affected are those that have been affected for the first time. The Yingom outreach clinic has also been affected. In Kanglung gewog 151 houses have been affected of which 107 are new cases. Three houses that have been affected again had received compensation for damages from earlier tremors. Five of the 75 houses suffered major damage. Three lhakhangs in the gewog also suffered major damage. The Zhabdrung statue in Khargoen lhakhang and the Nyinda of a chorten has fallen off. While no damages were reported in Merak and Sakteng, its neighbouring gewog, Phongmey, has reported damage to six houses. Samkhar gewog has reported 272 houses affected again by the 31st December quake and 35 houses being affected for the first time. The Rangshikhar school and the Rangshikhar goenpa have also suffered cracks. Of the five houses affected in Shongphu gewog, one has collapsed and the rest suffered minor cracks. Three of the 31 houses affected in Thrimshing have suffered major damage and the Ramchongma lhakhang has also been cracked in several places. In Udzorong, one house has collapsed and two people were injured by falling boulders. The Chiya School has also suffered damages. Five houses have been affected in Yangneer that suffered serious damage in the previous tremors. There have been no reports of damage in Trashigang town, apart from the Trashigang Dzong, which suffered cracks in the two earlier quakes.

Seismic hazard scenario in Bhutan

A total of 30 earthquakes have been recorded in Bhutan between years 1937 to 1998. Records with the Department of Geology and Mines indicate that a 1941 earthquake, on January 21, was the most powerful, measuring 6.7 on the Richter scale. Seismic hazard map shows that part of eastern and south western Bhutan lie in very high hazard zones, whereas central and north western show low hazard (Fig. 9.17). Historically, earthquakes in the M5.0–6.0 range have been experienced and at least one ~M7.0 event is thought to have occurred in the 1700's in eastern Bhutan and adjoining parts of India.

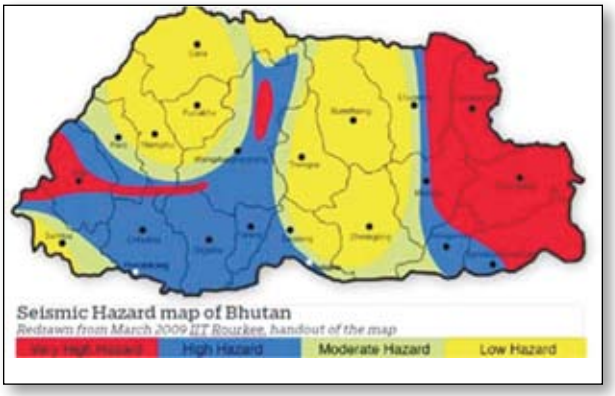


***Figure 9.17**: Seismic hazard map of Bhutan.*

India

In 2009, twelve low magnitude earthquakes occurred in India during 2009. However, none of the earthquakes were too damaging in nature. Some of the widely felt earthquake events are discussed below.

M6.4 Earthquake in Kashmir valley, 4th January 2009

An earthquake measuring 6.4 on the Richter scale rocked the Kashmir valley early on 4th January 2009, jolting residents out of their sleep in panic[7]. The quake struck the valley at 1.53 AM. The epicentre of the earthquake was located in the Hindukush region with latitude 36.5 degrees north and longitude 70.8 degrees east. There were no reports of damage to life and property. Doors and windows produced a creaking sound

in Srinagar. It is to be mentioned here that a devastating earthquake measuring 7.8 on the Richter scale had struck Kashmir in October 2005 in which thousands of people were killed and an even large number left homeless.

M5.4 Earthquake in Andaman Islands, 29th January 2009

A moderate earthquake struck northern parts of Andaman islands on 29th January 2009 morning[8]. The tremor measuring 5.4 on the Richter scale was felt at 02:00 hrs (IST) at latitude 13.7 degree north and longitude 92.9 degree east. There were no reports of any damage or casualties and no tsunami warning was issued.

M4.4 Earthquake in Dhubri District[7] of Assam, 16th Feb 2009

A low intensity earthquake of magnitude 4.4 on the Richter scale had hit Assam's Dhubri district[9] on 16th February 2009. The epicentre of the earthquake, which occurred at 1:06 hrs (IST), was located on the Assam–Meghalaya border (at 26.0 degree north latitude and 90.2 degree east longitude). There were no reports of casualties or damage.

M5.4 Earthquake in Kashmir, 20th Feb 2009

A moderate earthquake of 5.4 in magnitude jolted Kashmir on 20th February 2009[8]. The quake shook buildings in Srinagar, sending residents rushing from their homes in panic. There were no reports of damage or injuries. The epicentre of the quake was 91 km west of Srinagar and 93 km northeast of the Pakistani capital Islamabad, a mountain area.

Parts of southern Jharkhand, including Chaibasa and Jamshedpur[7], were rocked by a mild earthquake on the morning of 25th March 2009. The tremor was felt at 10:14 AM in the southern part of Jharkhand, Central Seismological Observatory (CSO), Shillong reported. Five students and a teacher of a college were injured in Chaibasa, the district headquarter of West Singhbhum, when a stampede-like situation occurred in the institute due to the tremor. The situation occurred as everybody tried to get out of the college building. Four of the five injured students have been admitted to the hospital. According to CSO, the epicentre of the tremor was at 22.6 degree north latitude and 87.5 degree east longitude.

M5.3 Earthquake in Rajasthan, 9th April 2009

Western part of Rajasthan was rocked by a moderate intensity earthquake in the morning of 9th April 2009. The earthquake was recorded at 5.3 on Richter scale and its epicentre was around 50 km away from Jaisalmer city towards Pakistan. The earthquake was experienced in Jaisalmer, Barmer and other nearby areas at 07:17 hrs for 15–20 seconds causing cracks in walls of buildings. Three persons, including a woman, were injured in Jaisalmer following the tremors. Depth of the earthquake was 33 km in rotation of 27.1 degree north and 70.7 degree east.

More than 150 structures[10], including some residential houses and government buildings, were partially damaged in an earthquake of moderate intensity that rocked Doda and Kishtwar districts on May 19. While the earthquake was mild in Doda district, Chatroo, Dharabshalla, Sarthal and Saroor areas of Kishtwar district witnessed the main impact of the quake. The earthquake struck around 12.56 AM and was followed by a massive aftershock after 10 minutes. The tremor triggered panic among residents and people came out of their houses. People spent the whole night in the open due to the fear of

aftershocks. The main impact of the earthquake was in some parts of Kishtwar district. The earthquake was of a moderate intensity, so there was no loss of human life. Teams of engineers had been deputed to assess the condition of those buildings that had developed cracks. Revenue officials had been directed to prepare a detailed report about the loss as early as possible. Similarly, police teams had been deputed in all areas to provide any assistance required by the local people. Initially, reports suggested that more than 150 structures had been partially damaged. A block of Government High School, Dharabshalla, developed cracks and engineers declared this building as unsafe. The boundary wall of the school was also damaged.

M7.6 earthquake in Andaman and Nicobar Islands, 11th August 2009

A high intensity earthquake on 11th August 2009, hit Andaman and Nicobar islands and shook many cities in southern and eastern India[11]. No casualties have been reported. The Indian Meteorological Department said, the 7.6 magnitude quake on the Richter scale struck at 01:26 AM about 265 km north of Port Blair. A Tsunami alert issued by the Pacific Tsunami Warning Centre was subsequently withdrawn. Tremors of the Quake in Andamans were felt in several places in Chennai, Vijaywada, and also in Orissa and Kolkata. In Chennai, residents of Anna Nagar, Mylapore, Besant Nagar and Nungambakkam areas felt the tremors and complaints of cracks in houses were also received from a few places. Several parts of Orissa including Bhubaneshwar, Cuttack, port town of Paradip, Jagatsinghpur, Kendrapara, Puri, Bhadrak and Balasore were shaken by the tremor. Panic-struck people rushed out of their houses in many areas. Mild tremors were also felt in Patamala Madhuranagar, Singhnagar, Pakayapuram and Vambay colony in Vijaywada.

M5.9 earthquake in Manipur, 4th September 2009

A moderate earthquake measuring 5.9 on the Richter scale shook India's northeastern part before dawn on 4 Sept 2009, triggering panic among sleeping residents in the region that experienced the fourth tremor in the past three weeks6. An official at the regional seismological centre in Shillong, capital of Meghalaya, said the tremor took place at 1.21 AM and had its epicentre along Manipur and Nagaland states, bordering Myanmar. The quake shook houses and other structures in Assam, Nagaland, Manipur and Tripura, besides being felt in Myanmar as well. People ran out of their homes with the tremor lasting for about 10 seconds. There has been no report of damage caused by the quake. This is the fourth tremor to have jolted the region so far this month - an earthquake measuring 5.3 on the Richter scale took place on 31st August 2009, while another of 4.9 magnitude was experienced on August 19th, and a tremor of 5.6 intensity shook the region August 11th. The seven northeastern states-Assam, Meghalaya, Mizoram, Tripura, Nagaland, Arunachal Pradesh and Manipur-considered by seismologists as the sixth major earthquake prone belt in the world. The region experienced one of the worst earthquakes, measuring 8.7 on the Richter scale, in 1897 that claimed lives of more than 1,600 people.

Nepal

In Nepal, National Seismological Centre (NSC) under the Department of Mines and Geology has been continuously monitoring the earthquake events since 1978. NSC documentation shows

that between 1994 and 1999, the average frequency of earthquakes having magnitude between 2.0 and less than 5.0 was approximately 10 per day, magnitude 6.0 and less than 7.0 was 1 in per 6 years. Similarly, total number of earthquakes of magnitude 2.0 to less than 7.0 between 1994 and 1999 were approximately 700, 900, 1,500, 1,700, 2,200, and 1,600, respectively. The distribution of micro-seismicity and moderate earthquake events throughout the Nepal shows cluster along the foothills of the Higher Himalaya[12], forming an E–W trending zone, as shown in Fig. 9.18. In western Nepal, this cluster lies between 80.5oE and 82.5oE, whereas in central Nepal it lies between longitudes 82.5oE and 86.5oE. The eastern Nepal cluster is characterized by higher level of events between 86.5oE and 88.5oE. The projection of micro-seismic events into the structural cross-section shows a noticeable change in the shape and location of clusters between central and western Nepal (Fig. 9.18). In central Nepal, the cluster has a rounded form and is located in the vicinity of the flat-ramp transition of the MHT. The cluster in western Nepal shows an elongate form and is nearly horizontal. These clusters reflect strain accumulation in the inter-seimic period, during which the decollement beneath the Higher Himalaya probably remained locked with the mid-crustal ramp acting as a geometrical asperity[12]. The release of this accumulated strain is the major cause to initiate crustal earthquake in Nepal. In 2009, NSC has recorded 18 earthquakes above 4.0 Richter scale (Appendix-VC). No damages and fatalities have been reported.

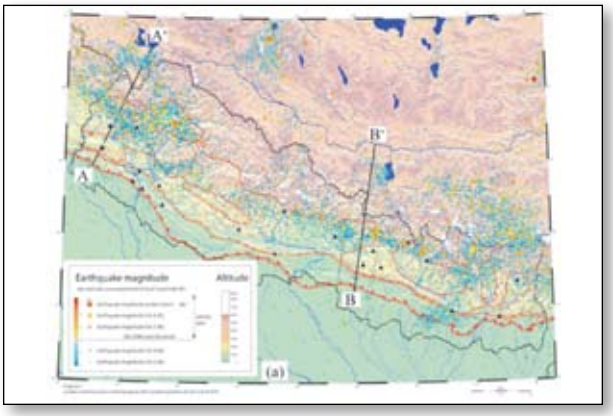


***Figure 9.18**: Seismicity map of Nepal*
(Source: National Seismological Centre, Nepal)

Pakistan

M5.9 NWFP, 4th January 2009

A strong earthquake with a magnitude of 5.9 on the Richter scale hit parts of NWFP[13] in the wee hours of 4th Jan 2009. Two women were among 5 people injured. The epicentre of the quake was in Hindu Kush region, which besides Peshawar also jolted various cities of Punjab, Federally Administered Tribal Areas (Fata) and Kashmir. Due to the tremor and aftershocks, people came out of their homes in panic. Soon after the powerful string of earthquake, 3 injured persons were rushed to the Lady Reading Hospital in Peshawar. In Mardan district, a woman died while 2 others sustained injuries. In Takhtbahi tehsil, a 70-year-old woman of village Maday Baba was pronounced dead because of heart failure in the wake of earthquake. Another 2 women suffered multiple wounds when roofs of their houses collapsed in separate incidents because of the tremor that rattled the district severely. A resident of Lund Khwar village got seriously injured when the roof of the room fell down in the earthquake. In another incident in the nearby Mayar village, a woman sustained injuries when the roof of the room caved in because of the earthquake. No reports of casualties were received from Hazara division, the most affected area in 8th October 2005 earthquake.

M6.4 Islamabad earthquake, 23rd October 2009

A strong earthquake measuring 6.4 on Richter scale jolted Islamabad13, Peshawar, Lahore, Azad Kashmir besides northern regions of the country at 01:51 AM on 23rd October 2009. Strong tremors were felt in Islamabad, Rawalpindi, Peshawar, Lahore and Northern areas forcing people to leave their houses in the cold night. The epicentre of the earthquake was 180 km deep in the Hindu Kush range. Strong jolts of quake were also felt in Peshawar, Hungo, Kohat, Abbotabad, Mardan, Chitral, Mansehra and Haripur in NWFP. People living in the areas affected by the deadly earthquake of October 8th 2005 were highly panic stricken, however, no casualties and damage has been reported as the epicentre of the quake was quite deep in the Hindu Kush range.

Sri Lanka

An earth tremor has been reported around 7.45 am on 26th November 2009 from Hambanthota, Tissamaharama, Lungamvehera and Badula areas[14]. No property damage or injuries were reported. In Sri Lanka earthquake events are not very frequent. However, some small events are reported recently. It is important to record the events regularly and to monitor the micro-seismicity for analysing the seismicity patterns in the country in relation to its tectonic features. This will help in understanding the future seismic hazard scenario in the country.

SDMC initiatives for Earthquake Risk Management in South Asia

During 2009 SAARC Disaster Management Centre (SDMC) has taken two important initiatives towards earthquake risk management in the region. A week long ToT was organised in collaboration with Indian Institute of Technology a premier institute in India working in the field of earthquake research. This training programme was attended by 29 participants from SAARC member countries. Another important event was the SAARC workshop on earthquake risk management in South Asia organised in collaboration with NDMA Pakistan in Islamabad during October 2009. This workshop leads to the formulation of a road map for earthquake risk management in the region.

SAARC Training Programme on Eartquake Risk Mitigation, 30 March to 4 April 2009, IIT Roorkee, India

The South Asian countries with in SAARC are highly vulnerable to earthquakes due to the presence of one of the most active seismic sources of the world. Six out of eight SAARC countries viz., Afganistan, Bangladesh, Bhutan, India, Nepal and Pakistan are located in this active seismic belt (Fig. 9.19). Many of the important and densely populated cities in these countries including the capital cities like Kabul, Dhaka, Thimphu, Delhi, Kathmandu and Islamabad are located in moderate to severe seismic hazard zones. Severe ground shaking, liquefaction and seismically induced landslides (SIL) adds to further hazards. Many of the prevalent construction practices and type of buildings in the SAARC countries are very similar and need to be addressed with respect to vulnerability and risk reduction. It is therefore, very appropriate to reduce vulnerability of these constructions by imparting appropriate training to field engineers, architects and teachers in Engineering and Geoscience Colleges in SAARC countries.

Many of these SAARC countries have witnessed several major earthquake disasters in the

***Figure 9.19**: Participants of the SAARC training programme on earthquake risk mitigation at Indian Institute of Technology, Roorkee, India.*

current decade such as Bhuj earthquake of 26th January 2001, Sumatra earthquake of 26th December 2004, Pakistan earthquake of 8th October 2005. Most of the causalities were due to collapse of the buildings in vulnerable areas. Earthquakes do not kill people but poorly designed or constructed buildings do. The earthquake devastation have clearly brought out a consensus that we need to have a comprehensive strategy for disaster management and risk mitigation which should include planning, design and construction of earthquake resistant buildings through strict compliance of Codal provisions for earthquake counter-measures. As of today, it is unfortunate that in spite of having the most scientific know-how available in the field of earthquake engineering and the Codal provisions for safe constructions, we continue to find that our engineers and builders are not following the prescribed practices either due to ignorance or fear of added cost. Common people are not aware of many aspects of earthquake disaster and better building practices in the active seismic zones of the countries. The problem is further aggravated by inappropriate land use planning due to lack of knowledge on geology and geotechnical conditions of the sites in a region.

In accordance with the approved agenda of SDMC for 2009, one week short-term training on earthquake risk mitigation was organised at IIT Roorkee, India, so as to train architects, town planners, and structural engineers and all other relevant stakeholders in SAARC countries to acquaint them about the current practices of earthquake hazard assessment and risk mitigation. This has provided an opportunity to all stakeholders of these countries to meet and interact on these very important issues of earthquake disaster mitigation, mitigation methods and response mechanism.

The main objective of the training course was to train stakeholders from SAARC countries about the earthquake hazard, vulnerability of buildings and immediate need to adopt different mitigation measures, exchange of knowledge and sharing of best practices in the field of earth-

quake resistant design, construction and other mitigation measures.

The course received an overwhelming response and against a initial capacity of 25 participants, due to interest of member countries, 29 participants from 7 member countries were accommodated: Afghanistan (3), Bangladesh (3), Bhutan (6), India (8), Nepal (4), Pakistan (2) and Sri Lanka (3).

SAARC Workshop on Earthquake Risk Management in South Asia Islamabad, Pakistan, 8–9 October 2009

South Asia is one of the most earthquake prone regions in the world. Six out of the eight countries of South Asia—Afghanistan, Pakistan, India, Nepal, Bhutan and Bangladesh—are located within most seismically active Himalayan–Hindu ush belt which has seen some of the worst earthquakes recorded in history. Sri Lanka, Maldives and large parts of the coastal areas of Bangladesh, India and Pakistan are vulnerable to tsunamigenic earthquake in the Indian Ocean.

Earthquakes have caused heavy damages in terms of deaths, injuries, destruction of habitat and disruption of economic activity. Realising the potentially catastrophic consequences of largely unpredictable earthquakes, particularly in growing urban areas in different seismic zones of South Asia, it has become imperative that countries of the region pool their resources, expertise and strengths and share their experiences with each other in assessing the risk of earthquakes at regional and local levels, mitigate the risks through a combination of structural and non-structural measures, respond to the earthquake events by rapid response and relief to the victims and reconstruct the damaged houses, infrastructure and livelihood to restore normal life and economy in the affected areas. Such regional cooperation is envisaged under the SAARC Comprehensive Framework of Disaster Management adopted by the Member States. In order to discuss various issues of earthquake risk management in the region, a SAARC Workshop on Earthquake Risk Management was organized in Islamabad on

***Figure 9.20**: Participants of SAARC workshop on earthquake risk management in South Asia, Islamabad, Pakistan, October 2009.*

8–9 October 2009 by the SAARC Disaster Management Centre, New Delhi in collaboration with the National Disaster Management Authority of Pakistan (Fig. 9.20).

The workshop reviewed the strength, weakness and gaps of current status of earthquake risk- assessment, mitigation, response and recovery and reconstruction practices in the region and recommended that certain coordinated regional programmes should be taken up under the auspices of the SAARC Disaster Management Centre to supplement the efforts of the national, provincial and local governments in the respective countries.

The Workshop recommended the following Roadmap for Regional Cooperation for earthquake risk management in the region.

A. Earthquake Risk Assessment

The following regional programmes for assessing the hazards, vulnerabilities and risks of earthquake were recommended.

a) **Seismic Hazard Assessment:** An Expert / Working Group may be constituted under the auspices of the SAARC Disaster Management Centre to:

- identify and prioritize the regional seismicity and fault zones in Himalaya–Hindu Kush region for further detailed studies and recommend the methodology and procedure to be followed.
- review the existing Seismic Hazard maps of the countries and recommend the measures to be taken to develop a South Asia Regional Seismic Hazard, Risk and Vulnerability map.
- explore possibilities of facilitating upgradation of seismic networks for better monitoring of earthquake parameters at the regional level.

b) **Training and Capacity Building on Seismic Hazard and Risks:** SAARC Disaster Management Centre may plan and organize regional training programmes on seismology in collaboration with leading seismological research centres in South Asia. For this purpose a region specific training module may be developed in consultation with experts.

c) **Development of a Regional Attenuation Models:** Realistic attenuation models are essential for accurate estimation of seismic hazards. These are lacking in most of the South Asian Countries. A research programme may be taken up in collaboration with concerned agencies of the member States to develop such a model using available strong motion data from the countries.

d) **First-cut Microzonation study for Select Cities:** Based on available data a first order microzonation map may be developed for selected cities in the Member States as a prelude to full scale microzonation. For this purpose an appropriate methodology may be developed under the auspices of SAARC Disaster Management Centre, which shall be passed on the concerned states for necessary follow up action.

B. Earthquake Risk Mitigation

Risks of earthquakes can be mitigated through a combination of structural and non-structural measures, as mentioned below.

- **Building Codes, Regulation and Enforcement:** The SAARC Disaster Management Centre may constitute an Expert Group to study the existing earthquake resistant building codes of the countries and recommend mod-

el building code and guidelines. The Centre may further compile the seismic provisions of the building codes for dissemination to all the concerned stakeholders.

- **Retrofitting of Life-Line Structure:** The requirement to improve the ability of an existing building to withstand the ground shaking due to earthquake requires retrofitting of the structure. For the countries that do not have any experience in retrofitting, the SAARC Disaster Management Centre may provide technical support for retrofitting once life-line structure provided the basic costs of retrofitting are met by the country from its own resources. The experiences gained from such model retrofitting may be utilized for retrofitting of other life line structures in a phased manner.
- **Compendium of Building Typologies:** South Asia has enormous variety of building typologies which need to be documented and assessed from earthquake safety point of view. The SAARC Disaster Management Centre may prepare a compendium of building types of non-engineering construction in South Asian countries.
- **Documentation of Indigenous Technology:** South Asia has rich reservoir of indigenous knowledge of building materials and construction technology that has withstood the test-of-time. Such building practices are not only cost-effective and thermally-efficient these also conform to the culture and way of life of the local communities. Many of these technologies have the danger of becoming extinct due to their neglect and promotion of concrete buildings by the engineers and architects. Many such indigenous earthquake-resistant housing technology and practices like the bhongas in the Kutch Region of Gujarat, dhajjidiwari buildings in Jammu & Kashmir, brick-nogged wood frame constructions in Himachal Pradesh and ekra constructions made of bamboo in Assam and similar construction methods in Nepal and other countries needs to be documented and further promoted if the local conditions permit.
- **Capacity Building of Engineers, Planners, Architects and Masons:** Capacity building measures need to be implemented through training and education at various levels by making use of the expertise and infrastructure available in the region. SAARC Disaster Management Centre had organised such training programmes which were found to be very useful. Such training programmes should be organized more frequently.
- **School and Hospital Safety:** Keeping in view the devastating impact of earthquakes on schools and hospitals and the importance of the safety of these institutions, a Regional Plan for School and Hospital Safety may be developed by the SAARC Disaster Management Centre in consultation with the Member States for implementation by the Member States.
- **Development of Guidelines for Environment Friendly Debris Management:** None of the countries of the region has developed guidelines for debris management that would conform to the standards of environment protection. The SAARC Disaster Management Centre may take up development of such guidelines which is specific to the diverse conditions of the region.

C. Earthquake Response, Recovery and Reconstruction

Recent mega earthquakes in South Asia had exposed the limitations of existing capacity to effectively respond to earthquake disasters and provided opportunities to develop the capacities. Initiatives taken by India and Pakistan following the earthquakes in Gujarat and Kashmir have significantly augmented the regional capacity for earthquake response, recovery and reconstruction, which should be utilized for the benefit of the region. In this context following specific programmes may be taken up by the SAARC Disaster Management Centre.

- **Documentation and Sharing of Good Practices:** The experiences gained in respect to Gujarat and Kashmir earthquakes should be documented in a comprehensive manner covering various local, provincial, national and international level initiatives for earthquake response, relief, rehabilitation and reconstruction.
- **Regional Framework for Earthquake Response, Recovery and Reconstruction:** Based on these experiences a Regional Framework for Earthquake Response, Recovery and Reconstruction may be developed by the SAARC Disaster Management Centre. Based on this framework each country may develop its own pre-disaster recovery planning which may be relevant for other disasters.
- **Sharing of Response under NDRRM:** SAARC Disaster Management Centre has been mandated to develop a Natural Disaster Rapid Response Mechanism. As a part of this mechanism the SAARC Disaster Management Centre may develop a regional response plan for mega earthquakes in consultation with the concerned agencies of the Member States.

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Chapter 10

Landslide

An Overview

South Asia is one of the hot spots of landslide disaster. Landslides along with associated slope failure phenomena are one of the major geological hazards in South Asia, affecting hill tracts of seven countries of SAARC, namely Afghanistan, Pakistan, India, Nepal, Bhutan, Bangladesh and Sri Lanka. It occurs in four principal geographical settings: in Hindu Kush–Himalaya including outer/sub Himalaya (Siwalik hills), lesser and higher Himalaya; hill tracts of Northeast India and Chittagong area of Bangladesh; Western Ghats of India and hill tracts and central high land of Sri Lanka. Mostly landslides are triggered by intense and prolonged precipitation and in some cases by earthquakes as experienced during 2005 in Kashmir (India and Pakistan). The causative factors can be attributed to a combination of factors related to tectonic settings, rock mass strength, terrain condition, land use/ land cover, geomorphology, climatic variations and human interventions in the form of unplanned settlements, mining and infrastructure development. In the past decade, the occurrence and extent of damage to human settlements and infrastructures due to landslides have been increasing due to climatic variations, unplanned settlement and infrastructure development in fragile mountain ecosystem.

The Hindu Kush–Himalayan landslide belt is quite conspicuous on a global scene as regards to landslide events. There is a very high concentration of landslides along the southern edge of the Himalayan ranges, extending from Afghanistan through Pakistan, India, Nepal, Bhutan and Bangladesh. This belt is responsible for major landslide activity in six of the SAARC countries. The second concentration of landslide events can be seen along the west coast of India with in the rugged Western Ghat hill ranges. The third concentration of landslides is in the hilly areas of Sri Lanka.

An important factor in the Himalayan belt is the earthquake phenomena which triggers a large number of landslides. The 2005 Kashmir earthquake had a very profound effect on the trigger statistics as the earthquake induced landslides have taken a toll of thousands of human lives. During 2007–09 there were no big earthquakes in populated mountainous regions of South Asia. This has changed the statistics of landslides in the region as there are no earthquake induced landslides.

In 2009, altogether 57 fatal landslides have been recorded worldwide amounting to a death toll of 821. These global data show South Asia as the worst affected region in terms of landslide disaster. South Asia alone witnessed 57.90% of total fatal landslides and 30.08% of total death toll (Table 10.1, Figs. 10.1 and 10.2).

***Table .10.1**: Global Distribution of Fatal Landslides and Fatalities During the Year 2009*

Area	Number of fatal landslide events	% of fatal landslides events	Number of recorded fatalities	% of all landslide fatalities	Total affected
Africa	1	1.76	27	3.17	10,006
Central Asia	2	3.50	1	0.12	7,836
South Asia	33	57.90	277	32.55	272
East Asia	7	12.28	240	28.20	10,422
South-East Asia	5	8.78	76	8.93	1,373
Central America/Caribbean	1	1.75	36	4.23	3,028
South America	8	14.03	194	22.80	22,085
Total	**57**	**100**	**851**	**100**	**55,022**

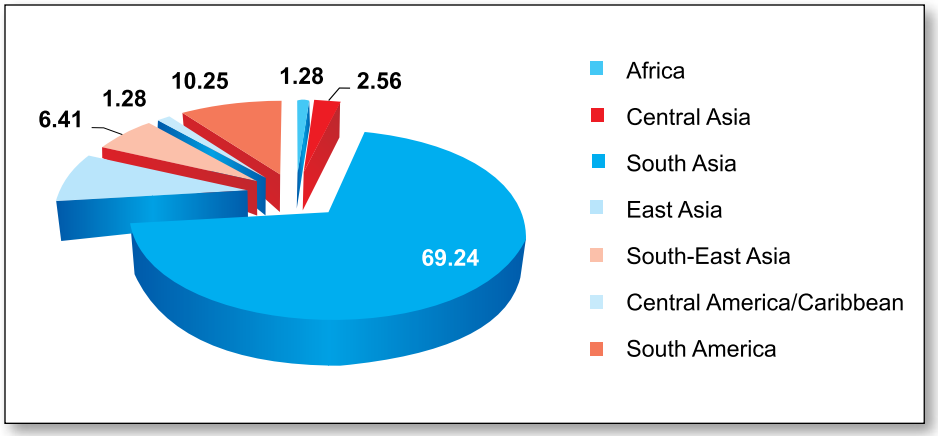

***Figure10.1**: Global distribution of fatal landslides during the year 2009
(Source: EM-DAT and media report prepared by SDMC).*

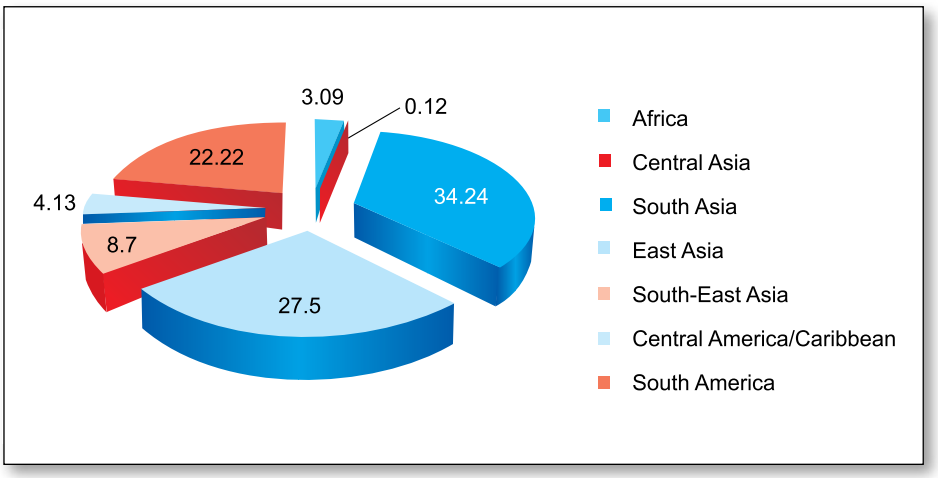

***Figure10.2**: Global distribution of fatalities due to landslide during the year 2009
(Source: EM-DAT and media report prepared by SDMC).*

In 2009, 33 fatal landslides occurred in South Asian countries out of which India faced the worst devastation 6 of 15 landslides in which 106 people were killed. Similarly, Nepal was badly affected by 15 fatal landslides resulting in death of 93 people (Table 10.2). Similarly, in Pakistan 33, Bangladesh 23, Bhutan 9, Sri Lankav 8 and Afghanistan 5 people lost their lives due to landslides (Table 10.2).

***Table .10.2**: Distribution and Damages due to Landslide in South Asia, 2009*

Country	People		Affected	Damages & loss
	Killed	Missing		
Afghanistan	05	NA	180	20 houses, 2,000 sheeps, 2 dams and mills
Bangladesh	23	NA	50	NA
Bhutan	9	NA	NA	Heavy Damage to cattle
India	106	NA	31	846 Houses, 100 villages affected
Nepal	93	16	4	107 houses, 84 Households and 225 people displaced
Pakistan	33	2	5	NA
Sri Lanka	8		2	10 families displaced,28 houses, 86 people displaced

In 2007, there were 1,036 deaths and which decreased to 261 deaths in 2008. But in the year 2009 death toll increased to 277 (Fig. 10.3). In comparison to 2007 data base1, in 2009 South Asia witnessed few fatalities and damages due to landslides. The reasons behind this may be due to low rainfall in the region and absence of devastatingearthquakes in the region. Major South Asian landslides that occurred during 2009 are described below.

Afghanistan

On 8 February 2009, a landslide occurred near Pul-e-Khumri village in the northern Baghlan province of Afghanistan which completely destroyed 5 houses and damaged 6 others, leaving a large number of people homeless[3]. The homeless included a large number of women and children. Five children aged between 7 and 10 were killed in another mudslide incidence which took place in the northern province of Balkh on 22nd May 2009. The incidence took place in the evening and the victims were buried under earth and stones as they were outdoors. The slide was caused due to loosening of soil due to construction and prolonged downpour. As per the information from Disaster Management Directorate, Northern Afghanistan had suffered heavy rains since March during that year, with the consequent floods, mudslides and avalanches killing around 150 people.

Bangladesh

In a landslide incidence on 1st January 2009, a labourer was buried under the debris of the landslide while collecting boulders from the Garo hill at Sandhakura under Jhenaigati upazila in Sherpur. The labourers were engaged in collecting boulders by cutting the hill slopes which triggered the slide[4]. In the early hours of 18th May 2009, landslides triggered by heavy rains killed 6 people, 5 of them of a family, in 2 tea gardens in Srimangal upazila of Bangladesh[5]. A massive mudslide took place on the hill slope in one of the tea gardens, and buried the house along with 5 persons sleeping inside the house while 1 per-

son died in a landslide in another tea garden during heavy shower.

A mudslide took place in Habiganj on 4th July 2009 due to heavy rains killing a family of 6, including 4 children, as their house collapsed due to the impact of the slide. The landslide was triggered due to incessant rainfall. The rainfall recorded in 24 hours was 88 mm in Sylhet, 60 mm in Lorergarh, 62 mm in Noakhali and 57 mm in Comilla[6]. In the same month on 31st July at least 10 people, including a minor, were killed in a landslide triggered due to heavy rain at Islampur and Tetulia villages under Lama Upazila in Bandarban district[6]. After the disaster local people were actively engaged in the rescue operation (Fig. 10.4). Improper use of hill slope is one of the major reasons in Chittagong area (Fig. 10.5).

***Figure10.4**: Rescue operation in Bandarban where 10 people including 5 members of a family were killed in a landslide (Source: Focus Bangla).*

***Figure10.5**: Houses built by cutting hills at Salimpur area of Chittagong city hoodwinking consequence. Inset, firemen and locals recovering a body at Harinmara of Lama in Bandarban after the mudslide (Source: Star)*

Two information centres were opened at Lama upazila and district sadar in this connection.

Bhutan

A massive landslide took place on 1st April 2009 at Takti, on the Phuentsholing–Thimphu highway and killed a Dantak site supervisor on the spot and swept away a tipper truck with its driver and assistant[7]. The tipper truck was approaching the worksite with stone chips from Jemina, Thimphu. Following the accident, hundreds of vehicles were stranded on the highway. In another landslide which took place on 26th May 2009, 6 farmers from Chokhor gewog, Bumthang district, were buried alive under the slide debris[7]. The Chokhor gup, informed that the bodies of the deceased could not be located as they were buried under mud and boulders. Two persons, who survived the landslide, reported the incident to the army officials. The bodies could not be recovered as the rescue team could not reach the spot of the accident. On 8th June 2009, a devastating landslide took place in Laya area of Gasa district of Bhutan. The loss included 213 yaks, 45 horses, 19 mules and a cow, all buried under landslide and snow avalanche making it one of the worst affected dzongkhags due to landslides triggered by heavy rainfall[7]. This was a major economic loss for Laya with more than a hundred households with yaks as their main source of income and livelihood. Landslides also destroyed mule tracks from Laya to Gasa, Lunana and Lingzhi. Three bridges —Koina zam heading to Laya, Mentahgang zam to Lingzhi, and Lunhku zam to Laya— were also washed away.

India

On 26th May 2009, at least 21 people were killed and another 21 injured in a landslide in Darjeel-

ing hills of eastern India[8]. The landslide was triggered as cyclone Aila, which having moved to North Bengal, caused heavy rains in the area. Nine bodies were recovered from the debris of landslide in Darjeeling while 6 others died in mudslides at Kurseong. The hill station of Darjeeling remained cut-off from Siliguri in the plains, as both Hill Cart Road and Pankhabari Road from the North Bengal town remained blocked due to landslides at Ghoom and other places. In Gangtok, roads in the Himalayan state were blocked by minor landslides, while 300 houses collapsed. Seventy seven centimetres of rain was recorded in Sikkim since 25th May 2009. The Geyzing–Jorethang and Namchi–Melli roads were blocked by landslides which were cleared later. Over 300 wood houses collapsed and evacuation of the people was difficult with roads remaining blocked at several places due to incessant rains. Earlier, on 16th July, 2009 landslides took place in Kalpetta district due heavy rains in the region over a period of 3 days[9]. Two persons were reported missing after landslips took place at Neelimala, near Vaduvanchal, and Kathanpara, near Rippon, in the district on 16th July 2009. The official information indicates that nearly 100 landslips occurred at various parts of the district.

On 20th July 2009, a landslide took place in Lambagar and Tangari areas in Chamoli district blocking the Rishikesh–Badrinath highway in Uttarakhand[9]. Pilgrims were asked not to visit Badrinath shrine as it was cut-off from rest of the country due to landslides triggered by a cloudburst. Nearly 1,000 pilgrims were stranded in Badrinath area. The district administration ensured availability of food items for the stranded pilgrims. A temporary bridge was erected in the area for people's easy movement. The state of Uttarakhand witnessed another major landslide on 8th August 2009 triggered by cloudburst in the twin villages of Jhakla and Leh in the remote Munsyari block in Pithoragarh district[11] in which 45 people were feared killed and dozens went missing (Fig. 10.6). The affected area was entirely cut off from the outer world and all communication networks had collapsed due to the incessant rains. A large number of bodies appeared to have been swept away into a nearby rivulet, which flows adjacent to the affected villages. A joint team of Indo–Tibetan Border Police, Provincial Armed Constabulary and the State Police carried out rescue operations for recovering dead bodies of the victims.

***Figure10.6**: Landslide in Pithoragarh district (Source: www.deccanchronicle.com)*

***Figure10.7**: Local people search for survivors at the scene of a landslide in Nilgiris district of Tamil Nadu (Source: team-bhp.com).*

On 16th August 2009 a series of landslides took place in Darjeeling killing 7 people, including 2 children and injuring many others[8]. The

slide caused blockade of main road link between Siliguri and the hill state. The National highway 55 was blocked at many places by falling rocks and boulders and work was on to clear the main road link of Darjeeling. Road communication, in particular, was affected as mud and rocks fell on at least 500 spots and incessant heavy rains caused around 60 springs to change their courses. On 2nd September 2009 a landslide was triggered due to incessant rains killing 11 people, injuring more than 10 and burying 16 hutments in Saki Naka Area of Mumbai[10]. On 4th October 2009, 2 landslips were reported from the Muralidhar Math road and High Church road in Karwar city causing panic amongst the residents of Karwar and surrounding areas[9]. The hillock adjacent to the residential locality at the Muralidhar Math road slid down creating fear in the people of the area. Many people fled the area to the safer places. Boulders and mud slide down the hillock creating further panic. The residents of the area had to be shifted elsewhere in the city. On 15th October 2009 landslides snapped road connectivity to the hill station of Kodaikanal, killing a car driver instantly, 5 km away from Dum Dum Rock, on the Batlagundu–Kodaikanal Ghat road[9]. Over 60 passengers travelling in a private bus to Kodaikanal from Batlagundu had a miraculous escape as the bus driver, who saw boulders falling on the road, stopped the vehicle and returned to the Batlagundu bus stand. In another incident, the landslides caused by heavy rainfall in the Ooty mountain ranges had destroyed several houses near Coonoor on 10th November 2009 (Fig. 10.7). Twenty-eight fatalities were reported, taking the death toll due to monsoon-related incidents in the Nilgiris district to more than 43.

Nepal

Landslides are common during the monsoon season in the hilly districts of the country. Every year hundreds die and equal number of people are injured in the landslides related incidents.

On 28th June 2009 a landslide buried 7 houses in Banku village of Uku-1, Darchula district of Nepal11. The landslide that followed heavy downpour buried the houses lying down the slope. According to the authorities, there were no casualties as all the families came out of their houses before the landslide struck. On 2nd July 2009 in separate landslide-related incidents in various parts of the country caused by incessant rainfall from the previous few days at least 6 people died and 2 more were reported missing[11]. Three members of a family died when a house was swept away by a mud-slide at Deurali VDC-8, Kaski district. On 3rd July 2009 the Kulekhani–Kathmandu road sector has been obstructed due to mudslide at Jurikhet of Bhimfedi VDC in Makwanpur[11]. The torrential rainfall in the area since past 24 hours did not allow cleaning up the road as a result many vehicles were stranded on the road. On 27th July 2009, a landslide at Tallo Siddhababa in Butwal–Tansen road section caused by continuous rainfall obstructed transportation along the Siddhartha highway. The landslides have especially affected Siddhababa Bhir and Tallo Siddhababa of Palpa. The incessant rainfall had made the task of clearing the road section difficult[12].

On 28th July 2009, at least 11 people died after they got buried under the mudslide triggered by the incessant rainfall since 26 July 2009[13]. In Tamku VDC-9 of Sankhuwasabha district, 4 people were killed and 9 others went missing after

being buried under the landslide. The houses of local people were swept away by the landslide. Likewise, landslide killed 2 people at Khara VDC-5 in Darchula district while 2 others were injured after their house was buried in the landslide. In Dhanusha district, 5people were swept away by the Kamala river. Their bodies were recovered from the riverbank at Portaha. The landslide also buried houses and destroyed 2 wooden bridges and drinking water supply at Gagan Khola VDC. Likewise, a building of Himalaya Primary School was also affected by landslide. On 31st July 2009, 9 people were reported killed and 4 others were missing in landslides caused by torrential rain in different parts of Nepal[13]. Five people including 4 belonging the same family were killed in a landslide at Daunne village in Chitrabhanjyang VDC in Syangja district. In Tananun district, 3 persons of same family died when landslide swept their house at Goredanda in Kinhu VDC.

On 9th August 2009, 4 members of a family were killed in a landslide in Dolakha district when a landslide triggered by an incessant rainfall swept away a house at Lapsa in Shyama VDC-1 of the district in eastern Nepal[11]. One person was killed while another injured after being buried under a landslide at Paiyupata VDC in Baglung district. On 14th August 2009, 9 families were displaced after landslide was triggered by incessant rainfall swept away their houses in Darling VDC of Gulmi[14].

On 1st September 2009, 13 persons were found missing in the debris of a landslide that had struck Jaleshwori VDC of Khotang district around midnight[12]. There were only 3 houses in the area and the landslide occurred some 1,000 metres above them. According to an Inspector of Khotang district police office, 72 security personnel were engaged in the rescue operation. On 3rd September 2009 alone, 10 families were displaced by a landslip, which occurred after a downpour, in the area. People of adjoining Meheltoli, Chauratha and Salleri VDCs had stopped using the village as their route fearing other landslips. On 5th September 2009, 2 members of a family were killed and 3 others were seriously injured when a house at Ramechhap district was swept away by landslides caused by incessant rainfall. Similarly, on 7th September 2009, 2 women were killed after being buried in a mudslide at Laaduk VDC in the Northern part of Dolakha district. They died when the mudslide buried them while digging for the red soil at Bhimanei in Laaduk-5. The red soil is used for coloring the houses in the villages in festivals including Dashain.

On 23rd September 2009, 47 families of Khatamma and Chauki Danda Village Development Committees (VDC) in Bhojpur were displaced due to landslides while 1 person was buried under the debris of the landslide. Among the families 34 of the displaced were from Khatamma and the rest from Chauki Danda. In another major incident on 6th October 2009, a total of 34 persons died in separate landslide incidences in the country. 18 persons died in Achham district, 12 died in Dadeldhura, 2 in Bajhang and 1 each in Doti and Baitadi districts.

Pakistan

On 5th March 2009, 3 persons including 2 children and a woman were killed and another 2 girls were injured in a landslide in Ghulam Bandah area on the outskirts of Kohat. According to police sources, an Afghan refugee was digging up soil from mountain when the landslide happened, killing her and her 2 sons on the spot. The local people rescued the injured children and shifted them to the District Hospital of Kohat. On

5th May 2009, at least 28 people were trapped under a landslide in Neelam Valley. In another incident on 29th June 2 miners were killed and 3 others seriously injured at the Pir Sabaq hills when a landslide comprising huge mass of mud and rocks fell on the labourers busy in digging[15]. At the time of the incident more than 25 labourers were busy in digging the mountain slopes. The gigantic landslide also damaged 2 tractor trolleys.

Sri Lanka

On 28th January 2009, at least 10 families were displaced due to a landslide in Gampolawela area in Gampola electorate16. The human activities including haphazard sand mining and damage to the river bank were reported to have resulted in this disastrous situation. On 20th May 2009, 6 people were killed in a landslide in Norton bridge, Hatton in an area which was always under threat of disaster16. It was reported that continuous showers since 18th May had made a huge mountain of soil crash into the house of the victims. On 23rd May 2009, about 28 houses in Nuwara Eliya in the hill country of Sri Lanka were damaged due to the landslides caused by torrential rains17. The Disaster Management Center (DMC) said 86 people were displaced by the landslides. According to the DMC 22 houses were damaged in Ambagamuwa area and other 6 houses were damaged in Oltan States in Nuwara Eliya.

Landslide Disaster Management in the SAARC Region

A. Bioengineering methods for Landslide Hazard Mitigation

There have been considerable attempts in different geographical regions of the world demonstrating bioengineering as an inexpensive as well as very effective tool for controlling erosion and reducing shallow slope instabilities. This has been very successfully applied in Himalayan region particularly in Nepal Himalaya for roadside slope stabilization and agricultural slope protection by farmers. This is one of the most cost-effective techniques for vast stretches of Himalaya where other engineering structural measures are prohibitively expensive.

Vegetation is a key factor that maintains equilibrium among the forces so as to maintain the stability of the hill slope. It is well known fact that if the vegetal cover from a hill slope is removed, the chances of its failure increase greatly. The use of any form of vegetation, either alone or in conjunction with other physical measures, as an engineering material is referred to as Bioengineering[12]. It has received increased attention due to its apparent positive role in landslide hazard mitigation, torrent control, rehabilitation of mine-spoils, and for natural or man-made slope stabilization. In the mountainous areas of the world, bioengineering is being practiced with a high degree of success. Another factor that appears to have greatly contributed to the rapid adoption of bioengineering practices pertains to increased environmental awareness, time-tested sustainability of traditional practices of hill slope stabilization and on account of being relatively inexpensive. Classical engineering techniques are probably not sustainable on account of their high initial investment and recurring high maintenance costs, whereas the vegetative measures are sustainable due to their inherent capacity to respond to varying spatio–temporal site conditions and low-maintenance costs. In the coming section a successful case study from Nepal on application of bioengineering techniques is given.

Stabilization of the Krishnabhir Landslide (Nepal) Using Bioengineering Techniques: A case study[12]

Krishnabhir Landslide, occurred in 11th August, 2000, is one of the worst slope disasters that Nepal has ever had along the highway corridor (Fig. 10.8). It is situated 82.50 km west of Kathmandu in the Prithvi highway, which is the only route connecting Kathmandu to southern part of Nepal. The closure of this highway for 11 consecutive days from 11th August 2000 created unforgettable havoc in the entire nation.

***Figure10.8**: Krishnabhir Landslide (Nepal), 11 August 200012.*

It was a translational failure with failure surface roughly at 10 m depth from the ground surface. The failure stretched 240 m (vertical height) above the road level and 200 meters wide along the road. The failed mass deposited further 90 m (inclined length) down the slope to the river Trishuli. The huge mass of debris was too mobile and very dangerous to even walk along the newly cut track for opening the road for vehicular movement. After this slide, the road was closed quite frequently even at minor drizzle or wind. The problems for stabilization of this site were unavailability of sound rock even at 18 to 20 m. depth from the surface, covering of the surface with very loose debris which was very mobile and the overland flow causing severe debris flow closing the road frequently. As a mitigative measure, bioengineering techniques were proposed because of its cost effectiveness and environment friendly nature. In the initial stage entire slope was trimmed and debris was removed (Fig. 10.9). For the proper selection of bioengineering measures, entire slope was divided into zones. Water management did appear to be one of the significant measures to be designed in order to control the overland and sub-surface flow. Construction of drainage system on this loose debris was a great challenge as the whole drainage system could be washed off in the torrential rain fall. So, civil engineering measures such as check dams, cascade drains and culverts were provided to withstand against great force of impact from the flowing water/debris (Fig. 10.10). There was no firm ground on the sides of check dams and cascade drains, so, vegetative structures were provided at the keys of check dams and other structure/soil interface. Main functions of civil structures were to support and drain whereas the functions of vegetative structures were to armour and reinforce the soil. At the toe of the slope, 6 m high concrete toe wall

***Figure10.9**: Zonation of slope for bioengineering measures[12].*

***Figure10.9**: Gabion wall constructed to stabilize uphill slope*[12]

was provided. 3–4 m high gabion retaining walls were provided at the road level. At hill side, 6 m high gabion breast wall was provided to support moving upslope.

The ends of check dams were extended sideways to partly function as slope support wall as well. Surface drains of gabion bolster tubes in the herring bone pattern were provided at the middle part of the slope to drain the slope surface. In between the slope support walls and branch drains of herring bone drains, vegetative structures mainly of grass and shrubs in the diagonal pattern were provided. Armour, reinforce and drainage improvement were the main engineering functions that were expected with these vegetative structures. On the steep up slope where the thickness of debris was relatively thin, random grass plantation with the support of wiremesh nets or ROFA (planting board) (Fig. 10.11) were provided to armour and reinforce the slope surface (Fig. 10.11).

With such structures, the huge slope instability problems of Krishnabhir was stabilized (Fig. 10.12) with a total cost of 55 million Nepalese Rupees which was about 2% of the total cost proposed by a foreign consultant to solve the same problem with civil engineering structures alone.

***Figure10.11**: Plantation work (left) and application of ROFA (right)* [12]

***Figure10.12**: Failed slope at Krishnabhir in 2000 (left) and stabilized Krishnabhir in 2009 (right)* [12]

From this experience of Nepal, it is clear that the bioengineering techniques may also be useful in all member states of SAARC. And the expertise gained by Nepal may be useful to reduce landslide risk not only along the road corridor but also for watershed and land management.

B. Green solution to tackle landslides, Himachal Pradesh, India

Gabion-retaining structures and use of high-strength geo-synthetics for soil reinforcement can find a lasting, environment friendly and cost-effective solution to the problem of recurring landslides in the geologically fragile hill state like Himachal Pradesh. The gabion structures constructed using big, corrosion-resistant wire mesh boxes to confine stones of various sizes are not only strong and more durable but also 20 to 25 per cent cheaper compared to stone masonry walls. More importantly, they are breathing structures and support growth of vegetation in void between the stones. The gabion structures allow enough flexibility to take care of settlement of strata and they also absorb the stresses and strains generated during sliding earth mass. With the growth of vegetation, the roots of bushes and trees further bind the soil to set the process of natural slope stabilisation in motion. Geotechnical engineering has made remarkable advances with advent of new synthetic materials in the recent past. The new materials were not only strong but also corrosion-resistant had made it possible to design retaining and other structures for all kinds of strata and geological conditions right from unstable hills, river banks and coastal areas. Gabion structures were being used all over Europe but states like Himachal where terrain was similar these had not been introduced as yet. In fact, Kerala, Maharashtra and some other southern states had used the new technology to solve some intractable geological problems. The practice may be adopted in the mountainous landslide prone areas of the SAARC member countries.

C. Community forest to off-set landslides in Bhutan

Records with the gup of Lumang gewog in Trashigang show that 128 households from 4 of its villages have abandoned their homes for resettlement elsewhere in the country[6]. They had to move as the landslides threatened their livestock, farms and their own lives. Now Lumang gewog hopes to stop this trend by reforesting the landslide prone areas of Moshi and Tshogonpa, by establishing a community forest that will be owned and looked after by the people of Lumang. The Trashigang dzongkhag administration handed over the Kosphu community forest to the people of Lumang gewog. The 578 acre Kosphu community forest covers the landslide prone areas of Moshi and certain parts of Tshogonpa. The community forest has plans of afforestation and the members will plant trees in the vacant and necessary areas. Aimed at alleviating poverty and increasing ownership of the villagers towards the natural resources, the Kosphu community forest, if all goes as planned, will save farms and homes of many villages in Lumang gewog. As observed by the Lumang gup, Jangchub Wangdi, it is very important for the people who live within the landslide prone areas. This way the villagers would now strive towards promoting and protecting the forest and their villages. The forest would further benefit 96 households from 12 villages in the gewog. With the establishment of Koshu CFC, there are now 14 CFCs in Trashigang alone. According to dzongkhag forestry officials,

formation of community forests begets better ownership and management by the local people. Forest fires in Uzorong compared to past years have greatly reduced since the formation of a community forest in the gewog. One significant benefit is obtaining a permit to obtain timber, which earlier took months now it can be completed within a few days. The remaining villagers now feel safer.

SDMC Initiatives for Landslide Hazard Mitigation

SAARC Disaster Management Centre and Research and Development Unit of Khwopa Engineering College have jointly organized a one week training programme on Bioengineering Methods for Landslide Hazard Mitigation, September 6–12 2009 at Khwopa Engineering College, Bhaktapur, Kathmandu Valley, Nepal. The aim was to train Engineers/ Geoscientists/Environmental scientists/Forestors/Soil scientists & Planners from SAARC countries to acquaint them about the current practices of slope stabilization and landslide mitigation through bioengineering techniques. This has provided an opportunity to all stakeholders of these countries to meet and interact on this very important issue of "Landslide Hazard Mitigation technique". Altogether 25 participants from Afghanistan, Bhutan, India, Nepal, Pakistan and Sri Lanka participated in the training programme (Fig. 10.13).

The course was designed to provide the basic practical knowledge and skills in bio-engineering required by technicians engaged in landslide hazard mitigation. Efforts were made to expose them to all aspects of bioengineering to enable them to implement mitigation measures more effectively. During the course wide range of reference materials were provided with case examples and field visits to expose the participants to practical aspects of bio-engineering application in landslide remedial measures (Fig. 10.14).

***Figure10.13**: Participants of the SAARC training on bioengineering methods for Landslide Hazard Mitigation, Khwopa Engineering College, Bhaktapur, Nepal.*

***Figure10.14**: Field visit for participants to expose them to practical application of bioengineering measures.*

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Chapter 11

Epidemics

An Overview

Natural disasters are a major problem, but epidemics can also be considered as another major problem in South Asia as well as some parts of the Africa in terms of casualties. The reasons for this are lack of hygienic drinking water, substandard food, lack of sanitation, and inadequate facilities for the displaced people during and post-disaster situation. The year 2009 witnessed a very high incidence of epidemics across the globe. About 3,476 people were killed due to various epidemic situations during 2009, globally as per the global data base (EM-DAT) (Fig. 11.1). As is seen from the figure the maximum fatalities were recorded from the western African countries (2,465) followed by the South Asia (527).

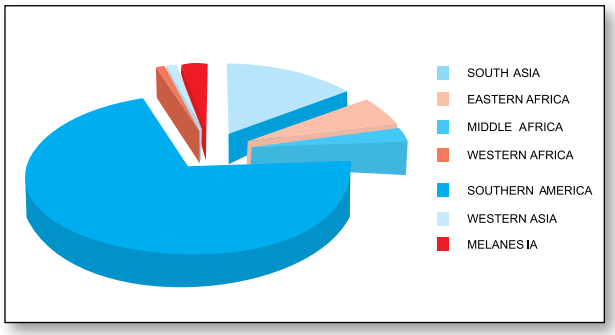

***Figure11.1**: Global distribution of death by epidemics during 2009. (Source:EM-DAT).*

It is to be mentioned here that EM-DAT records only the major events. In South Asia this data base has recorded only the epidemic events from Nepal (282 fatalities due to Diarrhoea) and Sri Lanka (245 fatalities due to Dengue). According to EM-DAT, this year there is higher number

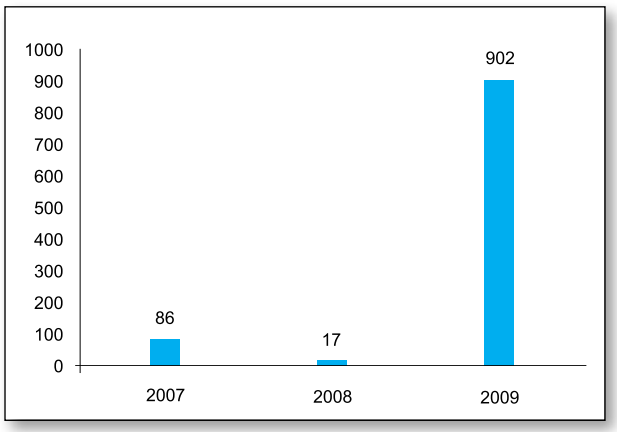

***Figure 11.2**: Total number of deaths due to epidemics in South Asia from 2007 to 2009. (Source EM-DAT)*

of causalities mainly due to diarrhoea in Nepal and dengue in Sri Lanka (Fig. 11.2). Details of the cases is given in Appendix-VIIA and VIIB. After the investigation, National Human Rights Commission (NHRC) of Nepal concluded that the sub-standard, contaminated food distributed by different organisations, including World Food Programme (WFP), was one of the reasons behind the large scale diarrhoea deaths in far western Nepal. Similarly, lack of sanitation facilities and awareness and contaminated water were the other reasons for the outbreak of diarrhoea in far western Nepal. The other main reason for accelerating deaths in South Asia is increasing cases of dengue, which severely affected Sri Lanka in 2009.

The country wise description of the epidemic cases in the individual SAARC countries is discussed below.

Afghanistan

Respiratory diseases

During 2009 Afghanistan saw a phenomenal rise in respiratory diseases causing deaths of 2–4 people daily[1]. As per the information from Ministry of Public Health (MoPH), every winter there is a marked increase in respiratory diseases. Observations of the United Nations Children's Fund (UNICEF) states that immunisation coverage being still very low in Afghanistan, preventable diseases kill thousands of children annually, with respiratory infections being among the leading causes of childhood deaths. Pneumonia, asthma and other breathing problems peak among vulnerable people, particularly children, in sub-zero winter temperatures (Fig. 11.3). The situation is aggravated by high levels of pollution in big cities. About 9 million of the country's estimated 27 million people are food insecure, making them prone to seasonal and contagious diseases. Over 230,000 people are living in wretched conditions as internally displaced persons (IDPs) in tents, mud huts and dilapidated buildings; they generally lack access to heating, clothing and health services. Afghanistan has one of the highest infant mortality rates in the world, with pneumonia and respiratory infections killing thousands of children every year.

In October 2008 the MoPH reported establishment of 129 mobile health teams tasked with assisting needy communities during winter when snow often blocks access to local health centres. The teams have helped prevent a major outbreak of winter diseases so far this year, but they are hampered by snow and transport difficulties. Because many roads in rural areas are rough and become impassable in winter, mobile health workers also use animals or trek to villages on foot to deliver life-saving health services in some mountainous and rugged regions in Paktika, Nooristan, Daykundi, Badghis and Badakhshan provinces.

Cholera/Acute Watery Diarrhoea

In the year 2009, 28 deaths from cholera and Acute Watery Diarrhoea (AWD) were reported in Afghanistan as per the information of the MoPH. About 673 cases of AWD and/or cholera had been reported in 11 of the country's 34 provinces. According to the World Health Organization (WHO), cholera, is an acute diarrhoeal infection caused by ingestion of the bacterium Vibrio cholerae. The disease is characterized in its most severe form by a sudden onset of AWD that can lead to death by severe dehydration and kidney failure. There are strong diagnostic similarities between AWD and cholera and the health workers had difficulty in distinguishing between the two. The disease was reported from the eastern province of Nangarhar where flash floods affected about 4,000 people in August this year as per the reports of the UN Office for the Coordination of Humanitarian Affairs (OCHA). MoPH has sent medical supplies, including antibiotics and sachets of oral rehydration salts, to cholera-affected provinces.

Lack of access to safe drinking water and sanitation as well as poor awareness about personal hygiene appear to be major causes of cholera and AWD (Fig. 11.3). The UNICEF estimates that only 23% of Afghanistan's estimated 27 million people have access to clean drinking water and 12% to safe sanitation, and that annually up to 50,000 children die from diarrhoeal diseases.

***Figure11.3**: A mother waiting with her infant child suffering from cold-related respiratory diseases in Afghanistan (Source: Noorullah Stanikzai/IRIN).*

***Figure11.4**: Children drinking unsanitised water, a major source of diarrhoeal diseases in Afghanistan (Source: Manoocher Deghati/ IRIN).*

Bangladesh

Bangladesh is one of the most epidemic prone countries in South Asia. During 2009 it has suffered due to various diseases which took the form of an epidemic. Some of the most alarming epidemics are described below.

Child Mortality

Inspite of significant progress in reducing child mortality, the rate of maternal and newborn mortality in Bangladesh still remains high. About 12,000 mothers and 120,000 newborn babies die every year in the country, as per the UNICEF report[2] titled "State of the World's Children 2009". In Bangladesh, only 18% of births are attended by medically trained providers while 85% of births take place at home and only one in five mothers and newborn children receive postnatal care from a medically trained provider within 42 days after birth.

Cancer

Cervical cancer causes death to some 18 women in the country everyday. The experts indicate that approximately 12,000 women are diagnosed with cervical cancer and of them 6,500 die in the country every year[2]. Quoting from the South Asia Regional Report, a Professor of Dhaka Medical College said some 4.50 lakh women above the age of 15 years are at risk of cervical cancer in the country. It is estimated that some 500,000 women have been suffering from breast cancer[2].

Cancer specialists feel that government and private hospitals have the capacity to treat only 25,000 cancer patients in the country. A mass awareness programme is needed to combat the deadly disease. As per experts opinion obesity increases the risk of cancer which should be taken care of. At the same time, smoking both active and passive increases the risk of cancer.

Kidney Diseases

As per the experts in Bangladesh every year a large number of people die of kidney diseases and the main reasons of the diseases are nephritis, diabetes and high blood pressure[3]. Experts advise all to remain cautious about these predominant factors of kidney diseases and to increase treatment facilities at different public and private hospitals as well.

Health experts are of the opinion that a huge number of patients seek treatment at the advance stage of the disease due to lack of awareness. As the symptoms of kidney diseases are not exposed at the primary stage, people do not seek treatments and by the time of exposure of the symptoms, 75% of the kidney get damaged. Unfortunately, 90% people of the country cannot bear expenses of the disease as the treatment is still much costly.

Bangladesh has 2 crore kidney patients and nearly 40,000 of them die annually due to renal failure, according to the Kidney Foundation[3]. The number of chronic kidney patients increased by 50% over the last 10 years and currently 18% of the country's total population is suffering from

the disease. According to Kidney Foundation statistics at least 80% to 90% of the kidney patients die due to lack of proper treatment. A kidney patient, according to it, has to spend at least Taka 2 lakh a year on hemodialysis twice a week and Taka 2.50 lakh for dialysis thrice a week. Only 5% to 8% of the patients, according to the foundation statistics, can bear the treatment expenses on their own.

In Bangladesh, kidney transplantation is done at the Bangabandhu Sheikh Mujib Medical University, Kidney Foundation Hospital and BIRDEM Hospital in the public sector. Besides, there are 40 dialysis units across the country. The limited number of hospitals equipped with the treatment facilities, cannot cope with the rush of kidney patients.

Water-borne Diseases

About 1.1 lakh people in the country die every year, who are affected by the water-borne diseases3. As per the Chairman of Transparency International Bangladesh (TIB) the safe water is a fundamental human right, which should be ensured and safeguarded. Bangladesh is facing a water crisis because of poor water management, as there is plenty of water during the rainy season. Every day more than 700 diarrhoea patients from different parts of the capital flock for treatment at Institute of Cholera and Diarrhoeal Diseases and Research, Bangladesh (ICDDRB) due to lack of clean water supply (Fig. 11.5). About half of the patients are infants and children (Fig. 11.6). The Water and Sanitation Authorities (WASA) sources said the water pollution has reached such a level that it has become almost impossible to purify it. Besides, supply water is getting contaminated through the pipeline leakages due to lack of maintenance. Every day WASA supplies more than 22 crore litres of water to Dhaka households, which is only 15% of total water demand in the capital. All this water comes from the stinky pitch-black water of the Shitalakkhya and Buriganga.

Figure11.5: *ICDDRB Hospital overcrowded with diarrhoeal patients as the disease was spreading fast in the city (Source: Focus Bangla).*

Figure11.6: *A child admitted with diarrhoea cries in discomfort and pain as his mother tries to soothe him at ICDDR (Source: Daily Star).*

Malaria

Malaria is caused by a parasite of Plasmodium species, which is transmitted via the bites of infected mosquitoes. In the human body, the parasites multiply in the liver, and then infect red blood cells. Symptoms of malaria include shivering fever, headache and vomiting and usually appear between 10 and 15 days after the mosquito bite. If not treated, malaria can quickly pose to be dangerous to life by disrupting the blood supply to vital organs.

In Bangladesh more than 11 lakh people, most of them children under five die of malaria every year[4]. The disease is prevalent in 70 upazilas of 12 districts. The affected districts are Rangamati, Bandarban, Khagrachhari, Chittagong, Cox's Bazar, Habiganj, Moulvibazar, Sylhet, Sunamganj, Netrakona, Mymensingh and Sherpur.

Eye Diseases

Some 50,000 people in Bangladesh are suffering from different eye diseases in Thakurgaon and

Panchagarh districts[4]. The affected people, mostly poor, cannot avail the healthcare facilities in the absence of government eye hospital or eye camp in the two districts. According to an estimate of an NGO, some 20,000 children in Thakurgaon are suffering from various eye diseases. They are deprived of getting treatment due to abject poverty. Indiscriminate use of pesticides and environment pollution were thought to be responsible for the outbreak of the eye diseases. Most of the affected children turn blind at later life for lack of treatment facilities. Shafiuddin Foundation, a non-government organization, in 2006 set up an eye hospital at Devipur in Sadar upazila of Thakurgaon for providing treatment to affected people. Tasrifa Khatun, Chairman of Shafiuddin Foundation, said eyes of 28,800 children would be examined and given treatment free of cost this year .

Tuberculosis

About 70,000 people die of tuberculosis and nearly three lakh are afflicted with the disease every year in the country[4]. There is a need for creating mass awareness about tuberculosis as people affected with the disease should be detected at the early stage and given proper treatment.

Foot-and-mouth disease

Over a thousand cows have died and about 5,000 others have been affected with "foot-and-mouth disease", locally known as khura rog, in 9 upazilas of Sirajganj district[2] (Fig. 11.7).

Farmers are facing problem as they cannot use their cows to prepare lands. Owners of milk producing farms are also worried over the situation. Symptom of the disease first appears in the form of fever in the animals. After 2 or 3 days, the animal is affected by foot and mouth disease and refrains from taking food. Within 10 to 15 days, it dies. There is no treatment for the disease although it can be prevented if vaccine is used before infection. Shortage of vaccine and lack of necessary steps by the concerned livestock officials is seen as the cause for the large scale spread of the disease. There is no treatment for the disease while the vaccine to prevent the disease is yet to reach the areas. There are about 2.5 lakh cows in 9 upazilas of Sirajganj district, which is famous for dairy farms. Many people of the district, especially in Shahzadpur upazila, depend on dairy farms that have been set up centring the Milk Vita Company and some other milk collection centres in Baghabari area. The disease appeared in a small scale but it has spread in an epidemic form in Raiganj, Kazipur, Sirajganj Sadar, Belkuchi, Tarash, Shahzadpur, Chowhaly, Ullapara and Kamarkhanda upazilas of the district.

***Figure11.7**: A cow suffering from the foot and mouth disease in Bangladesh (Source: Daily Star).*

Bhutan

Malaria

With 123 malaria cases recorded during 2009, which started in March, contrary to its usual beginning in April, Sarpang dzongkhag had reported the most malaria infections among the five southern malaria prone dzongkhags in the Bhutan[5].

Chief program officer of the vector-borne disease control program (VDCP) in Gelephu, informed that malaria started early this year because of the onset of early monsoon rain. VDCP, knowing that early rains would aggravate malaria infections, had carried out awareness campaigns in all the vulnerable regions.

Dengue

As per the health officials of Bhutan, dengue, an epidemic disease, could be controlled marginally due to awareness programmes conducted by the Health Ministry. Dengue is of two types, (1) a viral disease transmitted to humans by the dengue-infected mosquito—the Aedes aegypti and Aedes albopictus species of mosquito; (2) the severe form of dengue, also called dengue haemorrhagic fever (DHF), which can result in death if not treated properly, though mortality due to DHF is below 1%. Children below 15 years were more vulnerable to the virus. The outbreak of dengue in Bhutan is an indicator of climate change, according to the WHO[5]. With the change in climate, higher altitude places in Bhutan could see cases of dengue fever. Dengue is an urban disease occurring in tropical and subtropical regions and outbreak commonly occurs in towns and cities. Dengue fever-related cases had crossed last year's figures and at least 5 people died from it. There were 32 dengue cases in August in Phuentsholing. By October, that number had shot up to 154 cases, with one death, recording an increase of 122 cases in just over a month.

Soil borne disease kills wild pigs

An outbreak of Clostridial infection (a soil borne disease) was responsible for the death of 17 wild pigs in Bumthang district of Bhutan[5]. Doctors explained that the soil borne organisms infect animals through broken skin or any open wound on the body. As it is a contagious disease, it can spread to other susceptible population of wild pigs. While farmers believe that there will be less damage to crops this autumn with the death of the pigs whereas, the forestry officials said that death of a large group of wild pigs would be disadvantageous ecologically.

India

Hepatitis B

The epidemic had first broken out in the Sabarkantha district in western Gujarat which fell into the grip of the deadly Hepatitis B virus[6]. Death toll in Gujarat's Sabarkantha district[8] due to hepatitis B rose to 58. The health authorities have circulated 30,000 pamphlets as a public awareness campaign and have appealed to them not to panic. The situation had forced the administration to call state and national level health teams to look into the matter. State Pollution Control Board issued closure notice to 5 pharmaceutical companies believed to be involved in medical waste recycling. Meanwhile, the Gujarat Pollution Control Board (GPCB), issued closure notices to 5 pharmaceutical companies in Ahmedabad. With the issuance of closure notices, the Gujarat Vrja Vikas Nigam Limited would be disconnecting their electricity supply soon. After the hepatitis B situation worsened in the state, the Gujarat government has fully gone into the prevention mode[6].

A vaccination drive was initiated in North Gujarat continued trying to cover as many people as possible. Around 56,000 people were administered hepatitis B vaccines in Modasa, the most affected area whose total population is estimated to be over 60,000. All the hotels and restaurants

in Modasa town in Sabarkantha district in north Gujarat were ordered to be closed down as the hepatitis B epidemic continued unabated[7]. Special teams of experts from the National Institute of Virology, Pune, the All India Institute of Medical Sciences, New Delhi, and the National Institute of Communicable Diseases visited Modasa and other affected parts of Sabarkantha district. A special laboratory had been opened at the Civil Hospital, Ahmedabad, to test the hepatitis virus. The Sabarkantha police had arrested a medical practitioner, on the charge of culpable homicide not amounting to murder after it was found that most of the patients who died in the current epidemic were initially treated in his clinic opposite the Modasa primary health centre. The police have found that the doctor reused disposable syringes and this may have caused spread of the epidemic[7]. At least 7 other doctors were earlier booked for various irregularities. Three engineers in the Water Supply Department were suspended for allowing sewage to mix with potable water.

Encephalitis

Encephalitis is of two types (1) the Japanese Encephalitis (JE) (2) Acute Encephalitis Syndrome (AES). The JE spreads due to a virus present in pigs and wild birds and is transmitted to the humans through mosquito bite while the AES is caused by entero virus present in the contaminated water[8]. During the year 2009 several cases of this disease were reported from many parts of India. The fatalities due to the deadly brain fever has reached 481 since January this year in eastern districts of Uttar Pradesh and adjoining districts of Bihar[9]. A total of 2,787 patients suffering from JE and AES were admitted this year to different hospitals of the region. Out of these 481 had died. The disease was also reported in July from upper Assam's Sibsagar district where at least 8 people died because of encephalitis and 16 others were reported to be suffering from the disease[10].

There has been a worrisome trend in the instances of Encephalitis cases in India during the recent years. According to official figures, 3 children died and 21 JE cases were reported in 2006, while the death toll rose to 164 in 2007 during which 336 cases were reported. Similarly in 2008, 46 children died of the disease and 198 were affected[11].

Dengue

During the year 2009 dengue took the form of an epidemic in the state of Andhra Pradesh in India. Disease broke out in 14 districts. The government officially put the dengue fever toll across the State, at 8 and the affected cases at 782[6]. Though the disease broke out in 14 districts, but deaths occurred ironically in Karimnagar and Hyderabad (urban) districts, where medical facilities are amply available. Karimnagar accounted for 5 deaths and Hyderabad for 3. With 220 cases, Ranga Reddy district topped the list of deaths followed by Hyderabad (204) and Karimnagar 49. The other districts which reported dengue cases were Warangal (49), Khammam (34), Nalgonda (27), Adilabad (21), Medak (10), Nizamabad and Nellore (5 each), Kurnool (4), Krishna (2) and Pakasam and West Godavari (1 each).

Delhi had also faced the disease in a big way during the year 2009. The total number of those suffering from this vector-borne disease in the capital city of Delhi has risen to 438 and 2 were reported dead. The MCD had intensified measures to prevent the spread of dengue and were conducting fogging operations in various areas.

Six deaths were reported due to dengue in Lalkuan, Nainital district of Uttarakhand. A team

of doctors was deployed to deal with the emergency and required arrangements for medical help and fogging have been ensured[6].

In Bangalore in Karnataka, 3 dengue deaths including 2 children were reported during August 2009[6]. Apart from this, a 10-year-old boy of Dabbegunta village in Tumkur district of Karnataka also died of dengue fever[6]. District health staff rushed to the village following news of the death of the boy and took steps to minimise the spread of the disease.

Malaria

In parts of Bihar, an outbreak of cerebral malaria assumed epidemic proportions and had claimed 30 victims in Munger district till first week of August 2009. The first case was reported a month ago, and by August 1,500 people were reported affected6. Huge crowds thronged Munger's Sadar hospital for investigation of the disease (Fig. 11.8). People come to hospitals with high fever and headache. In a day or two, some of them started to vomit, and then became unconscious. The Centre had sent 8 doctors from the National Vector-borne Disease Control Programme.

In parts of Karnataka state as many as 885 cases of malaria and 1 death was reported from Dakshina Kannada district in the first 2 months of 2009. A total of 837 malaria cases were reported in the district during the corresponding period last year which shows a lack of preparedness and increase in the numbers of malaria-affected people. Malaria has claimed the life of one person in the district this year[6]. Similarly, as many as 365 malaria cases were reported from Mangalore in February and 520 cases were reported in January. One person died of malaria in the Mangalore City Corporation limits in February. Local administration, educational institutions, anganwadis and town planning commissions were involved in creating awareness against malaria in the area.

In Orissa, deaths were reported in the month of September 2009 at Gudrigaon village in Saramuli panchayat of Daringbadi block in Kandhamal district,suspected to have been caused by cerebral malaria, according to the team of medical experts and officials. Eight deaths, including 7 children below the age of 10 were reported from the village in a space of 3 days[6]. Earlier it was suspected that they had died of food poisoning. The administration had started measures in all remote areas of Daringbadi block to check cases of malaria and cerebral malaria.

Figure11.8: *People undergoing treatment for malaria in India* ***(Source:*** *http://nimg.sulekha.com/health/original700/when-drugs-stop-working-malaria-fights-back-2009-12-27-15-10-51.jpg*

Cholera

In Hyderabad (Andhra Pradesh), there were at least 12 deaths due to contaminated water, and hundreds were admitted in hospital[12]. The health authorities directed their focus on supplying zinc supplements, ensuring safe drinking water and spreading awareness about abuse of antibiotics and hygiene.

In Hamirpur district of Uttar Pradesh residents of Bari village under the Pharnol panchayat, where 124 persons had developed symptoms of

diarrhoea, have said that there might be residues of some dead animal or bird in the bowli water that led to its contamination[12]. A team of doctors was camping in the village so that immediate treatment could be ensured for the ill.

In Orissa's Kalahandi district in September 2009 an outbreak of cholera created panic. Twenty six people were reported dead[12]. Over 35 villages were affected and medical teams worked round the clock to ensure there is no repetition of 2007 events when the outbreak claimed over 100 people. Kalahandi is one of the most backward districts in the entire country. The reason behind this outbreak was said to be lack of safe drinking water.

Rat fever

In Bangalore (Karnataka) the city hospitals had recorded cases of leptospirosis, a bacterial disease commonly known as rat fever. Over 20 suspected cases of leptospirosis had been treated as outpatients in the state-run Victoria hospital and 7 of these had tested positive for the disease in the month of July 2009[7]. Leptospirosis is caused when the skin comes in contact with dirty water, wet soil or vegetation that has been contaminated with the urine of infected animals, especially rodents, which pass the bacteria in their urine. This bacteria can live for a long time in fresh water, damp soil, vegetation and mud and enter the human body through small skin abrasions. Commonly found to affect the poor in the slums, the incidence is higher after rains as flooding and water logging helps spread the bacteria in the environment. The disease can be fatal if the patient does not get timely treatment. The infection that usually starts with fever, body pain and sore throat in the first week turns into jaundice by the second week. If left untreated, it could affect the kidney causing hepato–renal disease.

In Rameswaram district in Tamil Nadu, more than 400 people were reported as affected by suspected leptospirosis, known as rat fever[7], in several villages in and around Pamban in May 2009. The disease was attributed to water stagnation.

Chikungunya

In Karnataka as many as 13,073 suspected cases of chikungunya had been reported from 26 districts till July 2009[11]. In Shimoga district (Karnatka) as many as 32 chikungunya cases were reported till mid of June 2009. According to reports from the health department of the 10 cases of chikungunya in Sorab and Sagar taluks, 2 in Hosnagar taluk and 8 in Shimoga taluk were registered[7]. Patients were treated in local health centres (Fig. 11.9). According to district health officer all precautionary measures were being taken up in the district to control the disease and the department officials were operating swiftly in the district to trace it and create awareness among people. In Uttara Kannada district cases of people suffering from chikungunya rose to more than 25,000 in different taluks till the first week of July 2009[7].

In the Madurai city of Chennai over 1,000 suspected chikungunya cases were reported at various places in the month of September 2009. Private hospitals in Chinthamani, Melamadai, Vilachery, Karimedu and Ponnagaram had reported cases of suspected chikungunya. Patients complained of fever, headache and severe joint pain. Preventive measures, including sprinkling bleaching powder, fogging pesticides and removal of water stagnated in these areas, had been taken up.

***Figure11.9** : People undergoing treatment for Chikungunya*

Bird-flu

The year 2009 saw many parts of India especially eastern India reporting bird-flu. In Sikkim over 4,000 poultry birds were culled in the month of January since a bird-flu outbreak was reported in the north-eastern state[10]. Culling had started on January 19. A central rapid response team from the health ministry, which was rushed to Gangtok, assisted state health authorities in planning the containment measures. Apart from conducting house-to-house human surveillance, health workers were treating people suffering from fever. The Department of Animal Husbandry had on January 19 notified the outbreak of bird-flu in poultry in the Hospital road locality of Ravongla Municipality in south Sikkim district. No human case of avian influenza has been reported in the area. The official said they were undertaking a massive awareness campaign against bird-flu in the state—by distributing pamphlets and making announcements through radio and television channels. The health ministry had also provided medicines, protective equipment and masks to health workers. The outbreak of the virus was also confirmed in West Bengal and Assam. A total of 483,726 birds have been culled in the two states. In West Bengal culling operation continued in the avian flu-affected villages of south Dinajpur district with an estimated 22,398 birds killed till February 2009[10]. Culling operation had initially been slow due to logistical reasons and apprehension among a section of villagers, but it has gradually picked up momentum. After the culling operation there were moping and sanitation operations for two days. The outbreak of avian influenza was officially confirmed in the area on the night of February 17. The affected villages include Barmahar, Cheity, Mahespur, Kakadighi and Altadighi.

Maldives

Chikungunya

The outbreak of chikungunya in the month of January 2009, on several islands in Laamu atoll has been described as an epidemic by doctors[13]. Outbreak began around a month ago on Isdhoo–Kalaidhoo before spreading to several other islands including Fonadhoo and Gaadhoo.

Dengue

As per the centre for community health and disease control the dengue fever is spreading rapidly in Malé and the atolls. According to the centre, 304 cases had been reported till May 2009—156 in Malé and 148 in the atolls—with 26% of those affected children under the age of five.

Health ministry records showed 2,768 people in 2006 and 1,671 people in 2007 suffered from dengue fever, while the disease caused 12 deaths over the two years. Controlling mosquitoes required the support of the public. There was currently no law which empowered the government to order people to destroy mosquito breeding grounds. Mosquito-borne diseases such as chi-

kungunya and dengue fever have increased in the Maldives in recent years.

Viral fever

The ministry of health had reported a viral fever spreading across all the atolls of the country. An official from the centre said that the highest number of cases had been reported in Haa Alifu, Haa Dhaalu, Lhaviyani, Laamu, Gaafu Alifu and Gaafu Dhaalu atolls[13]. A total 1,463 cases of viral fever were reported in Malé between 14 June and 11 July 2009.

Nepal

Diarrhoea

In Nepal the bacterial disease diarrhoea assumed the proportions of an epidemic. As per EM-DAT there were about 282 fatalities and 52,014 affected due to the disease between May and August. 2009.

The Ministry of Health had put the death toll due to diarrhea–cholera epidemic at 301 including 151 in Jajarkot[14]. Forty six diarrhoea deaths were confirmed in Rukum, 20 in Dailekh, 17 in Achham, 14 in Surkhet, 8 each in Baitadi and Doti, 7 in Dolpa, 6 each in Salyan and Bajhang, 4 each in Rolpa, Dadeldhura and Kailali, 3 in Bajura, 2 in Pyuthan and 1 in Kanchanpur. Doctors working in the affected districts blamed lack of awareness and sanitation, and difficult terrain for the severity of the outbreak. The doctors said that there is bound to be differences in numbers because no one has a foolproof mechanism to verify the cause of deaths and have to rely on narration of villagers.

The worst affected was the Jajarkot district where 151 people have died in three weeks in the month of July 2009. According to the Nepal Health Research Council (NHRC), the cholera bacterium, Vibrio cholerae, had been confirmed in 30% of the patients suffering from diarrhoea in the mid-western district[15]. The control of the disease faced a mammoth challenge as the family members of the ones who had suffered from diarrhoea had started abstaining from treatment fearing the spread of cholera bacteria.

In the Suikot VDC of Salyan district diarrhoea caused 5 fatalities in the month of July 2009. Health professionals said that contaminated drinking water was behind the spread of the disease[15]. 4 children were reported to have died of diarrhoea within two days in July 2009 in the Dolpa district[15]. Two persons died of diarrhoea while another 100 were affected by the disease in four VDCs in Doti district over a period of 10 days in July 2009[26]. More than 300 people of different VDCs of Dadeldhura district were affected with diarrhoea in July 2009. The outbreak had hit Koteli, Ajayameru, Bhadrapur, Bagarkot, Jogbuda, Atital, Shrisha, Bhageswor and Gangkhet VDCs of the district[16]. In Kailai district 2 minors had died of the disease, and dozens of people were taken ill[15]. Patients were ferried to the Seti Zonal hospital for treatment. Health personnel from Nepal Army also provided medication to infected people during the outbreak (Fig. 11.10). However, there was shortage of medicine and treatment was difficult.

National Human Rights Commission (NHRC) explained that sub-standard, contaminated food distributed by different organisations, including WFP, was one of the reasons behind the large scale diarrhoea deaths in far-western Nepal[17]. NHRC concluded this after a month-long investigation of the diarrhoea outbreak and distribution of food ration in the far-western region this year. Though it is not the only reason behind the outbreak, multiple lab-tests of WFP-distributed

***Figure11.10**: An army paramedic inserting IV cannula to carry out rehydration therapy of a minor who fell unconscious due to diarrhoea in Dandimandi of Dailekh (Source:The Kantipur News).*

***Figure11.11** :In Rolpa district as there was no rainfall in the district during monsoon, people facing water shortage were compelled to consume poor quality water (Source: The Kantipur News).*

samples of rice and lentil showed the items were contaminated and unfit for human consumption (Fig. 11.11). The report also states that most of the WFP-distributed food packages did not have basic details and information required by the law concerning consumer rights. The quality of WFP-imported food rations was never checked at the customs until the diarrhoea broke out. The first lab test found that about 16.5 metric tonnes of rice imported for distribution by WFP did not meet the standard, according to NHRC[17].

Unknown Disease

At least 6 persons died and an estimated 100 fell ill following the outbreak of an "unknown disease" in Bhagwoti VDC of Jajarkot district[16], in the month of September 2009. The disease outbreak coincides with the Dashain vacation, where health workers were packing off home. The VDC was also suffering from the dearth of medicines in the health posts. Finding that health workers are gone home, panick-stricken people started visiting faith doctors and resorted to local healing. In Sindhuli district the death toll from the unidentified disease was 5. Four people died and more than a dozen others were taken ill by an unknown disease at Neulapur-2 of Bardiya district in the month of July 2009. Two people died of an unknown disease at Ghurkot here in Nawalparasi district. It was learnt that the deceased complained of headache, fever and problem in breathing. The patients struck by the mystery illness fell unconscious with severe pain from the head to the chest as if they had been stung by poisonous insects. But the patients did not show any mark of insect bites on them[16].

HIV/AIDS

Seven persons died of HIV/AIDS in the Kapilvastu district in 2009 due to lack of anti-retroviral (ARV) medicine. Among the dead were 4 children, 2 men and 1 woman. A total of 48 out of 281 HIV infected had died in the district. The people suffering from HIV complained that they are not getting the ARV regularly[18].

Pakistan

Gastroenteritis

During 2009 gastro instances assumed epidemic proportions and affected several parts of Pakistan between April and October 2009. The number of gastro patients had increased to 2,700 in Lahore during May 2009. The health department had issued instructions to the government and private hospitals to give ORS to the patients[19]. In Nawabshah 5 people including 2 children and 1 woman were dead from gastro disease while dozens of people were admitted to hospital during June.

In Multan district after the first downpour of monsoon season, the outbreak of viral and bacterial diseases, like gastroenteritis was reported from various health facilities of the district[20]. The inflow of patients having gastroenteritis, an inflammation of the stomach and the intestines, admitted in different government and private hospitals complained of drinking contaminated water. A large number of patients from different

areas of Multan were admitted in the government-run hospitals. In Nowshera district 2 minor girls had died, while hundreds reached hospitals of gastro-related problems during August 2009[21]. In Chichawatni district at least 2 women died and 1,000 were infected as gastro broke out[20]. The health department provided treatment facilities by setting up medical camps. According to deputy district officer health Chichawatni, more than 1,000 people had fallen victims, and complained of vomiting and diarrhoea in Shah Kot village and were provided medical aid in camps.

In Manshera village 2 people were killed and hundreds got affected in Bajna village after a gastro intestinal outbreak in August 2009[22]. Hundreds of affected people of area were taken to a camp near the village and mobile teams of nearby basic health unit treated the affected people who were profusely vomiting and complained of loose motions. The locals said drinking water pipelines were old and broken at several points, leading to contamination of water in the village. One villager said a non-governmental organisation had also provided the water purifying pills to the villagers but that could not cover the entire village.

In Muzzafargarh district at least 3 persons including 2 girls and 1 woman were killed and dozens others affected as gastro broke out in Rasoolabad area of Tehsil Jatoi during August 2009[21]. According to health sources, epidemic disease Gastro gripped Rasoolabad and other adjoining areas of Tehsil Jatoi of Muzzafargarh due to unhygienic conditions of food items and polluted drinking water. Two children died of gastro in Jalalpur Bhattiyan area[20]. The disease broke out due to the use of rotten vegetables, spurious beverages and contaminated water in the area. Two minors died and several others were affected when diarrhoea erupted in Swarai area in Buner in August[22]. At least 2 children died and 37 have been affected of gastro disease and admitted to hospital in Banga Khail an area of Kalabagh during October 2009[20].

Dengue

At least 25 deaths and as many as 1,800 dengue fever cases were reported from Pakistan confirmed in the country[19]. In Lahore 2 people died of dengue fever after reports about spread of dengue here in the city[20]. The number of patients suffering from dengue fever were on the rise and the number of patients suffering from dengue reached 20, who were admitted to various public hospitals. All the hospitals had made arrangement to tackle any outbreak of dengue. Health experts had repeatedly expressed that the spike of the infection this time might be more deadly as a patient's second exposure to dengue virus might cause DHF that was more fatal than dengue fever. Dozens of new dengue cases were reported from various parts of Haripur after 7 people died from the virus[31]. At least 7 patients diagnosed with dengue fever died during September in Khanpur, Pind Gujran, Khoi Nara, Raniwah and other parts of Haripur. Dozens of new dengue patients were also admitted to hospital.

Viral disease in wild animals

The Kirthar National Park, the second biggest National Park in Pakistan witnessed a deadly outbreak of viral diseases in the month of September which had claimed the lives of 62 animals during 2009 (Fig. 11.12). The results of the DNA test of the dead animals, which the Sindh Wildlife Department (SWD) had sent to the Islamabad laboratory, revealed that the diseases was diagnosed as peste de petits ruminants (PPR), a viru-

***Figure11.12**: A snap showing sick wild animal*

lent disease that spreads mostly among sheep and goats. SWD officials have confirmed that the diseases, which previously spread among the ibexes' population of certain areas of the park, have now spread in almost the entire parts of the park. The SWD had declared a critical emergency in the park during which four substantial quarantines were built in the park to accommodate the affected animals for proper treatment. Besides that, the SWD had also launched a mass campaign to vaccinate the 40,000 sheep and goats in the premises of the park with the help of the livestock department.

Sri Lanka

Dengue

As per EM-DAT, and the Epidemiology Unit of the Health Ministry, Sri Lanka, the total number of dengue cases in Sri Lanka has risen to 28,194 during 2009 (Fig. 11.13). According to the statistics released by the Epidemiology Unit, 264 people had died due to the disease1. The figures reported within the period of eight months this year were the highest in the history of Sri Lankan health sector. The worst that was reported is in 2004 with 15,457 cases and 88 deaths.

Kandy District was the worst affected reporting 3,296 cases and 35 deaths. Colombo, Gampaha, Kurunegala, Kegalle and Ratnapura districts also showed high prevalence of the disease. The number of affected people peaked in June with 7,048 and the numbers declined since then. According to the Epidemiology Unit the mosquito-

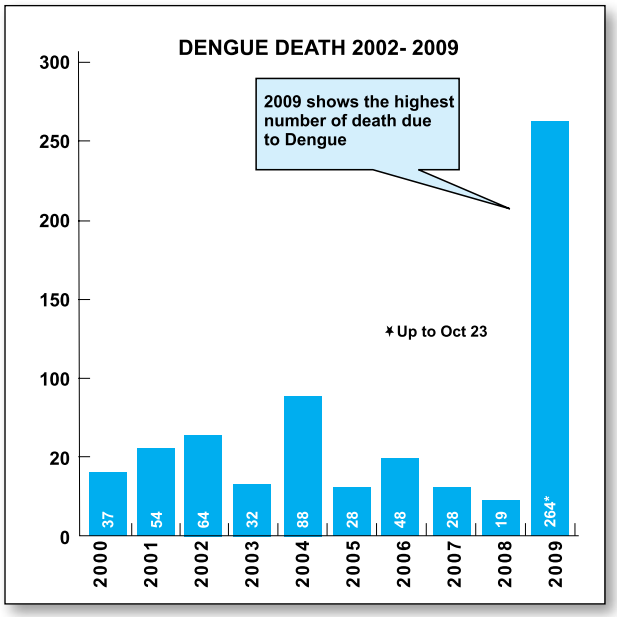

***Figure11.13**: Number of deaths due to dengue in Sri Lanka between 2002 and 2009*
(Data source: Epidemiology unit, Health Ministry, Sri Lanka).

borne disease shows a seasonal trend, where two peaks of dengue occur following monsoon rains in June–July (Fig. 11.14).

The decline is due to the stern measures taken by the Health Ministry to control the spread of the mosquitoes through extensive public awareness programs. After a peak in the month of June, the number of dengue cases declined in Sri Lanka, according to the data released by the epidemiology unit of Sri Lanka's Health Ministry.

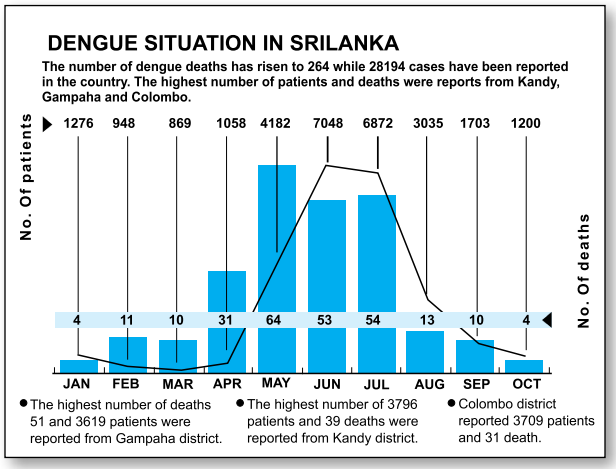

Figure11.14: *Monthly distribution of dengue-related deaths in Sri Lanka during 2009. Data upto October 2009.*

The Ministry even took legal action against the negligent public who promoted the epidemic by inadvertently providing breeding grounds for the mosquitoes. The Health Ministry also consulted Cuban epidemiologists to curb the growth of mosquito population by introducing a bacterium to kill the mosquito larva.

Sri Lanka Ministry of Healthcare and Nutrition had declared the fourth week of September as the Dengue Prevention Week to conduct a island wide awareness program. Several awareness programs were conducted during this week to educate the public to control the spread of sometimes fatal disease. Fogging and chemical control methods were applied.

Hepatitis

Health authorities in Badulla had warned about the danger of Hepatitis spreading in Bandarapura and Rambukpotha in the Badulla Pradeshiya Sabha area23. According to the Director Provincial Health Services, 60 cases of Hepatitis were reported in these localities. The investigations conducted by the health officials revealed that the running water supplied by the Badulla Pradeshiya Sabha, to Bandarapura, Rambukpotha, 2nd Mile Post and Vineethagama, had been found to be contaminated with faecal matter and it was suspected to be the cause for the spread of the disease. Further, it was also discovered that the source of water flowing from Glen Alpin estate was prone to contamination by the disposal systems of the estate workers' latrines and the cowsheds, and that there existed no system for purification through water treatment before distribution.

Rat Fever

Healthcare and Nutrition Ministry of Sri Lanka said that around 2,100 persons infected with rat fever or leptospirosis were reported in the year 2009 of which 81 had died. When comparing with last year there is around a 50% decrease in leptospirosis in 2009. The majority of the affected persons belonged to the country's work force who are between the age of 35 and 55. Colombo, Gampaha, Matara, Matale, Kandy and Kegalle have been badly affected.

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Chapter 12

Man-made Disaster

An Overview

The man-made disasters account for very high number of casualties in the South Asian countries. These include technological disasters like bomb blasts, air strikes, mine blasts, military/arm forces strikes, militant strikes, industrial disasters like industrial fire, road and train accidents, airplane accidents etc. The documentation of the man-made disasters is very essential as these incidents are often isolated and their impacts to the society and the economic losses incurred by the nations are considerable. The causes behind many of these disasters are complicated in nature and are governed by socio-economic, political and technological factors or sometimes, combination of these. The events are often witnessed in scattered distribution and many a times not properly reported. In 2009, among the man-made disasters transport accident shares 67.10%, miscellaneous accident 18.72% and industrial accident covers 14.18% (Fig. 12.1).

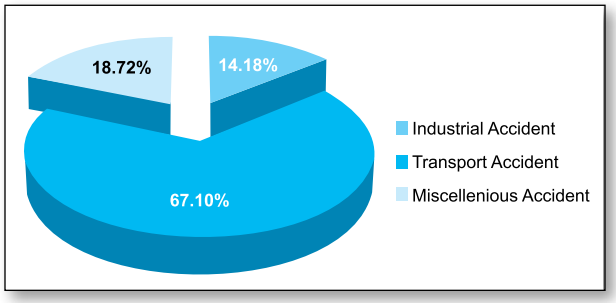

***Fig. 12.1**: People killed by different manmade disasters in South Asia. (Data source: EM-DAT)*

Some of the major man-made disasters witnessed in the South Asian countries during the year 2009 are discussed below and events are listed in Appendix-VIII.

Afghanistan

During the year 2009, Afghanistan was a witness to several incidents which were influenced by human activities and the majority of them were incidents related to bomb blasts and violence due to military attacks on insurgents or counter attacks by the insurgents on the military or allied forces and these had claimed nearly 3000 lives in the war-ravaged country during the year.

Bomb blasts/Violence

In a well coordinated exercise on 7th January 2009, the US-led coalition killed 32 armed insurgents during a strike on a Taliban bomb making cell in eastern Afghanistan. According to the reports the troops also destroyed two caches of weapons and roadside bomb-making materials that were too unstable to move to another location[1]. On 19th January 2009, the US led coalition forces killed 22 militants, including 2 Taliban commanders, during a series of operations in southern and eastern Afghanistan[2]. Afghan and international forces had killed around 30 militants in Afghanistan, 22 of them in NATO air strikes after an International Security Assistance Force (ISAF) patrol retaliated after being attacked near the Pakistan border. A suicide bomber in police uniform killed 25 policemen and wounded several others on 3rd February 2009, after infiltrating their morning exercises in southern Afghanistan.

The powerful blast, claimed by the insurgent Taliban, was the one of the deadliest in Afghanistan during the year and caused a scene of bloody carnage that an ambulance driver likened to a butcher's shop. The bomber walked into the station in the town of Tirin Kot, capital of the southern province of Uruzgan, and detonated explosives strapped to his body, as the authorities said3.

Thirty Taliban-linked militants were killed and 17 injured in a police operation in the Uruzgan and Helmand provinces of southern Afghanistan and 3 others died in an explosion during a bomb-training session in the eastern province of Khost on 31st March 2009 (Fig. 12.2). The incidents occurred in the backdrop of the summit in Hague where the world leaders had gathered to focus on ways to help Afghanistan tackle the growing extremist insurgency and build stability3.

Figure12.2*:Afghan security forces fighting insurgents following attack on government offices in Khost province, east of Kabul (Source: Nashanuddin Khan/AP).*

Afghan and international forces killed 40 Taliban militants in separate battles in the troubled country on 12th April 2009. In one incident, the rebels ambushed a joint Afghan and foreign forces patrol in Shinkay district of Zabul province, sparking off an exchange of gunfire in which 22 rebels died. According to ISAF sources, in another

Figure12.3*: A victim of ISAF airstrike on an oil tanker is being carried to the Kundz Hospital (Source: AFP).*

incident troops killed 18 insurgents in the north-eastern province of Kunar (Fig. 12.3). In yet another set of separate incident, the US-led troops had killed 42 militants in Afghanistan on 29th April 2009. The deadliest battle of the day fought in the southern province of Uruzgan where the US military said nearly 2 dozen militants were killed after ambushing a patrol of coalition troops and police. Nine more were killed in the adjoining province of Helmand in a fighting that erupted when troops identified armed militants preparing an attack from inside a wood area. According to the US military, another 10 insurgents were killed in a battle with troops under US command in the southwest of Kabul in the strategic province of Logar—the site of a multibillion-dollar Chinese project to develop a copper mine[3]. In one of major incidents in the year 1995, Afghani civilians were reported to have died in a United States-Taliban battle in western Afghanistan, according to Obeidullah Helali, a lawmaker from Farah, involved in the investigation into the deaths. According to the American sources the Taliban had kept villagers hostage which was the reason for such high number of civilian deaths[1]. On 5th June 2009, 3 Afghan children were killed by a mortar left over from a battle between po-

lice and Taliban, while bomb attacks and clashes left 28 more people dead, most of them militants. The children, aged 4 to 10 years, were killed when they touched a mortar shell left over from an exchange of fire the previous day between Taliban and police in the central province of Ghazni, police sources said[4].

Ahead of the August 20th elections, the Afghan and International forces had intensified the operations to curb insurgency and in the process of coordinated attacks 47 militants along with 5 Afghan police and soldiers lost their lives on 10th June 2009. Unconfirmed reports also mentioned loss of civilian lives in the attack5. In a similar operation, part of an anti-insurgent drive, local troops backed by NATO-led international forces stormed a militant stronghold in the southern province of Uruzgan killing 23 insurgents1 on 24th June 2009. Over 40 members of an anti-Iran terrorist group have been killed during deadly fighting with Taliban militants in Afghanistan. The killed were reported to be members of Mujahedin-e-Khalq (MKO)6. A cluster of vehicle bombs detonated simultaneously on 25th August 2009 in the Taliban's spiritual homeland near a foreign-owned construction company that had recently taken over a contract to build a road through an insurgent-held area and had claimed at least 41 lives (Fig. 12.4). The thundering explosion occurred just after nightfall in a district that includes United Nations facilities and an Afghan intelligence office. The force of the blast shattered windows around the city and sent flames shooting into the sky.

On 5th September 2009, a NATO airstrike on a pair of hijacked fuel trucks in northern Afghanistan early Friday killed or injured at least 90 people—a mix of Taliban militants and civilians, provincial government officials said[7]. There were conflicting reports about the number of casualties. In the same month, at least 50 people, including 32 civilians, were killed in a string of attacks across Afghanistan. The largest loss of life was reported in southern Uruzgan, where a roadside bomb planted by Taliban militants killed 14 civilians and wounded several others in Chora district[6].

***Figure12.4**: A policeman at the scene of simultaneous destruction caused by detonation of 5 car bombs in Kandahar city on 25th August (Source: Allauddin Khilji/AP).*

In a violent incident 6 members of a family, including 4 minors, died in a bomb explosion, east of Afghanistan by a device that was planted beneath a cistern and was remotely detonated, reports say. The incident came amid the high water mark of violence despite the presence of about 110,000 US-led soldiers in Afghanistan (Fig. 12.5).

***Figure12.5**: Remains of the car bomb explosion that killed 6 members of a family, including 4 minors (Source: Press TV).*

Fire

Three people were killed and 6 others were wounded in a fire incident on a car garage in Nangarhar province on 13th May 2009. The fire occurred when a tanker of a corolla car was being welded by one of workers. According to the sources, the fire extended inside the car garage where 15 mini-vans and more than 20 shops were destroyed in the incident. The health conditions of the 3 injured individuals were reported to be quite serious[8].

Road/Rail Accidents

Eight people, including 5 of a family and 3 others died when a vehicle veered off a bridge while crossing a snow covered bridge in eastern Nuristan province of Afghanistan on 24th February 2009. The family was travelling to Paroon to visit the grave of their relative, who had died recently[10]. In another road accident in Kabul–Najrab highway 10 people died and 4 were injured.

In a traffic accident 4 people, including 2 women and 2 boys were killed and 3 were injured on 16th July 2009, in Logar province when a vehicle collided with a tree[8].

Poisoning

On 26th April 2009, 5 Afghan teachers and 40 of their pupils, most of them girls, were admitted to hospital with severe headaches after a suspected airborne poison attack. They fell ill during a ceremony at a school in the Sadiqi district of Parwan province, some 70 km (40 miles) north of the Afghan capital, Kabul (Fig. 12.6). According to some sources terrorist involvement was not ruled out.

Attacks on girls' schools had increased in 2009, particularly in east and south Afghanistan[2]. In another incident nearly 50 Afghan teenagers had to be admitted in hospital after a mystery gas attack on a girls' school in the northern town of Charikar on 11th May 2009. On 13th May 2009, another 98 Afghan girls were rushed to hospital as a spate of mysterious poisonings hit 3 schools north of Kabul in a fortnight, according to officials. The children fell ill as they entered the school building in the small town of Mahmud Raqi, about 70 kilometres (45 miles) north of the capital. A doctor dealing with the case said that the school had apparently been filled with gas overnight[3].

***Figure12.6**: Girls undergoing treatment in Afghanistan after mysterious gas attack in schools in Afghanistan (Source: AFP).*

Other accidents

An Indian teacher, working in an Afghan university, and his wife died following leakage of poisonous gas at a hotel in Kabul on 30th January 2009. The couple died following leakage of some poisonous gas in the hotel where some employees of the hotel too were injured[9].

Collapse

Seven Afghan women and a 4-year-old girl were killed when a roof collapsed under them during a wedding party, police sources reported on Tuesday. Another 10 people were injured in the accident late Monday in the northern province of Kunduz, said a provincial police commander, Abdurrahman Aqtash. About 40 women and chil-

dren were standing on the roof to watch men outside celebrating wedding, with music and dancing. The building was old and made in the traditional style of stakes and clay, according to the official sources[3].

Bangladesh

Fire

A major fire broke out in Shaheed Abdur Rab railway colony in Chittagong on 16th February (Fig. 12.7). Twenty nine shanties, thatched houses and properties worth around Tk 4 lakh were gutted in the fire. Nine fire fighting units from different stations rushed to the spot and doused the fire after 3 hours effort[12]. A number of shops were gutted in a fire that broke out at Yakub Market in city's Elephant Road on 20th February noon. Fire Brigade sources said the fire originated in a shop in the market, opposite to the Gausia Market, but the reason behind the fire could not be ascertained. Twenty two fire engines were pressed into service to control the fire and rescue the trapped people[13]. In another fire event at least 150 houses were destroyed at Yousufdia village in Saltha upazila in Faridpur on 23rd February 2009. Police and locals said a burning oven in the kitchen of Miraj Matbar sparked off the fire at about 12:30 pm, which soon engulfed the adjoining houses, mostly thatched and straw-made houses. Two fire-fighting units from the district town arrived at the spot one and a half hour later only to find that the villagers had already extinguished the blaze. The house owners claimed that some 75 families became homeless due to the fire that also destroyed their stock of rice and onion[12]. The loss was estimated at Tk 1 crore.

At least 70 dwellings were gutted and 25 people sustained injuries when a devastating fire broke out at Uttar Machhpara village in Sadar upazila on 11th March 2009. Locals said the fire originated from a kitchen at 1:00 pm and soon engulfed the adjacent houses burning down all the valuables, including cash, money and crops. On information, fire fighters from Sadar headquarters rushed to the spot but they failed to douse the fire as their fire fighting machines went out of order, which increased the extent of the loss. Additional fire fighting forces were pressed into service and the fire could be controlled with the help of the local people. 25 people had suffered injuries in the accident[14]. On 14th March 2009, at least 120 shops and an unspecified number of houses were gutted and 42 people suffered burn injuries in two separate fire incidents in Sadar and Tajumuddin upazilas. Witnesses said a fire originating from a candle shop swept through Elisha Junction Bazar in the Sadar upazila, burning down about 20 shops. Nearly 40 people were injured in the accident. Two female factory workers were burnt alive in a fire that broke out at Ms. Luna United Company, a cotton factory, in Kadamtoli area on 21st March2009. According to the factory sources, the 2 workers were burnt alive as they were trapped inside its bathroom during the blaze that also gutted goods kept in the factory. According to the sources the fire might have originated from a candle as the workers were working under the light of candles during load-shedding in the area[12].

A devastating fire swept through a refueling station in Mohakhali in the capital on 4th May afternoon (Fig. 12.8), burning at least eight vehicles including an octane-laden lorry and injuring 2 people. A minor girl and her cousin were burnt to death and her 5 family members suffered serious burn injuries in a fire that engulfed their house at Polashpur in Shanirakhra area under

Kadamtoli police station in the wee hours of 18th July 2009[13]. A devastating fire swept through the warehouse of National Curriculum and Textbook Board (NCTB) in the Tejgaon Industrial area on 18th October 2009. Fire service and NCTB officials said the fire originated on the ground floor and immediately spread through the three-storey building. About 15 fire fighting men suffered injuries during their efforts to put out the blaze. Huge stocks of published material and printing material were destroyed in the fire (Fig. 12.9). According to some sources a high degree of loss was attributed to non-observance of fire safety codes[13].

At least 800 slum dwellings were gutted in a big fire near Maghbazaar wireless gate on 22nd November 2009 morning, leaving 1 woman dead and 4 others injured (Fig. 12.10). Fire service duty officer informed that the fire broke out from a cooking stove at around 4.45 am.

***Figure12.7**: Firemen trying to douse fire at Abdur Rab Railway Colony in Chittgong (Source: Daily Star).*

***Figure12.8**: Fire fighters attempting to control fire in a oil tanker in Mohakhali (Source: Amran Hossain).*

***Figure12.9**: Huge quantity of textbooks gutted in fire at NCTB in Tejgaon Industrial Area (Source: The New Nation).*

***Figure12.10**: A wailing resident of slum at Maghbazar Wireless railgate (Source: The New Nation).*

Road/Rail Accident

Sixteen people were killed and at least 20 injured as a bus and truck collided head-on in Sirajganj on 28th May 2009 (Fig. 12.11). Most of the dead were bus passengers. In another accident 13 people were killed and 15 others injured in a tragic road accident on the Dhaka-Mymensingh highway on 13th July morning when an over-loaded truck skidded off the road and fell into a 10 feet deep ditch[12].

***Figure12.11**: A passenger bus seriously damaged in head-on collision with a truck in Sirajganj (Source: The New Nation).*

***Figure12.12**: Bogies of a Chittagong bound train derailed after collision with a truck (Source: The New Nation).*

At least 30 people were injured as four compartments of Chittagong bound "Turna Nishitha express" from Dhaka derailed when it crashed into a truck at Fatehpur rail gate on the outskirts of the district town on 24th July 2009 morning (Fig. 12.12). The truck was totally smashed on being hit by the train. Three of the injured train passengers were admitted to a local hospital while others were released after getting first-aid[13]. In another fatal accident in Purbo Sadarbari in Bhanga upzila on 6th December 2009, 21 people were killed and 50 were injured as 2 passenger-laden buses collided head-on and then crashed into a roadside ditch.

Industrial Accidents

At least 3 workers, including 2 women, were killed and 10 others injured in a boiler explosion at a rice mill in Burichang upazila on 26th March 2009. Police and fire fighters said around 3:15

AM the boiler of Nishad Rice Mill exploded scattering over a 250-yard-area damaging the tin-shade mill and the adjacent house of the mill owner[12].

Four workers were killed and 20 others injured in a big explosion at a ship-breaking yard at Madamdibir Haat in Sitakunda Upazila, Chittagong on 27th December 2009 morning (Figs. 12.13 and 12.14). The tragic accident occurred at

***Figure12.13**: Smoke coming out of the exploded oil tanker at Chittagong (Source: The New Nation).*

***Figure12.14**: One of the workers injured in the Chittagong shipyard explosion undergoing treatment*

Rahim Diamond Steel & Ship Breaking Yard when some 50 workers were dismantling an oil tanker of 14,000 tons. Witnesses said a boiler suddenly burst into flames at about 10:30 AM while the workers were cutting a ship, killing 4 of them on the spot and injuring15others[13].

Building collapse

Two children were killed and 25 others injured as an abandoned old structure of Kaligram Dodangi High School of Manda upazila in Naogaon collapsed during the school's Independence Day programme on 26th March 2009. According to the sources, the collapsed school building was abandoned years ago and it was suspected that the building had collapsed due to the load of the people climbing on the roof to enjoy the programme[12]. Six members of a family were killed as their mud house at Chatalgram in Nabiganj collapsed in the early hours of 3rd July due to torrential rain. As a turn of fate the family had started living in the newly built mud house on the same day. In another incident 4 children were killed on saturday 21st November 2009 afternoon when a big chunk of soil collapsed on them while playing on the bank of the river Karatoa in Sirajganj[15].

Food poisoning

On 9th June 2009, 352 students of Potkakhali Govt Primary School in the district fell sick after consuming biscuits distributed under a feeding programme of the United Nations World Food Programme (WFP). The affected students developed drowsiness, stomach-ache and vomiting shortly after taking the biscuits[13]. In a separate incident on 4th July 2009, at least 63 students of Bagerhat Government PC College fell sick after taking meal at the girls' hostel of the college. They were reported to be suffering from diarrhoea and vomiting. According to the civil surgeon, lizard droppings or similar contamination may have been the cause[15]. On 30th July 2009, about 300 workers of a garment factory at Palashbari fell sick after taking their lunch provided by the factory management.

Bhutan

Fire

The row of shops lining the Samdrupjongkhar–Trashigang highway that has defined Wamrong town for decades went up in flames 8th October afternoon, burning 12 houses to the ground (Fig. 12.15). However, no one was injured. The fire came at a time when the eastern dzongkhags were still reeling under the shock and damage from an earthquake and a windstorm. The fire, which started around noon and burned late into the evening, was suspected to have started from a house below the main line of shops, triggered by an electric short circuit from a kitchen. In another incident, about 12 families living in upper Haa town were rendered homeless when a fire, which broke out 18th November 2009 afternoon, completely gutted 3 houses and partially burnt another (Fig. 12.16). Nine families lost everything in the blaze while 3 families living in the partially gutted house managed to salvage some of their belongings[25].

Figure12.15*:The burning remains of a conflagration that gutted 12 houses in Wamrong*

Figure12.16*: One of the houses that was destroyed in the fire in Haa town (Source: Kuensel Newspaper).*

India

Bomb Blasts/ Violence

Terror struck on the first day of 2009 in Assam where 3 serial blasts triggered by suspected Ulfa militants left 5 people dead and more than 60 injured in Guwahati. The explosions took place a few hours before the Union Home Minister P. Chidambaram flew in for his maiden visit to review the law and order situation[16]. In one of the worst Maoist attacks on security forces in Maharashtra, 15 policemen including a sub-inspector were killed in the jungles of Markegaon village in Dhanora tehsil of Gadchiroli district, around 300 km from Nagpur, on 1st February 2009 morning. According to police sources, around 40 maoists of the newly-formed Border Platoon Dalam were involved in the ambush[16]. In the neighbouring state of Chattisgarh, 4 people, including 2 security personnel, were killed and another was injured in a powerful landmine explosion by the naxals on 12th April 2009, while 6 left-wing extremists were gunned down in 2 encounters in Bastar. The events took place in the wake of the Lok Sabha polls in the state[22].

Road/Rail Accident

Six persons were killed and around 200 others injured when they fell from the roof of a speeding train at Chilbila near Pratapgarh in Uttar Pradesh on 19th January 2009, night. The incident happened when people sitting on the roof of Saryu Express, many of them travelling from Faizabad to participate in defense recruitments scheduled for the youths of Allahabad division, were hit by a tree branch[9]. Thirteen school children and a teacher were killed and 26 others injured when a tempo in which they were travelling collided head-on with a truck on a national highway in Rajasthan's Barmer district on 20th January 2009. The children and the teacher were returning home from school when the accident occurred near Ramji-Ka-Gole village at Gudhamalani. On 24th January 2009, at least 12 pilgrims were killed and 30 others injured as a tractor trolley they were travelling in, collided with a speeding

train at Unchahar railway crossing near Rae Bareili, disrupting rail traffic on the section. Another mishap occured at around 9 AM when a tractor trolley carrying 65 pilgrims to Allahabad for a holy dip in the Sangam during the Magh Mela hit Allahabad–Kanpur passenger train[19].

At least 25 people were killed and 17 injured in a bus accident in the mountainous Doda district of Jammu and Kashmir on 24th February 2009 morning, police sources said. The accident took place when the bus skidded off the road and fell into Neeru nullah, a tributary of Chenab river at Pul Doda in Doda district, about 170 km north-east of Jammu[20]. At least 24 pilgrims were killed and about 75 injured when a truck carrying them from the shrine of Naina Devi in Himachal Pradesh overturned near Anandpur Sahib in Punjab on 30th March. The truck, with nearly 105 pilgrims, including women and children, was returning after the group prayed at the Naina Devi shrine on the occasion of the ongoing Navratra festival.

According to the police, the truck driver had turned the truck into a double-decker by fitting wooden slats so that he could squeeze in more passengers[16]. Nineteen people were killed and 15 injured when the truck they were travelling in turned turtle in Maharashtra's Pune district early on 19th April. The victims were travelling from Kalyan to Sholapur in a truck carrying iron pipes and the vehicle skidded off the Pune–Sholapur highway and overturned[20]. Thirty persons, 16 of them teachers, were killed after the minibus they were travelling in fell into the Chenab near Bandarkot village on 3rd May 2009 in Jammu and Kashmir. As the bus was on its way to Palmar from Kishtwar, a majority of the teachers from Government Higher Secondary School, Palmar, had boarded the ill-fated vehicle[23]. Twelve persons were killed and 8 injured in a road accident involving 4 vehicles near Palladam in Tirupur district, in Tamil Nadu on 22nd June 2009 (Fig. 12.17). Of the deceased, 10 were travelling in a van from Coimbatore to Palladam for an engagement function and 2 in a car were going from Coimbatore to Karur. Police sources said that the van collided with a lorry while it was trying to overtake a car. In the process, the van hit the car killing both the persons inside[21].

Figure 12.17: *Mangled remains of the vehicles involved in the road accident in Tamil Nadu (Source: http://picsdigger.com).*

In a major road accident in Jammu and Kashmir, 26 people were killed and 20 others injured when two buses coming from opposite directions collided head-on in the Udhampur district on 23rd June 2009. On 5th July 2009, 11 persons, including 3 women, were killed and as many injured when a speeding minibus skidded off the Bankim Setu flyover while attempting to overtake another and fell 40 feet below on railway tracks at Howrah station in Kolkata (Fig. 12.18). There was a loud screeching sound as the vehicle plunged off the flyover and hit the overhead traction wires sending sparks flying before overturning. As it fell on the tracks, the roof of the bus got torn off[9]. 70 people were injured when a Kerala State Road Transport Corporation (KSRTC) bus

***Figure12.18**: A Crane lifts a damaged coach of a passenger train near Mathura (Source: msnbc.msn.com).*

was hit by a lorry rolled 15 feet downhill at Ottakkal, near Thenmala, on National highway 208 on the evening of 10th August 2009. The bus went out of control when it was hit by the lorry and plunged downhill.

Twenty passengers were killed and around 17 injured when the driver of the Delhi-bound Goa Express apparently ignored signal and rammed into the last coach of the stationary Mewar Express near Mathura early on 20th October 2009. The smashed coach was reserved for women and physically handicapped people[16]. Thirty people, including 6 children and 12 women, were killed. Another 29 people were injured when an overcrowded private bus on its way from Nagrota Suriyan to Dehra, rolled down over 100 feet from a bridge over the Baner Khud, near Haripur in Kangra district, about 250 km from Shimla, on 8th November 2009. The impact is so severe that it took a long time for the rescuers to retrieve the bodies from the wreckage.

Fire

A 6-year-old girl was charred to death and over hundred huts were reduced to ashes when a fire broke out at Goginati in Bihar's Kishanganj district on 11th March 2009. Police said that the fire was caused by a burning stove and spread quickly through the village in Pothia block under the influence of strong westerly winds. Property worth several lakh of rupees was estimated to have been destroyed in the blaze[21]. In an incident of industrial fire, a large fire broke out in a firecracker factory in western India on 10th April 2009 killing at least 23 people and injuring another 48. On 29th April 2009, at least 29 shops, 8 houses, 3 temples and a police post were gutted in a devastating fire that broke out at Manikaran in the Parbati Valley in Himachal Pradesh.

Eyewitnesses said the fire broke out at around 2.30 AM and within a few minutes engulfed the entire area. Two persons, including a 3-year-old girl, were killed when a fire broke out in a slum at Anand Vihar in the Trans-Yamuna area in Delhi on 22nd June2009. Over 150 shanties were gutted in the blaze. At least 15 people were killed and 20 others injured when gelatin sticks stocked in a house blew up due to a fire triggered by a cylinder blast in a village in Guntur district on 15th November. The explosion was so powerful that nearly 15 neighbouring houses were razed, police sources said[16].

Industrial Accidents

Two persons were killed and 31 houses reduced to ashes, displacing over 150 people in two separate incidents of fire at Indian Oil Corporation Limited (IOCL) refinery town at Digboi, including one inside the refinery, on 13th May 2009. The fire broke out at the delayed coking unit (DCU) of the country's oldest oil refinery at Digboi owned by Assam Oil Division (AOD) of IOCL at around 6.30 AM and flared up in no time. Sixteen people were burnt to death and more than 25 others suffered serious injuries when a major fire raged through a fireworks factory and godown at Vadakkam-

patti near Madurai on 7th July 2009. Eight persons died on the spot while others succumbed to the burn injuries later. The factory was involved in manufacturing of unbranded crackers which produce hi-decibel sound with pyrotechniques, used in temple festivals, weddings and other such occasions[9]. Eight persons were killed and 45 workers suffered burns in an explosion at a private fireworks manufacturing unit at Vadapatti near Sivakasi on 20th July 2009. At the time of the accident, at least 200 to 225 workers were on the campus. Out of the 65 sheds (each measuring about 300 square feet) at least 25 were fully damaged and 7 were partially damaged. Though the sheds had been constructed as per norms, negligence in handling chemicals was cited as the cause behind the explosion[21].

On 30th September 2009, the town of Amritsar witnessed a major accident when the boiler of a milk processing unit exploded injuring 12 people. The powerful explosion was felt within a radius of one kilometre. Twelve persons died and 9 were grievously injured in a massive blast triggered by domestic gas leakage in a house that had 2 tonnes of explosive material stored in the thickly populated area of Nadikudi in Guntur district on 16th November 2009. Unauthorised stock of more than 2 tonnes of ammonium nitrate owned by an explosives licence holder was the cause for the accident.

In an accident of its kind a fire broke out in a chemical laboratory at the Bhabha Atomic Research Centre (BARC) in Trombay near Mumbai on 29th December 2009, killing 2 people[24].

Collapse

In a second such accident involving the Delhi metro rail in less than a year an overhead concrete bridge under construction gave way and collapsed, crushing 6 people to death and injuring fourteen on 12th July 2009[23](Fig. 12.19). At least 6 persons were killed and 3 injured while some others remained trapped under the debris when a three-storey shopping complex collapsed in Faridabad, the satellite township of the national capital. The "City Centre" collapsed at around 12.45 PM and sources said that repair work was going on in the top floor of the building and heavy machines were installed there (Fig. 12.20). In yet another incident, 20 workers were

***Figure12.19**: A section of an under-construction Delhi Metro flyover in the capital's Lakshminagar area collapsed and fell on a bus, killing at least two persons. (Source: blogs.reuters.com).*

killed and at least 50 trapped under the debris when a chimney of an under-construction power plant of Bharat Aluminium Company Ltd (Balco) collapsed in Chhattisgarh's Korba town on 23rd September 2009. The chimney structure had col-

***Figure12.20**: Figure12.20: Collapsed part of City Center in Faridabad (Source: NDTV News).*

lapsed amidst heavy rain. In a major bridge collapse incident a bridge under construction on the Chambal river caved in Kota district of Rajasthan. Twenty eight people died in the incident.

Maldives

Fire

Raging fire destroyed Thaa Veymandoo Youth Center on 30th May 2009. Although no casualties were reported, the fire destroyed an estimated one million Rufiyaa worth of goods and equipments inside the center. In another incident a water bungalow and six rooms in Vilu Reef Resort in Dhaalu atoll were destroyed in a fire that broke out on 3rd July 2009.

The fire was extinguished within an hour with the help of islanders, living in nearby islands, and assistance from other resorts nearby but all appliances and items in the bungalow and the six rooms were completely burned[11].

Road Accident

On 10th May 2009, 3 people were injured in a dangerous road accident involving 3 motor cycles and a car on Addu Link road. On 21st June 2009, a speeding car, while trying to overtake a cycle, collided with the cycle on Addu Link road, sending the cycle and its occupants crashing on to the asphalt causing serious injuries. Simultaneously, the collision sent the car rolling over several feet injuring the driver and rendering the vehicle unusable (Fig. 12.21). The car and the cycle were travelling in the same direction, towards Gan from Hithahdoo[11].

Fifteen people were injured in an accident that occurred on 4th December 2009, between a launch and a dhoni some 500 foot off Gaaf Dhaal atoll Kaadehdhoo. One of the injured reported to be in severe condition was brought to Male.The accident occurred when a launch which was travelling at a high speed from Kaadehdhoo collided with a dhoni which was travelling from Gaaf Dhaal Madaveli to Gaaf Dhaal Thinadhoo. There were 12 people on the launch and 13 on the boat. Out of the 15 who were injured in the accident, 10 were men and 5 were women. The man seriously injured was initially placed at intensive care unit (ICU) of Thinadhoo Regional hospital[11].

Figure12.21: *Car overturned in the road accident*

Nepal

Road/Rail Accident

At least 9 people were killed and 22 others injured when a tractor carrying pilgrims met with an accident at Ramgram in Nawalparasi district in the wee hours of 26th January 2009. Ten people died and 6 others were injured when a Mahendranagar-bound vehicle carrying 17 people met with an accident at Jhyulek of Siddeswor VDC along the Jaya Prithivi Singh highway on 2nd March 2009. The mishap probably occured due to narrow and muddy road conditions. In another accident nearly 20 passengers including the driver were confirmed dead and more than 10 injured after a passenger bus heading from Jalbire in Sindhupalchowk to Kathmandu veered off the

Araniko highway and plunged into the Sunkoshi river 30 meters below the road on 10th September 2009 morning (Fig. 12.22). The bus that had left Jalbire at seven in the morning met with the accident while it was speeding to prevent another bus coming from Barhabise from overtaking it, following an argument between the drivers at Balefi[27]. Seventeen passengers were killed and 11 injured when a bus they were travelling in met with an accident in Kamerepani of Hansapur VDC, some 27 km from the district headquarters

***Figure12.22**: Policemen and locals look at the ill-fated bus that plunged into the Sunkoshi river (Source: www.myrepublica.com)*

***Figure12.23**: Victims of the Pokhara bus accident being rescued (Source: www.myrepublica.com).*

Sandhikharka, on 7th November 2009 morning. The bus was heading towards Sandhikharka from Gokhunga of Arghakhanchi. According to the District Police Office Arghakhanchi, the passenger bus veered off the road and plummeted into a gorge, about 300 metres down the hilly road. Thirteen people were killed and 37 others injured when a Pokhara-bound overloaded passenger bus skidded off, and plunged 150 metres below into a gorge in Sarangkot VDC-1 around 10 AM on 15th December 2009 (Fig. 12.23). The police suspected that the accident might have occurred due to brake failure[26].

Boat capsize

On 5th January 2009, morning an overcrowded boat overturned in the Koshi river killing 6 people. The boat which was carrying around 25 passengers, mostly women and children had capsized after hitting a floating log. Sixteen people could however, survive the tragedy. Five of the 9 persons, who had gone to the Kamala river to collect holy water, were swept by the swollen river on 27th July 2009[2]6.

Collapse

A church building collapsed during a Christian convention in eastern Nepal, killing at least 23 people and injuring dozens more. Around 1,500 Christians had gathered in the town of Dharan for the meeting when a makeshift three-storey structure built to accommodate participants gave way at about midnight after hours of heavy rainfall. The wall was made of bamboo and it could not withstand the weight of the people. Many of the dead were women and children and at least one of the victims was from neighbouring India[26].

Fire

Three people died in the flames when one of the houses at Nayabazar in Kirtipur was ignited in the wee hours of 1st January 2009. The tenant family—father, mother and fifteen month old minor—residing in the house died in the inferno. The police guessed that the fire that they had burnt to keepthemselves warm might have been

the cause of the accident[27]. Over 100 houses were gutted by a fire which broke out in Mahadaiya of Pathargaiya VDC of Kapilvastu district on 21st February. According to District Police Office, the fire started at around 3 PM and quickly spread over the village due to gusty wind. In another major fire accident, over 200 houses were gutted when a fire broke out at Pramanpur in Tikuliya VDC-3, Saptari, on 1st April 2009[26]. A remote village across the Rapti river was gutted by a fire on 15th June 2009 evening. About 60 houses in Kalaphat VDC were burnt to ashes.

Pakistan

Building collapse

A mother and her five children died early on 18th January 2009 when the roof of their room collapsed due to heavy rain in the Rampura village, 15 kms off Bahawalnagar. The family was sleeping when the roof caved in the night[16]. On 22nd July 2009, a four-storey under construction building collapsed around 8:30 PM near Firdous market in Liaquatabad. Rescue workers from different agencies pulled out 13 injured people and 16 bodies from the debris[17].

Fire

At least 38 people were killed and 25 injured when a fire ripped through dozens of homes in a shanty town in Pakistan's largest city Karachi on 9th January 2009. Initial reports indicated the blaze in the teeming southern port city was sparked by a lowered power wire that fell onto the roofs of the huts. The deceased included 15 children and 12 women[18]. Furthermore, 7 members of a family including 1 woman and 2 children were burnt to death when a fire broke out in a house in Bugna village near Atmuquam in the Neelum valley on 16th January 2009. According to the police, the fire broke out after a gas cylinder exploded. Household articles worth thousands of rupees were reduced to ashes as the fire quickly engulfed the entire house[16].

Road/Rail Accident

A passenger coach travelling from Karachi to Nawabshah plunged into Rohri canal on 3rd August, killing 30 passengers. The coach carrying around 30 passengers went out of control and plunged in the canal[17]. On 6th August 2009, 34 people were killed when a passenger bus travelling from Rawalpindi to Skardu plunged into Indus river near Malopi Rando. The bus fell into Indus river due to over speeding and brake failure. According to the police all passengers died because of water flowing high in the river[4]. At least 7 people, including 2 women, were killed and 21 others injured on 4th September 2009, in a road accident near Khurianwala Morr, some 5 kms from Sheikhepura. According to the police, a Lahore-bound bus overturned due to overspeeding and collided with a car and a jeep. In the meantime, another car coming from behind crashed into the vehicles[17]. In another accident on 14th December 2009, at least 16 persons were killed and several others injured including women and children in a terrible road mishap near Mithi. A fast moving bus collided with a car coming from the opposite direction resulting in the death of the 16 passengers while several others sustained serious injuries[17].

At least 13 people were injured on 3rd May 2009, when 3 carriages of Shalimar Express derailed near Hyderabad (Fig. 12.24). The train was on its way to Lahore from Karachi when the accident took place[15]. On 3rd November 2009, at least 17 people died and 45 others were injured when

a passenger train collided head-on with a goods train near Jumma Goth in limits of Quaidaba. As per details, Karachi-bound Allama Iqbal Express collided with Super Parcel Goods train resulting in the gruesome accident[4] (Fig. 12.25).

***Figure12.24**: Police and rescue workers stand around derailed bogies of Shalimar Express at Latifabad (Source: Daily Times).*

***Figure12.25**: Passengers being rescued from the Allama Iqbal express (Source: http://news.bbc.co.uk)*

Boat capsize

Fourteen persons, including women and children drowned on 14th April 2009, when a boat capsized in the Indus river near Kundian. Eighteen persons of the Kacha Darhanwala area were travelling to the Seelwan area for wheat harvesting when their boat capsized due to the strong currents of the water. The local fishermen, working at the Chashma Barrage, managed to recover the bodies of a man, 2 women and 2 children[15]. On 16th June 2009, a boat going from Katcha to Karampur sank in Baigari Canal near Karampur area, killing 20 people on board. According to the police, 20 to 25 people, most of them women and children, were on board of the boat at the time of the accident[4]. On 22nd September 2009, 10 picnickers, mostly youngsters, drowned at sea off Gadani in Balochistan while 8 others were rescued by lifeguards. Rescuers and police said that 16 youths, who were among hundreds of others, went to Gadani on the second day of Eid-ul-Fitr, for picnic. They were seen drowning at sea by the lifeguards, who after hectic efforts, managed to rescue eight of them[4].

Bomb blasts/Violence

Two suspected US missile attacks in tribal areas of Pakistan claimed 22 lives in the month of January. Eight suspected foreign militants were among the dead. A senior security official said that authorities were trying to determine the seniority of an Egyptian Al-Qaeda militant believed to have been killed in the attacks[18]. Nearly 32 people were killed when a suspected suicide bombing ripped through a crowd of Shia worshippers outside a DG Khan mosque on 20th February 2009 (Fig. 12.26). Police said the blast targeted dozens of people converging on the Al-Hussainia Mosque after dark, shortly before a religious gathering. Although there was no immediate claim of responsibility, police were swift

***Figure12.26**: Relatives of people dead in the DG Khan bomb blast (Source: Daily Times).*

to blame sectarian extremists following a wave of violence in the country. On 20th February 2009, curfew had to be imposed in Dera Ismail Khan and the army called in to quell riots immediately after a suicide bomber killed at least 30 Shias and injured another 157 who were attending a funeral in southern Dera Ismail Khan district. Witnesses said police "ran off" when gunfire broke out after the blast at the funeral of Shia leader Sher Zaman—who was gunned down a day earlier[15]. In one of the major bomb blasts of Pakistan during the year 2009, at least 70 people were killed and 125 injured when a suicide bomber blew himself up at a mosque during friday prayers near Baghiari checkpost area in Jamrud tehsil of Khyber agency. The deceased included 10 security personnel. A witness told reporters that a man who had arrived in a black car entered the mosque—located on the Pak-Afghan highway—during the sermon and blew himself up[15]. In another similar incident, on 5th April 2009, at least 35 persons died and 160 injured, when a suicide attacker blew himself up at the gate of an Imambargah, as he was intercepted by a constable at the gate while trying to force into the courtyard. Seventeen people, including 5 children, who were close to the gate died instantly while 8 others succumbed to injuries soon after reaching Chakwal District Headquarter hospital (Fig. 12.27). The Imambargah is situated at Mohala Sarpak in City Police Station jurisdiction where some 2,000 people were busy listening sermon[17]. In a suicide bomb attack that took place on 6th June 2009, 40 people were killed and another 70 injured when a suicide bomber blew himself up outside a mosque in Hayagai Sharqai village in Upper Dir district. The bomber blew himself up near the entrance when people were leaving the mosque after offering friday prayers, the sources said, adding that the attack could be a retaliation by terrorists who were earlier driven out of the area by local residents15. On 9th October 2009, a suicide attack at Khyber bazaar killed 48 people and injured more than 148, according to the official and hospital sources. According to the Cantt Superintendent of Police, the blast occurred at 12:15 PM after a white car rammed into a public transport bus (Fig. 12.28). He said the car was packed with 100 kg of explosives. Bomb disposal squad chief Shafqat Malik confirmed that a suicide attacker was responsible, adding the device was planted in the door panels of the vehicle and included machinegun ammunition, designed to inflict maximum casualties, AFP reported. The

***Figure12.27**:Terror struck affected people of the Chakwal bomb blast incident (Source: The Post).*

***Figure12.28**: Shattered and charred remains of the bus blown up in the Khyber bazar suicide bomb attack (Source: Daily Times).*

blast left a charred skeleton of a bus flipped on its side in the middle of the road, with the twisted remains of a motorbike nearby. In another major bomb attack, a remote-controlled car bomb killed at least 105 people—including women and children—and injured around 200 others in Peshawar's Meena bazaar on 28th October 2009, hours after US Secretary of State Hillary Clinton arrived in Pakistan to bolster the two countries' alliance against Taliban and Al-Qaeda[15](Fig. 12.29).

***Figure12.29**: Site of bomb blast in the Pearl Continental hotel in Peshawar (Source: BBC News).*

Sri Lanka

Road/Rail Accident

A fatal accident involving a bus, a tractor and a motorcycle in Kekirawa late night on 8th May 2009 killed 4 people and injured 29 others. According to the police the bus carrying a group of pilgrims from Kurunegala was plying towards Anuradhapura when it collided with a tractor. Four persons, 3 of them in the same family were killed on the spot. In another accident at least 6 people were killed and another 30 were injured in a bus accident at Mara Colony in Tangalle on the night of 22nd May 2009. According to the Tangalle police a private bus heading to Kataragama with more than 35 passengers pilgrims collided with a parked lorry loaded with commercial gas cylinders. Six people were killed and 23 others were injured when a lorry carrying pilgrims collided with a dump truck transporting sand in southern Sri Lanka on 24th December 2009. The lorry was plying to Kataragama with a group of pilgrims from Horana area while the dump truck was heading to Wellavaya[28].

On 15th May 2009, a train ploughed into a bus packed with school children on an excursion killing 12 of them and maiming 45 others at Manampitiya in the Batticaloa area. The tragedy occurred at the Manampitiya level crossing around 7.45 in the morning. According to the sources, the bus had crept through the railway gate which was closed at the time when the train ploughed into the bus dragging it nearly 250 metres[29].

Boat capsize/Water accident

Five people drowned in a boat mishap in the Nawagiriyawa tank in Uhana, Ampara, 15th June 2009 afternoon, according to the police sources. The incident occurred while a local party along with another party from Parakaduwa, Ratnapura was enjoying a boat ride. The victims included 3 males, 1 female and an infant. Seven people drowned on 10th May 2009,in two separate lakes at Madampella, in Kochchikade and Udawalawa while bathing. According to the Kochchikade police 5 people were drowned at Madampella Lake and 3 of them were from the same family from Piliyandala while the other 2 were a father and a daughter from Katana[28].

Bomb blast/Violence

Thirty people, including 20 soldiers and 10 civilians were killed and 64 people, including 40 civilians were injured when a woman, who had arrived with a group of displaced people, blew herself up at a receiving centre for displaced at Sugandarapuram in Vishvamadu on 9th Febru-

***Figure 12.29**: Scene of the suicide attack in Matara (Source: http://transcurrents.com*

ary 2009. The dead included several children. In another violent incident the Liberation Tigers of Tamil Ealam (LTTE) opened fire on civilians crossing to the safety of government controlled areas from the uncleared areas in Puthukuduiruppu on 10th February 2009, killing 19 and injuring 69, including children. In a suicide attack at the Jumma Mosque in Matara district 15 people were killed and 46 were injured which included the Posts and Telecommunication Minister Mahinda Wijesekera on 10th March 2009 (Fig. 12.30). Eye witnesses said around 5,000 people including several Government Minister's were proceeding to the Mosque in a procession to attend the main event held in celebration of Prophet Mohammed's birthday when the suspected LTTE suicide bomber struck[29]. In a separate incident, artillery shells hit a makeshift hospital in Sri Lanka's northern war zone on 2nd May 2009, killing at least 64 civilians. The new "Safe Zone" in Mulaitivu came under attack on 9th May 2009 with both the military and the LTTE blaming each other for the incident amidst reports of civilian casualties (Fig. 12.31). According to the BBC sources atleast 300 civilians were killed[30].

***Figure 12.29**: Scene of the suicide attack in Matara (Source: http://transcurrents.com*

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Chapter 13

Conclusion

The South Asia disaster report is an initiative to document and share information about the disasters, natural as well as man-made, in the South Asia Region in a calendar year and to analyse the trends in the global perspective. The earlier reports for the years 2007 and 2008 had evoked encouraging response from many quarters. The present report documents the geological, hydro-meteorological, biological and man-made disasters that were witnessed in the South Asian countries during the year 2009.

The datasets used for this publication are drawn from many sources. Daily reports of disasters in the member countries of SAARC have been meticulously collected from the published and electronic media reports and the essential information has been short listed to document the pattern and frequency of the disasters in these countries. The effort has been to collate and synthesize the data in a common platform. The information available in the report showcases the trends in regional level disaster occurrence and mitigation measures reflected in the declining trend in some of the disasters like flood, cyclone during the year. However, the higher number of casualties due to epidemics, heat and cold wave conditions and most importantly man-made disasters paint a grim picture and warrants urgent attention of the national government agencies, policy makers and various other agencies that are instrumental in disaster control and mitigation.

One of the major constraints of compiling this report has been lack of complete data sources for documentation and analysis of the disasters of the region, as has been experienced during the compilation of the previous annual reports for the years 2007 and 2008. The major and widely available dataset comes from International Emergency Disaster Database (EMDAT) maintained by the Centre for Research on Epidemiology of Disasters (CRED) but this data source has its inherent limitations. It documents disasters in which 10 or more people have been killed or 100 or more have been affected. Going by these norms, many of the small scale local level disasters in the countries of SAARC are missed. None of the countries of the region has been able to develop a comprehensive disaster statistical system that would capture every event of natural or man-made disaster however significant or insignificant that could be. To overcome this problem both local and national level media reports from print and electronic media have been widely utilized in this report.

The South Asian countries have faced some major disasters in 2009 especially in the form of epidemics and man-made disasters. The poor socio-economic conditions in parts of these countries are many times responsible for the magnified effects of natural and man-made disasters in these countries. There were widely reported incidents of water-borne diseases like cholera, hepatitis from SAARC countries. Much of the problem stemmed from lack of hygienic living conditions for a major section of the society and restricted access to safe drinking water. The year 2009 also

saw very high number of casualties due to various man-made disasters. The casualties in many of these cases like building collapse, bomb blasts were high because of high population densities in the affected areas.

There have been significant efforts from the national government agencies, relief organizations, non-governmental organisations (NGOs) and international organisations (IOs) in the recent years to address the issues related to disaster risk management. However, further fine tuned implementation of the programmes and policies can go a long way in outreaching these initiatives at the lowermost stratum of the society. Moreover, better coordinated efforts are needed to mainstream disaster risk reduction across all sectors.

The South Asia Disaster Report had been launched to bring together in a single volume the analytical results and summaries of natural and man-made disasters in the South Asian countries. The objective of systematic collection and documentation of disaster data will however, remain inconclusive if it does not contribute to improving the understanding of the causes and consequences of disasters that continue to afflict a large section of the South Asian countries. It is hoped that the publication of this report will generate interest among the researchers, policy makers, relief and rehabilitation agencies and large cross-sections of the society for better management of the risks of disasters in the subcontinent.

Appendix

Disaster Data - South Asia 2009

Appendix - I A

South Asia Disaster Profile 2009

Country	Cyclone	Earthquake	Drought	Avalanche	Flood	Heat and cold waves	Land slides	Epidemic	Total
Injured in number									
Afghanistan	-	59	-	-	16	-	-	-	75
Bangladesh	7,187	-	-	-	-	-	-	-	7,187
Bhutan	-	-	-				-	-	-
India	85	-	-	-	8	25	-	-	118
Maldives	-								-
Nepal	-	-	-	-	27	-	-	-	27
Pakistan	-	-	-	-	80	-	-	-	80
Sri Lanka	-	-	-	-	-	-	-	-	-
Total	7,272	59			131	25			7,487
Homeless in number									
Afghanistan	-	3,250	-	-	-	-	-	-	3,250
Bangladesh	-	-	-	-	-	-	-	-	-
Bhutan	-	-	-	-	-	-	-	-	
India	4,000	-	-	-	-	-	-	-	4,000
Maldives	-	-	-	-	-	-	-	-	-
Nepal	-	-	-	-	-	-	-	-	-
Pakistan	-	-	-	-	-	-	-	-	-
Sri Lanka	-	-	-	-	60,000	-	-	-	60,000
Total	4,000	3,250	-	-	60,000	-	-	-	67,250
Total affected in number									
Afghanistan	-	3,309	-	32	62,516	-	180*	-	66,037
Bangladesh	3,954,550	-	-	-	500,000	50,000	50*	-	4,504,600
Bhutan	-	12	-	-	-	-	-	-	12

Country	Cyclone	Earthquake	Drought	Avalanche	Flood	Heat and cold waves	Land slides	Epidemic	Total
India	5,109,085				3,886,008	25		1,521	8,996,639
Maldives	-	-	-	-	-	-	-	-	-
Nepal	-	-	-	-	175,027		-	58,874	233,901
Pakistan	-	-	-	-	75,080	-	-	-	75,080
Sri Lanka	-	-	-	-	380,000	-	--	33,856	413,856
Total	9,063,635	3,321		32	5,078,631	50,025	230	94,251	14,290,125
Killed in number									
Afghanistan	-	22	-	22*	69	-	15*	-	128
Bangladesh	197	-	-	-	16	135	23*	-	371
Bhutan	12	12					9*		33
India	218	-	-	10*	1,445	120	106*	311	2,210
Maldives	-	-	-	-	-	-	-	-	-
Nepal	-	-	-	-	108	18	93*	314	533
Pakistan	-	-	-	13*	102	-	33*	-	148
Sri Lanka	-	-	-	-	3	-	8*	277	288
Total	427	34		45	1,743	273	287	902	3,711
Estimated Damage (US$x1000)									
Afghanistan	-	-	-	-	20,000				20,000
Bangladesh	270,000	-	-	-	-	-	-	-	270,000
Bhutan	-	-	-	-	-	-	-	-	-
India	300,000	-	--	-	2,434,000	-	-	-	2,734,000
Maldives	-	-	-	-	-	-	-	-	-
Nepal	-	-	-	-	60,000	-	-	-	60,000
Pakistan	-	-	-	-	-	-	-	-	-
Sri Lanka	-	-	-	-	-	-	-	-	-
Total	570,000				2,514,000				3,084,000

Persons Killed in Technological Disasters				
Country	**Transport Accidents**	**Miscellaneous Accident**	**Industrial Accidents**	**Total**
Afghanistan	39	-	-	39
Bangladesh	215	-	-	215
Bhutan	-	-	-	-
India	84	45	83	212
Maldives	-		-	
Nepal	53	23	-	76
Pakistan	68	60	14	142
Sri Lanka	-	-	-	-
Total	459	128	97	684

***Source** : Emergency Database (EM-DAT) Centre for Research on Epidemiology of Disasters (CRED, Belgium accessed on September 27, 2010. Data version:v12.07*
**Data compiled by SDMC from media reports*

Appendix I-B

South Asia Disaster Events 2009

Number	Location	Disaster Type	Sub Type	Name	Date Starting	Date Ending	Killed	Total Affected	Damage Million US$x1000
Afghanistan									
1.	Sherzad, Hesarak (Nangarh ...	Earthquake (seismic activity)	Earthquake (ground shaking)		17/04/2009	17/04/2009	22	3,309	
2.	Laghman province, Alingar ...	Flood	General Flood		03/09/2009	03/09/2009	11		
3.	Kach Guzar, Nasrat Abad, ...	Flood	General Flood		25/04/2009	24/05/2009	39	60,016	20
4.	Daykundi, Kandahar, Herat ...	Flood	Flash Flood		04/04/2009	15/04/2009	19	2,500	
5.	Saland region (Hindu Kush ...	Mass Movement Wet	Avalanche		18/01/2009	18/01/2009	10	32	
6.	Heart and Ghor Provinces*		Avalanche		12/2/2009		12		
7.	Northern province of Balkh late*		Landslide		22/5/2009		5	180	
Bangldesh									
1.		Drought	Drought		00/07/2009	00/08/2009			
2.	Rajbari, Jessore, Chuadan ...	Extreme temperature	Cold wave		15/12/2009	31/01/2010	135	50,000	
3.	Dhaka, Comilla, Rajshahi, ...	Flood	General Flood		29/07/2009	29/07/2009	10		
4.	Near Habanganj	Flood	General Flood		03/07/2009	06/07/2009	6	500,000	
5.	Khulna, Satkhira, Patuak ...	Storm	Tropical cyclone	Cyclone 'Aila'	25/05/2009	26/05/2009	190	3,935,341	270
6.	Banshkhali, Anowara, Sita ...	Storm	Tropical cyclone	Cyclone 'Bijli'	19/04/2009	20/04/2009	7	19,209	
7.	Garo hill at Sandhakura under Jhenaigati upazila in Sherpur**		Landslide		2/1/2009		1	50	
8.	Tea gardens in Srimangal upazila*		Landslide		18/5/2009		6		
9.	Habiganj*		Landslide		3/7/2009		6		
10.	Slampur and Tetulia villages under Lama Upazila in Bandarban district*		Landslide		31/7/2009		10		

Number	Location	Disaster Type	Sub Type	Name	Date Starting	Date Ending	Killed	Total Affected	Damage Million US$x1000
Bhutan									
1.	Mungaar, Tashingang	Earthquake (seismic activity)	Earthquake (ground shaking)		21/09/2009	21/09/2009	12	12	
2.		Storm	Tropical cyclone	Cyclone 'Aila'	25/05/2009	26/05/2009	12		
3.	Takti*		Landslide		2/4/2009		3		
4.	Bumthang*		Landslide		28/5/2009		6		
India									
1.	Bongaigaon, Cachar, Dhubr ...	Drought	Drought		00/07/2009	00/08/2009			
2.	Uttar Pradesh	Epidemic	Viral Infectious Diseases	Japanese Encephalitis and Acute Encephalitis Syndrome	00/01/2009	00/10/2009	311	1,521	
3.	Orissa, West Bengal, Bihar	Extreme temperature	Heat wave		14/04/2009	26/06/2009	120	25	
4.	Bihar,Darbhanga, Purnia	Flood	Flood	General Flood	26/08/2009	28/08/2009	52		
5.	Nilgiris,Coonoor,	Flood	General Flood		03/11/2009	08/11/2009	70	8	64
6.	Jainta Hills district (Me ...	Flood	General Flood		09/10/2009	09/10/2009	20		
7.	Belgaum, Gulbarga, Bijapu ...	Flood	General Flood		25/09/2009	12/10/2009	300	2,000,000	2,150
8.	Bihar, Orissa, West Benga ...	Flood	General Flood		00/07/2009	00/09/2009	992	1,886,000	220
9.	Delhi	Flood	Flash Flood		29/07/2009	29/07/2009	11		
10.	Mumbai	Mass Movement Wet	Landslide		03/09/2009	03/09/2009	11		
11.	Pithoragarh district (Utt ...	Mass Movement Wet	Landslide		08/08/2009	08/08/2009	45		
12.	Darjeeling*		Landslide		26/5/2009	28/5/2009	21		
13.	Darjeeling*		Landslide		16/8/2009		7		
14.	Karwar*		Landslide		5/10/2009		21		
15.	Kodaikanal*		Landslide		16/8/2009		1		
12.	Kashmir*		Avalanche		12/1/2009		3		
16.	Srinagar*		Avalanche		14/4/2009		7		
17.	Uttar Pradesh	Storm	Local storm		07/06/2009	07/07/2009	20		
18.	Uttar Pradesh	storm	Local storm		11/05/2009	11/05/2009	32	23	
19.		Storm	Tropical cyclone	Cyclone Phyan	11/11/2009	12/11/2009	20		300

Number	Location	Disaster Type	Sub Type	Name	Date Starting	Date Ending	Killed	Total Affected	Damage Million US$x1000
20.	Bihar, Jharkhand states	Storm	Local storm		28/06/2009	28/06/2009	35	12	
21.	Calcutta, Parganas, Howra ...	Storm	Tropical cyclone	Cyclone 'Aila'	25/05/2009	25/05/2009	96	5,100,000	
22.	Kendrapara district (Oris ...	Storm	Local storm		31/03/2009	31/03/2009	15	9,050	
Nepal									
1.	Achham, Baitadi, Bahjang, ...	Epidemic	Bacterial Infectious Diseases	Diarrhoea	01/05/2009	23/08/2009	314	58,874	
2.	Saptari, Bara districts	Extreme temperature	Cold wave		00/12/2009	00/01/2010	18		
3.	Takdoo	Flood	General Flood		26/07/2009		30		
4.	Kanchanpur, Kailali, Dade ...	Flood	General Flood		04/10/2009		78	175,027	60
5.	Sankhuwasabha district	Mass Movement Wet	Landslide		28/07/2009		11		
6.	Pokhara*		Landslide		2/7/2009		6		
7.	Tanahun*		Landslide		31/7/2009		9		
8.	Dolakha*		Landslide		10/8/2009		4		
9.	Shyama VDC*		Landslide		11/8/2009		4		
10.	Balgung*		Landslide		11/8/2009		1		
11.	Dadeldhura*		Landslide		18/8/2009		1		
12.	Dhankuta*		Landslide		18/8/2009		1		
13.	Baitadi*		Landslide		19/8/2009		2		
14.	Dipayal*		Landslide		20/8/209		2		
15.	Jaleshwori VDC of Khotang*		Landslide		2/9/2009		13		
16.	Surhet & Ramechhap*		Landslide		6/9/2009		2		
17.	Laaduk VDC*		Landslide		7/9/2009		2		
18.	Doti*		Landslide		7/10/2009		1		
19.	Mahendranagar*		Landslide		7/10/2009		34		

Number	Location	Disaster Type	Sub Type	Name	Date Starting	Date Ending	Killed	Total Affected	Damage Million US$x1000
Pakistan									
1.	Ismalia, Kalu Khan, Adina ...	Flood	Flash Flood		15/08/2009		36	75,000	
2.	Karachi	Flood	General Flood		17/07/2009	19/07/2009	52	70	
3.	Mardan district	Flood	Flash Flood		14/04/2009		14	10	
4.			Avalanche*		8/2/2009		4		
5.			Avalanche*		16/2/2009		4		
6			Avalanche*		8/4/2009		5		
7.	Kohat*		Landslide		6/3/2009		3		
8.	Dora Area, Neelam Valley*		Landslide		6/5/2009		28		
9.	Nowsherea*		Landslide		29/6/2009		2		
Sri Lanka									
1.	Kandy, Colombo, Gampaha,	Epidemic	Viral Infectious Diseases	Dengue	00/01/2009	18/11/2009	277	33,856	
2.	Batticaloa, Ampara distri	Flood	Flash Flood		14/12/2009		3	300,000	
3.	Colombo and surburbs	Flood	Flash Flood		21/11/2009			60,000	
4.	Vavuniya, Ratnapura, Kalu ...	Flood	Flash Flood		15/08/2009			20,000	
5.	Norton Bridge, Hatton*		Landslide		21/5/2009		6		
6.	Galekele*		Landslide		21/8/2009		2		

***Source** : Emergency Database (EM-Dat) Centre for Research on Epidemiology of Disasters (CRED, Belgium accessed on Mar-4-2010. Data version:v12.07*
** Data compiled by SDMC from*

Appendix-II

Storms in South Asia-2009

S.I No.	Location	Disaster type	DateStarting	Date Ending	Name	Killed	Tot. Affected	Damage (US$ x1000)
Bangladesh								
1.	Khulna, Satkhira, Patuak ...	Tropical cyclone	25/05/2009	26/05/2009	Cyclone 'Aila'	190	3,935,341	270,000
2.	Banshkhali, Anowara, Sita ...	Tropical cyclone	19/04/2009	20/04/2009	Cyclone 'Bijli'	7	19,209	
Bhutan								
1.	-	Tropical cyclone	25/05/2009	26/05/2009	Cyclone 'Aila'	12		
India								
1.	Uttar Pradesh	Storm	07/07/2009	07/07/2009	Local Storm	20		
2.	Uttar Pradesh	Storm	11/05/2009	11/05/2009	Local Storm	32	23	
3.	-	Tropical cyclone	11/11/2009	12/11/2009	Cyclone Phyan	20		300,000
3.	Calcutta, Parganas, Howra ...	Tropical cyclone	25/05/2009	25/05/2009	Cyclone 'Aila'	96	5,100,000	
4.	Bihar, Jharkhand states	Local storm	28/06/2009	29/06/2009		35	12	
5.	Kendrapara district (Oris ...	Local Storm	31/03/2009	31/03/2009		15	9,050	

***Source** : Emergency Database (EM-Dat) Centre for Research on Epidemiology of Disasters (CRED)*
Accessed on Mar-4-2010.Data version:v12.07

Appendix-III

Flood in South Asia-2009

S.I No.	Location	Disaster type	Date Starting	Date Ending	Killed	Tot. Affected	Damage (US$ x1000)
Afghanistan							
1.	Kach Guzar, Nasrat Abad	General Flood	25/03/2009	24/05/2009	39	60,016	
2.	Daykundi, Kandahar, Herat	Flash Flood	04/04/2009	15/04/2009	19	2,500	
3.	Laghman province, Alingar	General Flood	03/09/2009	03/09/2009	11		20,000
Bangladesh							
1.	Near Habanganj	General Flood	03/07/2009	06/07/2009	6	500,000	
2.	Dhaka, Comilla, Rajshahi	General Flood	29/07/2009	29/07/2009	10		
India							
1.	Delhi	Flash Flood	29/07/2009	29/07/2009	11		
2.	Bihar, Orissa, West Bengal	General Flood	00/07/2009	00/09/2009	992	1,886,000	220,000
3.	Bihar Darbhanga, Purnia	General Flood	26/08/2009	28/08/2009	52		
4.	Belgaum, Gulbarga, Bijapur	General Flood	25/09/2009	12/10/2009	300	2,000,000	2,150,000
5.	Jainta Hills district	General Flood	09/10/2009	09/10/2009	20		
6.	Tamil Nadu	General Flood	03/11/2009	08/11/2009	70	8	64,000
Nepal							
1.	Takdoo	General Flood	26/07/2009	28/07/2009	30		
2.	Kanchanpur, Kailali	General Flood	04/10/2009	12/10/2009	78	175,027	60,000
Pakistan							
1.	Mardan district	Flash Flood	14/04/2009	14/04/2009	14	10	
2.	Karachi	General Flood	17/07/2009	19/07/2009	52	70	
3.	Ismalia, Kalu Khan, Adina	Flash Flood	15/08/2009	17/08/2009	36	75,000	
Sri Lanka							
1.	Vavuniya, Ratnapura	Flash Flood	15/08/2009	16/08/2009		20,000	
2.	Colombo and surburbs	Flash Flood	21/11/2009	22/11/2009		60,000	
3.	Batticaloa, Ampara district	Flash Flood	14/12/2009	16/12/2009	3	300,000	

***Source** : Emergency Database (EM-Dat) Centre for Research on Epidemiology of Disasters (CRED, Belgium Accessed on Mar-4-2010.Data version:v12.07*

Appendix-IV

Cold and Heat waves in South Asia 2009

Start	End	Country	Location	Type	Sub Type	Name	Killed	Tot. Affected	Est. Damage (US$ x1000)
15/12/2009	31/01/2010	Bangladesh	Rajbari, Jessore	Extreme temperature	Cold wave		135	50,000	
14/04/2009	26/06/2009	India	Orissa, West Bengal, Bihar	Extreme temperature	Heat wave		120	25	
00/12/2009	00/01/2010	Nepal	Saptari, Bara districts	Extreme temperature	Cold wave		18		

***Source** : Emergency Database (EM-Dat) Centre for Research on Epidemiology of Disasters (CRED), Belgium*
Accessed on Mar-4-2010.Data version:v12.07

Appendix- V A

Earthquake Data Of South Asia-2009

National Earthquake Information Centre, United States Geological Survey

Date	Lat (Deg N)	Long (Deg. E)	Dep-(km)	Magnitude	Region
5- May -09	37.323N	71.084E	220	4.7	Hindu Kush Region, Afghanistan
9- May-09	11.612N	91.940E	29	4.7	Andaman Islands, India, India Region
9 - May-09	7.655N	94.262E	52	4.4	Nicobar Islands, India Region
17 -May-09	36.602N	70.995E	222	4.8	Hindu Kush Region, Afghanistan
19- May-09	33.151N	75.730E	45	4.9	Eastern Kashmir
30- May-09	9.880N	93.399E	27	4.6	Nicobar Islands, India Region
6- June -09	34.990N	73.154E	69	4.3	Mingora, Pakistan
9- June -09	10.799N	91.748E	37	5.0	Andaman Islands, India, India Region
15 -June-09	8.790N	93.510E	33	5.6	Nicobar Islands, India Region
15- June-09	9.103N	93.670E	35	5.4	Nicobar Islands, India Region
21 -June-09	36.541N	70.813E	189	4.6	Hindu Kush Region, Afghanistan
22- June-09	12.168N	94.993E	25	5.0	Andaman Islands, India, India Region
22 -June-09	11.674N	94.565E	26	4.9	Andaman Islands, India, India Region
30 -June-09	10.543N	92.289E	35	4.8	Andaman Islands, India, India Region
5- July -09	36.488N	71.037E	241	4.8	Hindu Kush Region, Afghanistan
10-July- 09	36.768N	71.394E	141	4.5	Hindu Kush Region, Afghanistan
26-July -09	10.736N	94.287E	10	4.8	Andaman Islands, India, India Region
26-July -09	10.725N	94.347E	10	4.7	Andaman Islands, India, India Region
26-July -09	10.764N	94.368E	10	5.0	Andaman Islands, India, India Region
26-July -09	10.891N	94.480E	10	4.7	Andaman Islands, India, India Region
26-July- 09	10.887N	94.492E	10	4.8	Andaman Islands, India, India Region
26-July -09	10.824N	94.364E	10	4.7	Andaman Islands, India, India Region

Date	Lat (Deg N)	Long (Deg. E)	Dep-(km)	Magnitude	Region
26-July -09	10.666N	94.296E	10	5.1	Andaman Islands, India, India Region
26-July -09	11.862N	94.351E	10	5.2	Andaman Islands, India, India Region
27-July -09	34.903N	73.198E	38	5.1	Mingora Pakistan
27-July -09	10.722N	94.339E	10	4.8	Andaman Islands, India, India Region
27-July- 09	10.597N	94.369E	10	4.6	Andaman Islands, India, India Region
28-July -09	10.757N	94.088E	10	5.3	Andaman Islands, India, India Region
5-Aug. -09	22.360N	93.385E	74	4.7	Myanmar-India Border Region
10-Aug.-09	14.013N	92.922E	33	7.6	Andaman Islands, India, India Region
11-Aug.-09	14.029N	93.193E	35	4.8	Andaman Islands, India, India Region
11- Aug.-09	14.321N	92.957E	23	4.7	Andaman Islands, India, India Region
11-Aug. -09	14.450N	92.924E	36	4.9	Andaman Islands, India, India Region
12-Aug.- 09	24.270N	94.810E	137	5.6	Myanmar-India Border Region
12-Aug. -09	24.359N	94.783E	102	5.4	Myanmar-India Border Region
12-Aug. -09	9.107N	93.754E	35	4.9	Nicobar Islands, India Region
13- Aug.- 09	14.050N	92.890E	00	5.6	Andaman Islands, India, India Region
13- Aug.- 09	13.998N	92.806E	35	5.5	Andaman Islands, India, India Region
15- Aug.- 09	13.960N	93.060E	55	5.3	Andaman Islands, India, India Region
18-Aug.- 09	14.171N	93.001E	52	4.8	Andaman Islands, India, India Region
19-Aug.- 09	26.565N	92.485E	10	5.1	Assam, India Region
21 -Aug. -09	14.020N	92.936E	34	4.9	Andaman Islands, India, India Region
26-Aug. -09	14.113N	93.075E	36	4.7	Andaman Islands, India, India Region
31-Aug.- 09	14.034N	92.827E	10	4.8	Andaman Islands, India, India Region
4-Sept.- 09	24.318N	94.712E	97	5.9	Myanmar-India Border Region
6-Sept. -09	13.766N	93.698E	35	4.6	Andaman Islands, India, India Region
10-Sept.-09	28.661N	66.473E	35	4.9	Kalat Pakistan
10-Sept.-09	28.845N	66.320E	35	4.7	Kalat Pakistan
11-Sept.-09	10.268N	93.843E	171	4.6	Andaman Islands, India, India Region
12-Sept.-09	9.213N	94.511E	28	4.6	Nicobar Islands, India Region

Date	Lat (Deg N)	Long (Deg. E)	Dep-(km)	Magnitude	Region
19-Sept. -09	36.528N	70.750E	193	5.1	Hindu Kush Region, Afghanistan
21- Sept.-09	27.280N	91.425E	7	6.3	Thimphu Bhutan
21- Sept.-09	30.873N	79.049E	43	4.8	Uttranchal India
15-Oct- 09	37.019N	71.336E	88	5.0	Hindu Kush Region, Afghanistan
20-Oct -09	12.000N	94.985E	35	4.8	Andaman Islands, India, India Region
23-Oct -09	36.471N	70.925E	196	6.2	Hindu Kush Region, Afghanistan
29-Oct -09	36.500N	70.731E	201	6.0	Hindu Kush Region, Afghanistan
29-Oct- 09	36.460N	70.769E	196	6.0	Hindu Kush Region, Afghanistan
30-Oct-09	8.205N	91.792E	24	4.9	Nicobar Islands, India Region
2- Nov.- 09	14.100N	93.300E	57	5.4	Andaman Islands, India
3- Nov. 09	14.030N	93.108E	32	5.4	Andaman Islands, India
10-Nov. -09	8.099N	91.885E	17	6.2	Nicobar Islands, India Region
17-Nov. -09	27.630N	92.950E	60	4.6	Arunachal Pradesh, India
18-Nov.- 09	27.890N	90.001E	10	4.8	Bhutan
18-Nov. -09	17.057N	73.935E	10	4.6	Maharashtra, India
26-Nov. -09	13.635N	92.788E	35	5.1	Andaman Islands, India
1-Dec -09	13.627N	92.836E	35	5.2	Andaman Islands, India
12-Dec- 09	17.127N	73.832E	10	5.1	Maharashtra, India
12-Dec -09	28.412N	66.604E	41	5.0	Pakistan
13-Dec -09	22.093N	91.957E	28	5.3	Bangladesh
26-Dec -09	14.090N	92.949E	45	4.8	Andaman Islands, India
29-Dec.- 09	24.379N	94.858E	116	5.4	Myanmar-India Border Region
29-Dec. -09	24.416N	94.905E	95	5.6	Myanmar-India Border Region
31- Oct. -09	27.360 N	91.630E	10	5.6	Bhutan

***Source** : http://wcatwc.arh.noaa.gov, http://neic.usgs.gov*

***Remarks:** Locations of focal depths of earthquake events were based on preliminary determination of event data that correspond to different fixed depths in the location program used by different earthquake monitoring agencies (e.g., NEIC, USGS, IMD).*

Appendix V-B

Earthquake Data of South Asia-2008

As recorded by Indian Meteorological Department (IMD)

Date	Lat (Deg. N)	Long (Deg. E)	Depth (KM)	Magnitude	Region
03-Jan-2009	36.5°N	70.8°E	188	6.4	Hindkush Region, Afghanistan
04- Jan -2009	21.9°N	75.3°E	33	4.2	Madhya Pradesh
04- Jan -2009	6.4°N	94.3°E	15	5.4	Nicobar Islands
04- Jan -2009	36.6°N	71.0°E	188	5.8	Hindkush Region, Afghanistan
09- Jan -2009	31.7°N	78.4°E	10	3	Kinnaur District, Himachal Pradesh
09- Jan -2009	31.7°N	78.3°E	16	3.8	Kinnaur District, Himachal Pradesh
26- Jan -2009	27.4°N	88.7°E	7	3.2	Sikkim (India)-Bhutan Border
26- Jan -2009	33.7°N	75.2°E	10	2.1	Jammu & Kashmir
28- Jan -2009	13.7°N	92.9°E	20	5.4	Northern Andaman Islands
31- Jan -2009	32.5°N	75.9°E	10	3.7	Himachal Pradesh
02- Jan -2009	26.9°N	67.2°E	10	4.8	Pakistan
07-Feb-2009	23.4°N	70.5°E	15	3	Kachch, Gujarat
08- Feb-2009	34.3°N	73.5°E	8	4	Jammu & Kashmir
08- Feb-2009	27.4°N	75.5°E	5	2.8	Rajashthan
15- Feb-2009	26.0°N	90.2°E	30	4.4	Assam-Meghalaya Border
20- Feb-2009	34.3°N	73.9°E	10	5.5	India (J & K)-Pakistan Border
24- Feb-2009	25.9°N	94.3°E	10	4.8	India (Nagaland)-Mayambar Border
25- Feb-2009	30.6°N	79.3°E	10	3.7	Uttrakhand
11-03-2009	10.8°N	91.8°E	10	4.9	Andaman Islands
14-Mar-2009	30.0°N	68.4°E	32	4.9	Pakistan
17- Mar-2009	10.0°N	91.9°E	7	4.8	Andaman-Nicobar Islands
17- Mar -2009	26.0°N	67.4°E	35	4.8	Pakistan
18- Mar -2009	30.9°N	78.2°E	10	3.3	Uttarkashi, Uttrakhand

Date	Lat (Deg. N)	Long (Deg. E)	Depth (KM)	Magnitude	Region
23- Mar -2009	10.8°N	91.8°E	15	4.6	Off West Coast of Little Andaman
26- Mar -2009	22.6°N	85.7°E	10	3.8	Chaibasa (Paschimi Singhbhumi) Jharkhand
09-Apr-2009	27.1°N	70.7°E	33	5.3	Jaisalmer, Rajashthan
09- Apr -2009	06.2°N	94.5°E	33	5.3	Off Southeast Coast of Great Nicobar
12- Apr -2009	23.4°N	70.0°E	15	3.5	Kachch,Gujarat
16- Apr -2009	34.2°N	70.0°E	20	5.4	Hindkush Region, Afghanistan
18- Apr -2009	31.5°N	77.5°E	3	3.5	Kullu District, Himachal Pradesh
25- Apr -2009	26.4°N	91.7°E	10	4	Kamrup, Assam
09-May-2009	11.8°N	91.9°E	5	4.8	South Aandaman, Sea Region
10- May -2009	30.3°N	76.9°E	11	3.5	Ambala, Haryana
15- May -2009	24.7°N	94.5°E	15	4.5	Myanmar-India(Manipur) Border Region
15- May -2009	30.5°N	79.3°E	15	4.1	Chamoli, Uttrakhand
15- May -2009	30.6°N	79.3°E	10	4.5	Chamoli, Uttrakhand
17- May -2009	36.7°N	71.1°E	206	5.1	Afghanistan-Tajiskistan Border Region
19- May -2009	33.2°N	76.1°E	10	4.9	Jammu & Kashmir- H.P. Border Region
21- May -2009	36.3°N	77.6°E	92	5.3	China- India (J.&K.) Border Region
28- May -2009	16.9°N	86.1°W	10	7	Offshore Honduras
09-Jun-2009	10.8°N	91.7°E	10	5.2	Anadaman Sea
15- Jun -2009	09.0°N	93.7°E	10	5.4	Nicobar Islands
22- Jun -2009	12.1°N	94.9°E	10	5	North Anadaman Sea
22- Jun -2009	12.1°N	94.9°E	33	5	North Anadaman Sea
30- Jun -2009	10.6°N	92.2°E	10	4.9	Off Southwest Coast of Little Andaman
05-Jul-2009	36.5 N	71.2 E	231	5.2	Hindkush Region, Afghanistan
17- Jul -2009	32.3 N	76.1 E	10	3.7	Chamba District (Himachal Pradesh)
26- Jul -2009	10.8 N	94.3 E	10	5	Anadaman Sea
26- Jul -2009	10.8 N	94.3 E	10	5.2	Anadaman Sea
26- Jul -2009	10.9 N	94.2 E	29	5.1	Andaman Islands

Date	Lat (Deg. N)	Long (Deg. E)	Depth (KM)	Magnitude	Region
26-07-2009	10.5 N	94.3 E	10	5	Andaman Islands
27- Jul -2009	34.8 N	73.1 E	28	5	Pakistan
28- Jul -2009	10.7 N	93.9 E	37	5.3	Andaman Islands
05-Aug-2009	22.3°N	93.4°E	29	4.8	Myanmar-India(Mizoram) Border Region
10- Aug -2009	14.1°N	92.9°E	17	7.7	Andaman Islands
11- Aug -2009	24.4°N	94.8°E	22	5.6	Myanmar-India(Manipur) Border Region
13- Aug -2009	14.1°N	92.9°E	18	5.7	Andaman Islands
15- Aug -2009	14.1°N	93.2°E	30	5.3	Andaman Islands
19-Aug -2009	26.6°N	92.5°E	20	4.9	Sonitpur, Assam
27- Aug -2009	30.0°N	80.0°E	14	3.9	Uttrakhand
28- Aug -2009	07.2°S	123.5°E	625	6.6	
30- Aug -2009	25.2°N	94.8°E	66	5.3	Myanmar-India Border Region
03-Sept.-2009	24.3 N	94.6 E	100	5.9	Myanmar-India Border Region
05- Sept -2009	23.8 N	70.0 E	5	3.9	Rann of Kuchch, Gujarat
09- Sept -2009	10.6 N	93.9 E	168	4.8	Andaman Islands
10- Sept -2009	28.5 N	66.7 E	10	4.7	Pakistan
18- Sept -2009	30.5 N	79.2 E	20	3.4	Uttrakhand
21- Sept -2009	27.3 N	91.5 E	8	6.2	Bhutan
21- Sept -2009	30.9 N	79.1 E	13	4.7	Uttarkashi, Uttrakhand
03-Oct.-2009	30.0°N	79.9°E	15	4.3	District Bageshwar, Uttrakhand
11- Oct -2009	23.5°N	94.5°E	10	4.9	Myanmar-India Border Region
20- Oct -2009	12.2°N	95.1°E	5	4.7	Andaman Islands
22- Oct -2009	36.5°N	71.0°E	168	6.3	Hindkush Region, Afghanistan
25- Oct -2009	29.6°N	64.0°E	125	5.7	Pakistan (Baluchistan)- Afghanistan Border Region
28- Oct -2009	23.7°N	70.0°E	4	4.5	Kachch,Gujarat
29- Oct -2009	26.9°N	76.0°E	5	2.3	Jaipur, Rajasthan
29- Oct -2009	27.3°N	91.4°E	5	5.2	Bhutan

Date	Lat (Deg. N)	Long (Deg. E)	Depth (KM)	Magnitude	Region
29- Oct -2009	36.4°N	70.8°E	190	6	Hindkush Region, Afghanistan
29- Oct -2009	26.6°N	90.0°E	10	4.2	Kokrajhar, Assam
29- Oct -2009	08.2°N	91.8°E	10	4.8	Nicobar Islands
02-Nov.-2009	14.1°N	93.1°E	21	5.4	Andaman Islands
10- Nov.-2009	08.1°N	92.0°E	36	6.1	Nicobar Islands
14- Nov.-2009	17.1°N	73.8°E	5	4.8	Koyna, Maharashtra
14- Nov.-2009	17.1°N	73.8°E	20	3.9	Koyna, Maharashtra
17- Nov.-2009	27.7°N	92.6°E	30	4.5	East Ksmeng, Arunachal Pradesh
18- Nov.-2009	27.6°N	90.3°E	54	4.3	Bhutan
26- Nov.-2009	13.8°N	92.8°E	16	5.4	North Andaman Islands
01-Dec.-2009	13.8°N	92.8°E	10	5.5	North Andaman Islands Region
04- Dec.-2009	28.5°N	77.8°E	10	2.5	Bulandshahr, U.P
06- Dec.-2009	35.8°N	77.3°E	60	5.3	China-- India (J&K.) Border Region
08- Dec.-2009	30.4°N	80.2°E	10	4.1	India(Uttaranchal) - Tibet Border
12- Dec.-2009	17.2°N	73.8°E	10	5	Koyna, Maharashtra
12- Dec.-2009	17.2°N	73.8°E	10	4	Koyna Maharashtra
12- Dec.-2009	17.2°N	73.8°E	10	4.1	Koyna, Maharashtra
13- Dec.-2009	22.0°N	91.8°E	10	5.1	Bangladesh
23- Dec.-2009	17.2°N	73.7°E	11	3.8	Koyna, Maharashtra
26- Dec.-2009	14.2°N	92.9°E	15	4.9	North Andaman Islands
29- Dec.-2009	24.5°N	94.8°E	80	5.5	Myanmar - India (Manipur) border
31- Dec.-2009	27.3°N	91.4°E	7	5.5	Bhutan

***Remarks** : Locations of focal depths of earthquake events were based on preliminary determination of event data that correspond to different fixed depths in the location program used by different earthquake monitoring agencies (e.g., NEIC, USGS, IMD).*

Appendix V-C

Earthquake Data of South Asia

As recorded by National Seismological Centre (NSC), Nepal

DD/MM/YYYY	Latitude	Longitude	Epicentre	Magnitude	Remarks
10-01-2009	27.9	88.04	Taplejung	4.2	NSC
23-01-2009	29.05	81.4	Todkesal,Achham	4.2	NSC
08-03-2009	27.41	87.8	Tellok,Taplejung	4.5	NSC
12-03-2009	28.43	84.42	Tagrun,Lamjung	4.1	NSC
13-04-2009	28.30	84.55	Besisahar,Lamjung	4	NSC
13-04-2009	28.25	84.54	BesiSahar,Lamjung	4.3	NSC
14-05-2009	27.48	87.36	Sankhuwasava	4.6	NSC
14-05-2009	27.43	87.35	Sankhuwasava	4.2	NSC
12-07-2009	27.71	86.36	JataPokhari,Dolakha	4.3	NSC
02-08-2009	28.12	85.18	Karman,Rasuwa	4	NSC
26-09-2009	29.81	82.05	Humla	4.3	NSC
29-10-2009	28.73	83.11	Rukum	4.1	NSC
01-11-2009	30.1	81.81	Humla	4.5	NSC
02-11-2009	27.87	87.94	Taplejung	4	NSC
08-11-2009	30.11	81.91	Humla	4.3	NSC
22-11-2009	29.02	82.15	Jumla/Jajarkot	4.5	NSC
15-12-2009	28.28	84.4	Duradanda, Lamjung	4.1	NSC
16-12-2009	29.6	81.51	Dogragoth, Bajura	4.6	NSC

Remarks: *Locations of focal depths of earthquake events were based on preliminary determination of event data that correspond to different fixed depths in the location program used by different earthquake monitoring agencies (e.g., NEIC, USGS, IMD, NSC).*

Appendix-VI-A

Landslide Events in South Asia 2009

Country/Date	Location	Deaths	Affected	Damage & Loss
AFGHANISTAN				
09Feb. 2009	A village outside Pul-e-Khumri, the provincial capital of Baghlan province in Northern Afghanistan			Destroyed 5 houses and damaged 6 others leaving scores of people homeless
22 May 2009	Northern province of Balkh late	5	180	
BANGLADESH				
01 Jan. 2009	Garo hill at Sandhakura under Jhenaigati upazila in Sherpur	1	50	
18 May 2009	Tea gardens in Srimangal upazila	6		
03 July 2009	Habiganj	6		
31 July 2009	Slampur and Tetulia villages under Lama Upazila in Bandarban district	10		
BHUTAN				
2 April 2009	Takti	3		
28 May 2009	Bumthang	6		
8 June 2009	Laya, Gasa			
16 Sep 2009	Trashigang			
INDIA				
26May 2009				
to 28 May 2009	Darjeeling	21		300 houses collapsed
17 July 2009	Wayanad			46 houses destroyed
21 July 2009	Badrinath			1,000 pilgrims are stranded
09 Aug 2009	Pithoragarh	45		100 village effected
16 Aug 2009	Darjeeling	7		500 houses damaged in landslide
19 Sept 2009	Dindigul			Traffic was disrupted
04 Sept 2009	Mumbai	11	10	16 hutments were buried
05th Oct 2009	Karwar	21		
16 Oct 2009	Kodaikanal	1		

Country/Date	Location	Deaths	Affected	Damage & Loss
NEPAL				
1July 09	Darchula			7 housed buried
2 July 09	Pokhara	6		2 missing
4 July 09	Jurikhet			Block road
28 July 09	Palpa			Damaged Road
28 July 09	Tanku VDC	11		9 missing
31 July 09	Tanahun	9		4 missing & 20 household displaced
2 Aug. 09	Sundrawati-1, Dhedakaule			12 household displaced
10Aug. 09	Tamku VDC			225 people displaced
10 Aug. 09	Dolakha	4		
11Aug. 09	Shyama VDC	4		
11h Aug. 09	Balgung	1		
16 Aug. 09	Palpa			Displaced 9 families
18 Aug. 09	Dadeldhura	1	4	
18 Aug. 09	Dhankuta	1		
19 Aug. 09	Baitadi	2		
20 Aug. 09	Dipayal	2		100 houses collapsed, 30 goat and 17 cattles swept away
25 Aug. 09	Myagdi/ Ropani			35 families displaced & 500 ropani cultivated land
31 Aug. 09	Phidim			8 household displaced
2 Sept. 09	Jaleshwori VDC of Khotang	13		1 missing
4 Sept. 09	Dailekh			60 household displaced
6 Sept. 09	Sukhet & Ramechhap	2		100 families displaced in sukhet VDC
7Sept. 09	Laaduk VDC	2		
23 Sept. 09	Khatamma & Chauki Danda Village			47 families displaced
7 Oct. 09	Doti	1		34 displaced
7 Oct. 09	Mahendranagar	34		
PAKISTAN				
6 March 09	Kohat	3	2	
6 May 09	Dora Area, Neelam Valley	28		
29June 09	Nowsherea	2	3	

Country/Date	Location	Deaths	Affected	Damage & Loss
SRI LANKA				
28 Jan. 09	Gampolawela			10 families displaced
21 May 09	Norton Bridge, Hatton	6		
23 May 09	Nuwara Eliya			86 people displaced and 28 houses damaged
21Aug. 09	Galekele	2	2	
16Oct. 09	Kandy-Gampola Road			Block Rail line & Road

***Source** : Data compiled by SDMC from media reports. There is no reported data on Landslide in South Asia during 2009 by EM-DAT.*

Appendix-VI B

Avalanche Events in South Asia 2009

Occurrence Date	Location	Deaths	Injuries	Damage & Loss
AFGHANISTAN				
16 Jan. 2009	Northern Afghanistan	10		
12 Feb. 2009	Herat and Ghor provinces	12		Tens of houses were damaged
28 Feb. 2009	Shorakh village of Warsaj district in northern Takhar province			Killing 2,000 sheep, destroying 10 homes, 2 power producing dams and 2 grain mills.
INDIA				
12 Jan. 2009	Kashmir	3	3 people trapped and 1 rescued	
14 Apr. 2009	Srinagar	7		
PAKISTAN				
8Feb. 09	IHK, Islamabad	4	2	
16Feb. 09	Dabargar Area, Chitral	6		
8April 09	Dir, Chitral	5		

Source : *Data compiled by SDMC from media reports. There is no reported data on Avalanche in South Asia during 2009 by EM-DAT.*

Appendix-VII-A

Epidemics in South Asia 2009

Country	Location	Disaster Type	Sub Type	Name	Date Starting	Date Ending	Killed	Total Affected	Est. Damage (US$ x1000)
India	Uttar Pradesh	Epidemics	Viral Infectious Diseases	Japanese Encephalitis and Acute Encephalitis Syndrome	00/01/2009	00/10/2009	311	1,521	
Nepal	Achham, Baitadi	Epidemics	Bacterial Infectious Diseases	Diarrhoea	01/05/2009	23/08/2009	314	58,874	
Sri Lanka	Kandy, Colombo	Epidemics	Viral Infectious Diseases	Dengue	00/01/2009	18/11/2009	277	33,856	

***Source** : EM-DAT Accessed on Mar-5-2010.Data version:v12.07*

Appendix-VII-B

Epidemics in South Asia-2009 as Compiled by ProMED

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
Afghanistan			Cholera	15/09/2009	673 cases of AWD and/or cholera with 28 deaths reported in 11 of the country's 34 provinces.
Afghanistan			Crimean Congo haemorrhagic fever	10/11/2009	On 16 Sep 09, a US military soldier died from CCHF after being bitten by a tick while serving in southern Afghanistan. An earlier outbreak of CCHF was reported in Herat in Afghanistan in Aug 2008.
Afghanistan	Kandahar		Poliomyelitis	17/09/2009	Two new cases were reported, bringing the total number of cases for 2009 to 20.
Afghanistan	Ghowr		Poliomyelitis	03/09/2009	A wild poliovirus type 1 (WPV1) case reported from a previously uninfected province: Ghor.
Afghanistan			Swine Influenza A (H1N1) - Confirmed	10/07/2009	14 confirmed cases reported.
Afghanistan			Swine Influenza A (H1N1) - Confirmed	09/07/2009	14 cases reported among U.S. citizens on the main U.S. military base in Afghanistan.
Bangladesh	Dhaka and Pabna		Acute diarrhoeal syndrome	12/11/2009	An outbreak of diarrhoeal disease (suspected to be cholera) reported from Badda, Gulshan, Mirpur and Lalbagh. 484 people werer hospitalised in the space of 24 hours as of 11 Nov 09.
Bangladesh			Acute diarrhoeal syndrome	08/06/2009	A severe outbreak of diarrhoea was reported following cyclone 'Aila'. The districts of Koyra, Dakope and Khulna in Bangladesh were most affected by the outbreak, where at least two had died and over 5,000 people were treated for diarrhoea.
Bangladesh			Acute diarrhoeal syndrome	23/03/2009	As of 19 March 2009, 64,000, with 15 deaths, compared to 62,144 cases reported between January and March in 2008.
Bangladesh	Rajshahi		Anthrax	07/09/2009	26 suspected cases of anthrax reported.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
Bangladesh	Dhaka		Dengue fever	22/10/2009	A sudden increase in dengue cases was reported. As of 1 October 2009, 405 people had been admitted to hospital in Dhaka with dengue.
Bangladesh		Dhanmondi, Kalabagan, Central Road, Minto Road, Siddeswari, Muhammadpur, Ganderia, and Mirpur	Dengue fever	13/10/2009	319 people were diagnosed with dengue fever till 5 October 2009.
Bangladesh	Dhaka	Dhakar	Dengue fever	29/09/2009	As of 25 September, 34 cases treated in hospitals in the city.
Bangladesh	Chittagong		Influenza A (H5N1)	23/09/2009	An outbreak amongst birds in Chittagong with 53 new cases reported.
Bangladesh			Influenza A (H5N1)	18/06/2009	Outbreaks reported in birds in Chittagong and Dhaka.
Bangladesh	Cox's Bazar		Influenza A (H5N1)	19/05/2009	An outbreak of H5N1 avian influenza has been reported in birds.
Bangladesh	Barisal, Chittagong, Dhaka and Rajshahi		Influenza A (H5N1)	15/04/2009	12 new outbreaks of H5N1 avian influenza in birds on farms were reported between 8 and 23 March 2009.
Bangladesh	Netrakona and Gaibandha		Influenza A (H5N1)	19/03/2009	New outbreaks of avian influenza reported from poultry farms.
Bangladesh	Netrakona and Gaibandha		Influenza A (H5N1)	09/03/2009	
Bangladesh			Swine Influenza A (H1N1) - Confirmed	10/09/2009	One confirmed death reported.
Bangladesh			Swine Influenza A (H1N1) - Confirmed	23/06/2009	One confirmed death reported.
Bangladesh			Swine Influenza A (H1N1) - Confirmed	22/06/2009	One case confirmed in a man who had returned from the US.
Bhutan	Chhukha	Phuentsholing	Dengue fever	18/08/2009	32 suspected cases reported.
Bhutan			Swine Influenza A (H1N1) - Confirmed	28/07/2009	
India	West Bengal		Acute diarrhoeal syndrome	21/07/2009	85,000 cases and 28 deaths reported from across the state.
India	Orissa	Pindapathar village in Sundargarh district	Anthrax	30/06/2009	At least 12 people were reported be suffering from anthrax after eating raw beef.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
India	Andhra Pradesh	Visakhapatnam district	Anthrax	12/05/2009	11 deaths and 5 cases reported.
India	Andhra Pradesh	Prakasam district	Anthrax	31/03/2009	5 cases reported as of 30 Mar 2009. All had taken ill after consuming meat from affected sheep.
India	Orissa	Chancharaguda area, under Bissamcuttack block of Rayagada district	Anthrax	27/03/2009	In the last couple of weeks, at least 4 people had died from suspected anthrax and many others fell seriously ill after eating infected meat.
India	Karnataka	Nidagundi town of Basavana Bagewadi taluk	Chikungunya virus infection	02/11/2009	
India	Karnataka, Andra Pradesh, Goa&Kerala.		Chikungunya virus infection	30/07/2009	As of 29 April 2009, over 2,700 suspected cases of Chikungunya were reported, with no deaths.
India	Karanataka		Chikungunya virus infection	08/06/2009	Over 4,190 suspected cases of Chikungunya were reported from 23 districts. The highest number of suspected cases of chikungunya were from Uttara Kananda district (969) followed by Haveri (710) and Bangalore city (308).
India	Karnataka	DJ Halli	Chikungunya virus infection	07/05/2009	
India	Tamil Nadu	Ramanathapuram	Chikungunya virus infection	18/09/2009	Approximately 63 persons in Keezhakarai and surrounding villages in Ramanathapuram district were reported to have been infected by Chikungunya virus.
India	Tamil Nadu	Madurai	Chikungunya virus infection	15/09/2009	Over 1000 suspected chikungunya cases were reported from the city of Madurai.
India	Andhra Pradesh	Hyderabad	Chikungunya virus infection	08/09/2009	
India	Tamil Nadu	Rameswaram town in Ramanathapuram district	Chikungunya virus infection	10/08/2009	
India	Goa	Sanguem	Chikungunya virus infection	03/08/2009	More than 100 cases reported in mine workers.
India	Goa	Sanguem	Chikungunya virus infection	27/07/2009	15 confirmed cases reported.
India	Goa		Chikungunya virus infection	06/07/2009	
India	Kerala		Chikungunya virus infection	31/07/2009	
India	Karnataka		Chikungunya virus infection	30/06/2009	176 cases confirmed in Yellapur taluk.
India	Gujarat	Kothra village of Nandod taluka, Narmada district	Chikungunya virus infection	16/03/2009	More than 100 suspected cases of Chikungunya were reported.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
India	Maharashtra	Kalbadevi, Mumbai	Cholera	14/09/2009	
India	Gujarat	Lachras	Cholera	14/09/2009	
India	Punjab		Cholera	20/08/2009	
India	Karnataka	Udikeri village and adjoing areas of Bailhongal taluk	Cholera	06/08/2009	
India	Karnataka	M.K. Hubli and surrounding areas in Bailhongal taluk	Cholera	03/06/2009	
India	Maharashtra	Mumbai	Cholera	21/07/2009	3 confirmed cases reported.
India	Punjab	Dera Bassi	Cholera	21/07/2009	A total of 207 cases were reported in a 3 day period.
India	Gujarat	Surat	Cholera	13/07/2009	Four new patients diagnosed with cholera, taking the number of patients to 22 on 8 Jul 2009.
India	Karnataka	Tumkur	Cholera	13/07/2009	30 hospitalised cases and 5 deaths reported.
India	Gujarat	Bharuch town and Jhagadia in Bharuch district	Cholera	18/06/2009	16 cases have been reported.
India	Gujarat	Bharuch	Cholera	08/06/2009	1 case has tested positive for cholera. 65 people have fallen ill.
India	Delhi		Dengue fever	24/11/2009	Till 23 Nov 2009, 999 cases with 2 deaths were reported.
India	Delhi		Dengue fever	16/11/2009	As of 11 November 2009, 661 cases of dengue were reported in the city of Delhi. Two patients have died.
India	Delhi		Dengue fever	03/11/2009	Fourteen cases of dengue were confirmed on Sunday 1 Nov 2009, taking the total number of cases in the capital to 366.
India	Madhya Pradesh	Bhopal, Indore, Ashoknagar, Satna, Balaghat	Dengue fever	13/10/2009	300 cases and 9 deaths reported in three months.
India	Goa		Dengue fever	22/09/2009	
India	Gujarat		Dengue fever	01/09/2009	As of 31 Aug 09, 15 cases were reported.
India	Manipur		Dengue fever	14/07/2009	There were reports of an outbreak of fever and dengue-like symptoms amongst at least 200 people.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
India	West Bengal	Kankurgachi, Ultadanga, Manicktala, Camac Street, Bhowanipore, Dhakuria, Jodhpur Park, Lake Gardens	Dengue fever	14/07/2009	73 cases were reported till 14 July 2009.
India	Kerala	Vamanapuram	Dengue fever	26/05/2009	Three cases of dengue reported from the Vamanapuram area.
India	Kerala		Dengue fever	29/04/2009	A dengue outbreak was reported from some parts of Thiruvananthapuram district.
India	Kerala	Thiruvananthapuram	Dengue fever	22/04/2009	
India	Uttar Pradesh	Gorakphur, Basti	Encephalitis	14/12/2009	Around 4,000 patients were admitted to hospitals across the state with Japanese encephalitis or acute encephalitis syndrome. Since January 2009, a total of 552 people had died.
India	Uttar Pradesh	Gorakphur	Encephalitis	20/11/2009	Since January 2009 a total of 2,947 patients suffering from Japanese encephalitis and acute encephalitis syndrome were admitted to hospital in the region. Of this 515 patients had died. Since Friday 13 November 9 patients had died in Gorakphur.
India	Uttar Pradesh		Encephalitis	02/11/2009	As of 1 Nov 09, 471 children had died from JE. A total 2,738 patients have been admitted to hospitals with JE in 2009.
India	Uttar Pradesh		Encephalitis	12/10/2009	
India	Uttar Pradesh	Gorakhpur	Encephalitis	22/09/2009	11 children have died of Japanese encephalitis in 2 days.
India	Uttar Pradesh		Encephalitis	01/09/2009	As of 30 Aug 09, 960 cases including 210 deaths had been reported in 2009.
India	Uttar Pradesh		Encephalitis	27/08/2009	Since January 2009, 665 cases of acute encephalitis syndrome reported. Samples were collected and tested for all cases, and 34 cases and 4 deaths were laboratory-confirmed as Japanese encephalitis.
India	Uttar Pradesh		Encephalitis	25/08/2009	900 cases and at least 200 deaths in children reported. Some patients were from neighbouring Bihar state and Nepal.
India	Uttar Pradesh		Encephalitis	19/08/2009	468 cases and 100 deaths reported till date in 2009.
India			Encephalitis	21/05/2009	283 cases reported with 57 deaths so far in 2009, of which 245 were reported in Uttar Pradesh.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
India	Uttar Pradesh	Maharajganj district	Encephalitis	14/05/2009	Over 170 cases hospitalised and 38 people have died of suspected Japanese encephalitis since the beginning of 2009.
India	Uttar Pradesh	Gorakhpur	Encephalitis	02/10/2009	Till date 356 children have died from encephalitis in Gorakhpur district during 2009.
India	Uttar Pradesh	Gorakhpur	Encephalitis	18/09/2009	Five children were reported to have died from encephalitis.
India	Jammu and Kashmir	Seerhamdan in Mattan	Gastroenteritis	04/08/2009	150 cases reported.
India	Uttar Pradesh		Hepatitis B, C	01/09/2009	Blood contaminated with hepatitis B and C viruses as well as being diluted with saline were seized by authorities. 100,000 units of the blood was sold to private blood banks over a period of two years.
India	Gujarat	Sabarkantha district	Hepatitis B	13/03/2009	The previously reported outbreak of hepatitis B was due to the recycling and reuse of medical equipment, including needles and syringes. 240 people hadbeen infected and 70 have died.
India	Assam	Hajo, Rajabazar, Kamrup	Influenza A (H5N1)	28/10/2009	
India	West Bengal	Hemtabad	Influenza A (H5N1)	29/05/2009	
India	West Bengal		Influenza A (H5N1)	01/04/2009	9 outbreaks in birds were reported in West Bengal so far in 2009. The latest outbreak began in Uttar Dinajpur on 17 March 2009.
India	Assam	Eastern districts	Japanese encephalitis	01/09/2009	Around 1000 cases and 78 deaths were reported since April 09.
India	Nagaland		Japanese encephalitis	19/08/2009	17 suspected cases, including 5 confirmed deaths reported from one hospital in a 2 month period.
India	Rajasthan		Japanese encephalitis	06/08/2009	2 cases reported in Rajasthan. Rajasthan had not previously been known as a transmission zone for Japanese encephalitis.
India	Karnataka		Kyasanur forest disease	04/03/2009	24 villagers had been suffering from an unknown disease and 9 have tested positive for Kyasanur forest disease. 14 monkeys were found dead in the forest region near Bailgadde, Mavinhole, Hirebail,Chikkolli, Darbejaddi, Tolsani, Jinnod and Sigadi villages.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
India	Mizoram		Malaria	21/12/2009	An estimated 8426 cases and 119 deaths from P. falciparum malaria were reported between January and October 2009.
India	Bihar		Malaria	11/08/2009	An outbreak of malaria was reported, with 600 confirmed cases, and 6 deaths.
India	Meghalaya		Meningococcal meningitis	07/07/2009	More than 2000 cases were reported in 2009, with 127 deaths, 4 of which were confirmed.
India	Meghalaya and Tripura		Meningococcal meningitis	14/04/2009	There have been 1,791 cases of meningitis recorded in Meghalaya, of which 224 deaths have occurred since 2008. Tripura has recorded 126 confirmed meningitis cases since January 2009 with 33 deaths.
India	Tripura, Meghalaya and Mizoram		Meningococcal meningitis	07/04/2009	As of 25 March 2009, 140 cases and 32 deaths of meningococcal disease serotype A reported.
India	Tripura, Meghalaya and Mizoram		Meningococcal meningitis	11/03/2009	Since January 2009, 230 deaths and 2,000 possible cases.
India	Uttar Pradesh	Mathura District	Poliomyelitis	25/11/2009	As of 23 Nov 2009, the total number of cases for 2009 rose to 632.
India	Bihar		Poliomyelitis	17/09/2009	
India	Uttar Pradesh		Poliomyelitis	03/09/2009	
India	Uttar Pradesh		Poliomyelitis	27/05/2009	As of 25 May 09, 49 cases were reported. Date of most recent onset was 7 May 09 and location of most recent cases were from Badaun District, Uttar Pradesh
India	Uttar Pradesh	Moradabad	Poliomyelitis	24/03/2009	2 new polio cases reported till 23 March 2009. Date of most recent onset was 28 Feb 09. Poliovirus type 3 was confirmed.
India	Meghalaya		Scrub typhus (Tsutsugamushi disease)	18/12/2009	As of 17 Dec 2009, more than 80 people suffering from Scrub typhus. The people affected are mostly from the rural areas of West Khasi Hills, East Khasi Hills, and Ri Bhoi. 5 deaths have been reported.
India			Swine Influenza A (H1N1) - Confirmed	04/08/2009	One death confirmed.
India			Swine Influenza A (H1N1) - Confirmed	04/06/2009	Four cases confirmed.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
India			Swine Influenza A (H1N1) - Confirmed	02/06/2009	Three cases confirmed.
India	Andhra Pradesh		Swine Influenza A (H1N1) - Confirmed	18/05/2009	A 23 year old passenger who traveled from USA to Hyderabad and who had tested positive for Influenza A [H1N1]
India			Swine Influenza A (H1N1) - Confirmed	03/05/2009	3 suspected cases have tested negative, and one case is under investigation.
India			Swine Influenza A (H1N1) - Confirmed	02/05/2009	2 suspected cases reported in travellers who had stayed in Texas and one in a traveller who had been to London.
India			Swine Influenza A (H1N1) - Confirmed	30/04/2009	One suspected case reported who had returned from Texas.
India	Gujarat	Bhayla, Kairala and Kalyangadh in Bavla taluka in Ahmedabad	Typhoid fever	16/03/2009	70 confirmed cases reported.
India	Goa	Sanguem	Undiagnosed illness	23/07/2009	An outbreak of undiagnosed illness was reported.
Maldives			Chikungunya virus infection	23/09/2009	Two travellers, a father and his son, had tested positive for C hikungunya following a 10 day trip to the Maldives.
Maldives			Swine Influenza A (H1N1) - Confirmed	04/08/2009	One case confirmed.
Nepal			Acute diarrhoeal syndrome	26/08/2009	58874 cases and 314 deaths had been reported. Of the samples analysed, 36% were positive for Vibrio Cholerae 01 Tor Ogawa and remaining were positive for Enterotoxicogenic E Coli (LT and ST) and Aeromonas species.
Nepal			Acute diarrhoeal syndrome	11/08/2009	Almost 50,000 people have been affected by acute watery diarrhoea, attributed, in large measure, to cholera. A total of 268 people have been confirmed to have died.
Nepal			Acute diarrhoeal syndrome	05/08/2009	37,907 cases of diarrhoea and 241 deaths reported.
Nepal			Acute diarrhoeal syndrome	03/08/2009	27,456 cases of diarrhoea treated with 197 deaths.
Nepal		Jajorkot	Acute diarrhoeal syndrome	27/07/2009	Beginning May 2009, cases of acute watery diarrhoea were first observed in Jajarkot district. The diarrhoea outbreak spread to adjoining districts (Rukum, Salyan, Surkhet, Rolpa, Dailekh and Dang) and in Bajura and Dadeldhura of the far-west region.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
Nepal		Jajorkot&Rukum	Acute diarrhoeal syndrome	22/07/2009	143 deaths and about 2000 cases reported in Jajarkot. Rukum also reported over 500 cases with 33 deaths. Rolpa also reported 34 cases and 1 death.
Nepal	Bheri and Rapti	Jajarkot and Rukum.	Acute diarrhoeal syndrome	16/07/2009	103 deaths confirmed in Jajarkot between 1 May and 13 July 2009.
Nepal	Bheri	Jajarkot	Acute diarrhoeal syndrome	13/07/2009	65 deaths reported as of 7 July 2009.
Nepal	Bheri and Rapti	Jajarkot, Salyan, Dailekh, Rukum and Sukhet	Acute diarrhoeal syndrome	10/07/2009	Over 100 people killed and more than 4,000 affected.
Nepal	Mechi	Pathamari village of Jhapa district	Influenza A (Avian - suspected)	12/03/2009	
Nepal			Swine Influenza A (H1N1) - Confirmed	30/06/2009	One confirmed case reported.
Nepal	Janakpur	Kalpabriksha and Kyaneshwar in Sindhuli district	Undiagnosed illness	11/08/2009	5 deaths due to an undiagnosed illness reported. Symptoms included very high fever, severe headache, difficulty in breathing, and bleeding from the mouth and nose and discharge of blood in cough.
Nepal	Karnali	Chharka village, Dolpa district.	Undiagnosed illness	19/03/2009	A total of 5 persons had died of an unidentified sickness and several others infected with the disease. Symptoms included headache, fever, and cough.
Pakistan	Punjab	Garah Aashiq	Cholera	01/10/2009	One child was reported dead.
Pakistan	Islamabad		Cholera	21/07/2009	Cases of cholera were reported from camps for internally displaced persons and in the federal capital.
Pakistan	North-West Frontier	Dera Ismail Khan	Cholera	13/07/2009	At least 8 people were killed and scores of others admitted in hospitals following a cholera outbreak.
Pakistan		Abbotabad	Crimean Congo haemorrhagic fever	28/09/2009	A 58 year old man was confirmed with Crimean Congo HF.
Pakistan	North-West Frontier	Haripur	Dengue fever	29/09/2009	As of 20 September 2009, cases of dengue reported with 7 deaths.
Pakistan		Karachi	Dengue fever	08/09/2009	500 suspected cases of dengue were reported from various hospitals of Karachi.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
Pakistan		Larr on outskirts of Rawalpindi and Islamabad	Dengue fever	01/09/2009	Five confirmed cases of dengue fever were reported, a further four were under investigation.
Pakistan	Punjab		Dengue fever	07/04/2009	Six patients had been diagnosed with dengue in 2009.
Pakistan		Jan MuhammadJamali near New Saeedabad, Matiari District	Hepatitis (unspecified)	10/06/2009	464 cases reported with 4 deaths following consumption of contaminated water.
Pakistan	North-West Frontier		Poliomyelitis	17/09/2009	
Pakistan	North-West Frontier, Sind and Baluchistan		Poliomyelitis	03/09/2009	
Pakistan			Poliomyelitis	29/05/2009	Five new cases were reported in the past week bringing the total number of cases in 2009 to 17.
Pakistan			Swine Influenza A (H1N1) - Confirmed	03/08/2009	One confirmed case reported.
Sri Lanka	Colombo		Dengue fever	13/10/2009	
Sri Lanka	Hambantota	Tangalle, Puhulyaya, Walasmulla, Beliatta, Weeraketiya and Wadigala	Dengue fever	19/05/2009	130 suspected cases had been reported from 1 Apr to 10 May 2009 and 8 deaths were reported.
Sri Lanka		Kandy, Kegalle, Colombo, Gampaha and Kurunegala	Dengue fever	01/09/2009	As of 28 Aug 09, 24,629 cases and 245 deaths from dengue fever have been reported in 2009 so far. This is compared to 4,516 cases and 85 deaths reported for the whole of 2008.
Sri Lanka			Dengue fever	18/08/2009	The number of dengue cases had risen to 22 757, while 232 people have died so far in 2009.
Sri Lanka			Dengue fever	11/08/2009	21,745 cases and 227 deaths reported.
Sri Lanka			Dengue fever	21/07/2009	The number of dengue deaths had risen to 180 while 18,030 cases had been reported.
Sri Lanka			Dengue fever	08/07/2009	14,750 cases reported so far in 2009 with 163 deaths.
Sri Lanka			Dengue fever	07/07/2009	Over 13,000 cases with at least 156 deaths reported.
Sri Lanka			Dengue fever	30/06/2009	146 deaths due to dengue and more than 10,000 cases reported.

Country	Region	Location	Disease	Reported Date (DD/MM/YYYY)	Details
Sri Lanka			Dengue fever	22/06/2009	146 deaths due to dengue and more than 10,000 cases reported as of 19 June 2009.
Sri Lanka			Dengue fever	02/06/2009	85 deaths reported.
Sri Lanka			Dengue fever	13/05/2009	Nearly 4,000 dengue cases with 55 deaths reported between 1 Jan and 7 May 2009.
Sri Lanka			Dengue fever	20/04/2009	2,400 dengue cases had been reported within the last two months, from Colombo, Kandy, Ratnapura, Kalutara and Kegalle districts. This statistics show a sharp rise in dengue cases compared to 2008.
Sri Lanka			Dengue fever	16/03/2009	2,229 cases and 17 deaths reported between 1 January and 9 March 2009, a 15 percent increase comparing to the same period of 2008.
Sri Lanka			Dengue fever	13/03/2009	2,229 cases and 17 deaths reported between 1 January and 9 March 2009, a 15 percent increase comparing to the same period of 2008.
Sri Lanka			Swine Influenza A (H1N1) - Confirmed	17/06/2009	One case confirmed in an 8 year old Australian citizen. His sister had previously been identified as a case in Singapore.

***Source** : NaTHNaC Outbreak Report: Report date: 3 March 2010*
***http**://www.nathnac.org/CountrySearch.aspx?AREAID=196&COUNTRYID=186&DISEASEID=0&PERIODID=4&ANIMALINDICATOR=2*

Appendix-VIII

Man-made Disasters in South Asia-2009

Industrial Disaster

Sl No	Location	Type	Sub Type	Name	Date Starting	Date Ending	Killed	Tot. Affected
India								
1.	Jaipur (Rajasthan)	Industrial Accident	Explosion	Oil storage depot	29/10/2009	29/10/2009	11	2,135
2.	Tamil Nadu	Industrial Accident	Fire	Firecrackers depot	17/10/2009	17/10/2009	33	6
3.	Korba	Industrial Accident	Collapse	Thermal power station	23/09/2009	23/09/2009	39	
Pakistan								
1.	Sorange district (Baloutc ...	Industrial Accident	Explosion	Coal mine	5/3/2009	5/3/2009	14	11

Miscellaneous Accident

Sl No	Location	Disaster type	Subtype	Name	Date starting	Date Ending	Killed	Total afected
India								
1.	Rajasthan state	Miscellaneous accident	Collapse	Bridge	24/01/2009	24/01/2009	45	12
Nepal								
1.	East	Miscellaneous accident	Collapse	Temple	30/09/2009	30/09/2009	23	60
Pakistan								
1.	Karachi	Miscellaneous accident	Other		14/09/2009	14/09/2009	20	30
2.	Karachi	Miscellaneous accident	Fire	Slum	8/1/2009	9/1/2009	40	220

Transport Accident

Sl. No.	Location	Disaster Type	Sub type	Name	Date starting	Date ending	Killed	Total Affected
Afghanistan								
1.	West	Transport accident	Air	Helicopter	26/10/2009	26/10/2009	10	26
2.	Near Kandahar	Transport accident	Air	Helicopter	19/07/2009	19/07/2009	16	
3.	Zafar zone	Transport accident	Air	Helicopter	15/01/2009	15/01/2009	13	
Bangladesh								
1.		Transport accident	Road		00/12/2009	00/12/2009	20	50
2.	South	Transport accident	Water		27/11/2009	27/11/2009	91	
3.	Daira river (Kirshorgank ...	Transport accident	Water	Ferry	4/12/2009	4/12/2009	53	
4.	Padmar river	Transport accident	Water		24/10/2009	24/10/2009	14	
5.	South	Transport accident	Water		19/02/2009	19/02/2009	37	
India								
1.	Near Mathura	Transport accident	Rail		21/10/2009	21/10/2009	22	23
2.	Kerala	Transport accident	Water		30/09/2009	30/09/2009	46	25
3.	Jajpur (Orissa state)	Transport accident	Rail	Train Express Coromandel	14/02/2009	14/02/2009	16	200
Nepal								
1.		Transport accident	Road		10/9/2009	10/9/2009	31	
2.	Sunsari district	Transport accident	Water	Ferry	4/1/2009	4/1/2009	22	17
Pakistan								
1.	Sorandara (Mohmand distri ...	Transport accident	Road		23/10/2009	23/10/2009	15	
2.	Near Dabban village	Transport accident	Road		17/09/2009	17/09/2009	27	40
3.	Near Peshawar	Transport accident	Air	Helicopter MI-17	3/7/2009	3/7/2009	26	

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