Disaster Science and Management

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Tata McGraw Hill Education Private Limited NEW DELHI

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Published by Tata McGraw Hill Education Private Limited, 7 West Patel Nagar, New Delhi 110 008

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This edition can be exported from India only by the publishers, Tata McGraw Hill Education Private Limited.

ISBN (13): 978-1-25-900736-1 ISBN (10): 1-25-900736-7

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Typeset at Script Makers, 19, A1-B, DDA Market, Paschim Vihar, New Delhi 110063 and printed at ***

Cover Designer: Kapil Gupta

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To The disaster resilient people of India

Preface

The incidence of disasters is increasing. The economic losses associated with this are multiplying. The poor and the vulnerable are the worst affected. Repeated disasters are dropping poor peoples' well being making them more prone to shocks. Disasters pose the biggest obstacle in achieving development goals. The impact of climate change is going to adversely impact the agricultural sector in the near future. Because of these factors, development planners and executioners would have to look at disasters more holistically.

This book, *Disaster Science and Management*, has been written based on an extensive library research and on my empirical insight of responding to disasters in the various cultural and social contexts in India. The book has essentially six components: understanding of disasters and their relationship with human development; the international code of conduct and minimum standard of humanitarian response; the science of disasters; the Government of India's efforts in minimizing disaster losses; management of disasters; and real life case studies of responses after disasters, including disaster risk reduction by the poor and vulnerable.

There is no dichotomy between development and disaster management; both attempt to improve peoples' abilities to absorb macro and micro shocks. It would be rewarding if the policy makers, executioners and the academia find this book useful.

While writing this book, I have been continuously encouraged by Rini Bhattacharya, my partner. Ujan, our son, has ably supported me with his computer skills. Utin, our daughter has edited the text with great care.

I am indebted to the reviewers for their positive feedback.

TUSHAR BHATTACHARYA

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Chapter 1

GLOBAL DISASTER PERSPECTIVE

Between the years 2000 and 2009, the world was struck by 4000 disasters killing more than 780,000 people and affecting more than two billion people. The estimated economic losses were US Dollars (USD) 960 billion. There has been a 'dramatic' rise in natural disasters in the past decade, according to the Director of the Center for Research on the Epidemiology of Disasters (CRED), Geneva. During the period between the years 2000 and 2009, there has an increase in disaster of 233% compared with years 1980 and 1989.

2010 was one of the worst years of natural disasters for the entire world with 950 natural disasters, that included the massive earthquake in Haiti and the epic floods in China and Pakistan. The Haiti earthquake alone killed 225,570 people and it stood second to the worst disaster in terms of mortality, when 300,000 people had died due to the famine that had struck Ethiopia in 1983. The total mortality due to natural disasters in the year 2010 was 295,000. As a result of the disasters, the insurance companies suffered a staggering loss of 13 billion USD, which would have been far greater had the majority of Haitian population not been impoverished, and hence, unable to afford insurance. The economic loss due to all the natural disasters was estimated at 13 billion USD (Source: UNDP Bureau of Crisis Prevention and Recovery).

In the decades between 1980 and 2010, more than 1.5 million people were killed globally by natural disasters alone. Mortality is a key indicator for measuring the impact of a disaster: "this however reveals only the tip of the iceberg in terms of economic losses and human suffering" (Source: UNDP Bureau of Crisis Prevention and Recovery). It has been observed during the decades between 1980 and 2000 that for every person killed, 3000 people were exposed to the natural hazards. The annual economic losses

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due to disasters increased by more than 1200% from the decade of 1960 to the decade of 2000 (Source: Reducing Disaster Risk — A Challenge for Development UNDP).

Decade	Economic losses due to disasters in million USD
1960s	75.5
1970s	138.4
1980s	213.9
1990s	659.9
2000s	997 billion USD

Table 1.1 Global Economic Losses Due to Natural Disasters

The losses associated with disasters as depicted in Table 1.1 only take into account four natural disasters: flood, tropical cyclone, earthquake and drought. It has been estimated by the international agencies like, UNDP, DFID and a host of others that 25% of the world's geographic area and 75% of the total population are exposed at least once a year, to flood, cyclone, earthquake or drought. As a result of these natural disasters, between the years 1980 and 2000, globally, more than 184 deaths occurred per day. Although 11% of the people exposed to natural hazards live in low-income countries with low human development, they account for more than 53% of the total recorded deaths. Globally, 10 million hunger-related deaths occur every year, in which half are children⁵. A 6.5 Richter scale earthquake that hit California, USA, in 2003 took two lives and injured 42 people; whereas a 6.6 Richter scale quake, in Iran, four days later killed over 40,000 people¹. Therefore, the impact triggered by a natural hazard has an intrinsic relationship with human development.

The reasons behind the increasing losses associated with natural hazards are many, including global climate change, rapid urbanization often in high risk areas, like Mumbai or Dhaka and environmental degradation. Mumbai, with a population of 20 million people and 6.7 million slum dwellers, the financial capital of India contributing to almost 40% of India's tax revenue, according to the World Health Organization, is one of the 10 most vulnerable cities in the world in terms of floods, coastal storms and tropical cyclones. Mumbai is situated on the fault line, therefore, prone to earthquakes also. Most of the city is less than a meter above the sea level. The Haiti earthquake should be treated as a warning signal for the unplanned growth of cities. Any serious disruption triggered by a natural disaster in Mumbai can have a grave impact on the economy of India.



Fig. 1.1 The global economic loss in million US Dollars due to natural disasters between 1991 and 2001 and its distribution.

Source: OFDA / CRED international database

According to Figure 1.1, Asia accounted for 51% of the total global loss associated with natural hazards followed by America (26%) Europe (21%) and Oceania and Africa, the remaining (2%).

1.1 GLOBAL NATURAL RISK SPECIFIC PROFILES

FLOOD

On an average, 195 million people in more than 90 countries of the world are exposed to floods every year, between the years 1980 and 2000. India accounts for the maximum number of people: nearly 155 million, who are exposed to this natural hazard followed by China. More than 60% of the world's large dams are located in China and India (Source: World Commission of Dams).

TROPICAL CYCLONE

Globally, on an average, nearly 119 million people were exposed to this natural hazard every year between the years 1980 and 2000, causing a total mortality of 251,351. Bangladesh alone accounted for more than 60% of the registered deaths due to tropical cyclone. The Bay of Bengal is the most cyclone prone segment of the world. During this period, the number of people physically exposed to tropical cyclone was highest in China (600 million) followed by India (350 million) (Source: UNDP BPCR).

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EARTHQUAKE

Between the years 1980 and 2000, globally, a total of 158,551 deaths occurred due to earthquakes; in Iran alone 47,267 people were killed by them during the same period. Nearly 130 million people, on an average every year, were exposed to earthquakes. Between December 26, 2004 and September 30, 2009, Indonesia experienced 10 major quakes. Scientists are wondering how many more installments of tectonic stresses would have to be released before this part of the world becomes seismically stable.

DROUGHT

A drought is an extended period of months or years when a region denotes deficiency of water. Generally, this occurs when a region receives less rainfall than the average. The region could be as large as few countries or as small as a district. Drought is a slow impact disaster. It can have serious impact on the agriculture and ecosystem of the affected region. Long duration of drought has created the present-day problems faced in the Sahel of Africa. Sahel runs from the Atlantic Ocean in the West to the Red Sea in the East covering parts of countries of Senegal, Mauritania, Mali, Burkina Faso, Algeria, Niger, Nigeria, Chad, Sudan, Somalia, Ethiopia and Eritrea. This region experienced prolonged drought from 1968 to 1974.

The Intergovernmental Panel on Climate Change (IPCC) assessment report states: "Longer droughts have been observed over wider areas, particularly in the tropics and the subtropics since 1970". The assessment report also states: "Although precipitations have increased in certain parts of the globe, the area under drought has also increased".

	No. of droughts	No. of droughts ≥ 6 months	No. of droughts \leq 12 months	Longest duration (months)	Percentage of area
Africa	44	28	4	19 (1982 to 1984)	40
Asia	86	37	22	49 (1984 to 1988)	48.5
Europe	40	24	4	20 (1959 to 1961)	42.5
North America	57	34	8	44 (1950 to 1955)	39.1
Oceania	24	17	1	12 (1950 to 1852)	80
South America	45	37	4	12 (1958 to 1959)	51.2

Table 1.2 The Incidence of Drought from 1950 to 2000

Source: World Climate Report, February 2010

Oceania includes Australia, New Zealand, and Pacific Islands.

India's current expenditure on an important social sector, i.e., education, is around 4.1% of the National Gross Domestic Product (GDP), but the disaster response eats away almost half of this. It is, thus, vitally important to all the planners, technocrats, bureaucrats and academicians to realize the importance of reducing the impact of disasters on life, livelihood, agriculture, economy, infrastructure and environment. Disasters pose the biggest obstacle in achieving the "Millennium Development Goals" set out by the United Nations and ratified by most countries of the world, including India. From the contexts of population growth, rapid urbanization often in known disaster prone areas, climate change, which is likely to adversely affect the agricultural production in the near future in the country, learning from the failures of well-intended engineering and technological projects of the past, the geo-scientific and the present environmental contexts in the country, the social and legal aspects of disasters, disasters should be viewed and managed more holistically by all the stakeholders. There has already been a paradigm shift by the Government of India, the state governments and the union territories to become proactive in disaster management than reactively respond to the needs of the disaster affected people, as was the case even 10 years from now. The purpose of writing this book has been to look at disasters more holistically. understand its relationship with development and learn from some of the good and the not-so-good examples of disaster responses that the author has been involved with, so that the key stakeholders in disaster management are sensitized on the "management of disasters" in the country.

Chapter **9**

The Definition of Disaster: Its Relationship with Human Development

2.1 DEFINITION

The definition of disaster has undergone many changes in the recent past in the wake of improvement in the understanding of the relationship between poverty, vulnerability and the natural and man-caused hazards. Disaster means a catastrophe, a mishap, a calamity or a grave occurrence in any area, arising from natural or man-caused causes, or by accident or negligence, which results in a substantial loss of life or human suffering or damage to and destruction of property, or damage to and degradation of environment, and is of such a nature and magnitude, which is beyond the coping capacity of the community of the affected area. In 1997, World Disaster Report, the World Health Organization defined disaster as "any occurrence that causes damage, economic destruction, loss of human life and deterioration in health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area". This definition is a vast improvement from the past. The nongovernmental international and national development and relief organizations use a more simplified United Nation's definition of disaster: "A serious disruption of the functioning of a community or a society causing widespread human, material, economic and environmental losses which exceeds the ability of the affected communities or societies to cope with its own resources."

The Definition of Disaster: Its Relationship with Human Development 🔅 7

The present definitions put people at the center and also recognize that the communities or societies likely to be affected by certain types of disasters possess traditional wisdom of coping with it. As an example, Kashmir has weathered several earthquakes, major and minor, over the last 100 years prior to the high intensity quake that hit the valley in 2005. The traditional housing stock in Kashmir is tin roof, because of its proneness to earthquakes. When the houses collapsed in Kashmir, people inside the houses did not die in large numbers. As a result, the mortality in Kashmir quake with much higher intensity measured by Richter scale was negligible (1500) compared to the Bhuj earthquake in Gujarat (more than 13,000).

2.2 TYPES OF DISASTERS

Disasters, depending on their causes, may have the following distinctions:

- Sudden onset of natural phenomena, such as flood, tropical cyclone, earthquake, river erosion, landslide
- Slow onset of natural phenomena, such as drought, climate change
- Sudden onset of events, such as major accident, major civil war, nuclear explosion, war, terrorist attack
- Slow onset of events, such as HIV/AIDS epidemic, arsenic poisoning through drinking water, systematic discrimination against specific social groups, occupational hazards

(Partially adopted from Oxfam Field Worker's Handbook published by Oxfam, Great Britain)

There is a better way of classifying disasters. The reasons for most disasters, both natural and man-caused can be attributed to the following:

Hydro-meteorological

Under this category, the disasters, like floods, hailstorms, lightning, cloudbursts, droughts, extreme heat/cold, cyclones, tornadoes, etc., can be clubbed together.

Geological

Earthquakes, volcanic eruptions, *tsunami*, landslides, avalanches, soil erosion, mud flows, etc., can be put together under this category.

Industrial, nuclear and chemical

Under this category, disasters due to leakage of poisonous and harmful industrial gases, nuclear radiation, etc., can be put together.

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Accident related

This category includes disasters, like urban fire, forest fire or bush fire, sudden flooding of mine, oil spills, air, road, rail and boat accidents, collapse of buildings, bridges and dams, extraplanetary hazards from asteroids or comets hitting the earth.

Biological

In this category, human epidemics, like HIV/ AIDS, H1N1, *kala–azar*, malaria, cattle epidemic including bird flu and pest attacks can be put together.

Social

Ethnic, religious, caste and other forms of social conflict can be put under this category.

2.3 RELATIONSHIP BETWEEN DISASTER AND HUMAN DEVELOPMENT

Disaster impact is intimately connected with human development. A hazard turns into a disaster when the people, potentially in the danger zone, are vulnerable and do not have the capacity to cope with the impact of the hazard. For the sake of understanding the connection between hazard (H), disaster (D), vulnerability (V), and capacity (C), it can be concluded that:

$$D = \frac{H X V}{C}$$
 D is H multiplied by V and divided by C

WHAT DO THESE TERMINOLOGIES MEAN?

Natural hazards:

These are natural processes occurring in the biosphere that may result in damaging events, which may be amplified by human interventions, like environmental degradation, rapid urbanization and anti-poor development programs.

Vulnerability:

This refers to the human condition that is attributed to the physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a hazard. The difference between poverty and vulnerability is that poverty measurement is very static, depends on income or food intake, whereas vulnerability analysis is more dynamic encompassing the physical, social, economic and environmental factors. All the poor are vulnerable, but not all the vulnerable are poor.

Capacity

This refers to the manner in which an individual, a collection of individuals and organizations use the available and existing resources under their control to limit the impact of a disaster.

Vulnerability cannot be changed without the political will of the government and the long-term development interventions aimed at the poor and the vulnerable people living in the known disaster prone areas. Enhancement of the capacity of the coping mechanism of these communities is possible in a relatively short period of time. This is the essence of disaster preparedness, which now in the Aid Agencies' parlance is known as *Disaster Risk Reduction*. There are many good examples of such initiatives globally, including India.

Who are the most vulnerable?

Globally, the most vulnerable to disasters are women, children, the aged, the disabled, the people living with HIV/AIDS, the ethnic and religious minorities and the 'social misfits' like substance users. This is not an exhaustive list but most often they are found to be the worst affected by any disaster.

Which part of the world is most vulnerable?

According to Mahabubul Haq, "South Asia is fast emerging as the most illiterate, the most malnourished, the least gender sensitive — indeed the most deprived region of the world" (Source: *Human Development in South Asia* by Mahabubul Haq). It is not surprising that the Ganga–Brahmaputra–Meghna river basins have a concentration of more than one-third of the world's poor.

From the analysis of the relationship between hazard, disaster, vulnerability and capacity and the subsequent discussion, it is therefore imperative that South Asia in general and India in particular, are one of the most vulnerable geographic regions of the world prone to disaster.

The women, the children, the aged, the disabled, the PLWH/A, the ethnic and religious minorities and the 'social misfits' are the most affected sections of the society in times of disasters. (These sections of the society are termed by development thinkers as 'excluded'.)

2.4 DISASTER MANAGEMENT CYCLE

The disaster management cycle consists of seven stages: Response, Rehabilitation, Reconstruction, Development, Prevention, Mitigation and Preparedness, as shown in the Figure 2.1.

Figure 2.1 depicts the disaster management cycle: The continuum of Disaster – Response – Rehabilitation – Reconstruction – Development – Prevention – Mitigation – Preparedness. It is advised that the agencies involved in the development and humanitarian response follow the whole cycle of disaster management.



Fig. 2.1 Disaster management cycle

The disaster management cycle could also be explained through a graph with time along the X axis and well being along the Y axis as shown overleaf:





Fig. 2.2 Disaster Management Cycle in relation to poverty and vulnerability of the affected people.

Explanation of figure 2.2

The marginalized and thus vulnerable communities, because of their own effort and the resources from the government and the nongovernmental organizations aimed at poverty eradication, may over some time progressively improve their well being. But when a disaster strikes, it causes huge drop in their well being, bringing them back to where they were or even worse. At that point, further drop of well being is arrested by providing immediate relief provisions. The disaster affected communities are supported by medium to long-term interventions to put them back into the productive activities they were engaged in prior to the disaster. This phase, depending on the type and the extent of the damage, is aimed at improving the well being of the community — reaching to at

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least where they were before the disaster. Ideally, however, this effort should ensure that people gain an improved well being than what they had before the disaster. It is evident from this figure that the communities exposed to recurrent disasters without a space for recovery have very low well being as in northern Bihar, the Brahmaputra Valley, Eastern Uttar Pradesh, Jharkhand, Orissa, Andhra Pradesh, Madhya Pradesh, parts of Maharashtra and West Bengal. Once the communities, the state, the non-state actors, the PRIs are prepared for a disaster, the drop in the well being of the marginalized communities is less, meaningless impact of a disaster in the life and livelihood of people affected by it. It is, therefore, necessary for the government or the civil society to go through the whole disaster management cycle, for the 'management' of disasters. The middle class or the upper class is also affected by disasters, but the drop in their well being is marginal and they have the capacity to bounce back quickly to where they were. This clearly explains the relationship between poverty and vulnerability and disaster impact. The 12 January 2010 Haiti earthquake of 7.0 Mw with its epicenter 25 kilometers west of the capital Port-au-Prince killed nearly 220,000 people and made around 1.6 to 1.8 million people homeless. This was not a powerful earthquake to cause so much of human loss, miseries, and infrastructures and building collapse. Haiti is the poorest country in the western hemisphere, ranked 148 out of the 182 countries of the world in terms of the Human Development Index. This, along with engineering failures had caused such extensive damage to the lives and property in Haiti. A similar intensity earthquake in either Japan or USA would definitely not have created such a lot of mortality because of the vastly improved earthquake resistant buildings. Though Haiti and its neighbor, the Dominican Republic, have a long history of high-intensity earthquakes in the past, both the public and the private sectors did not take this in cognizance, constructing earthquake resistant buildings. Some professionals, mostly the civil engineers, have termed the Haiti disaster as an engineering one rather than a natural disaster. The relationship between hazard, disaster, vulnerability and capacity as explained in the above equation: Disaster = Hazard X Vulnerability/Capacity explains the relationship between disaster and human development. The following example further elicits the relationship between development and disaster impact: a 6.5 Richter scale earthquake that hit California, USA in 2003 took 2 lives and injured 42 people, whereas a 6.6 Richter scale quake in Iran four days later killed over 40,000 people. What had made such a huge difference in mortality? The people of California were and are vulnerable to earthquake, but they had the capacity to cope with it. Their houses were built with additional expensive reinforcement following strictly the building codes for earthquake prone areas, whereas in Iran, people did not have the required resources within their reach to build such earthquake resistant houses. The international relief and development organizations and institutes are now using a term: 'Fragile State (Country)'. A 'fragile state' by definition is a low-income country characterized by

weak state capacity and / or weak state legitimacy leaving citizens to a whole range of shocks. The opposite of fragile state is a stable state where statutory institutional arrangements are able to withstand internal and external shocks. It is estimated that out of the 6 billion population of the world, as high as 26% live in fragile states.

WHAT DO THE TERMINOLOGIES MENTIONED IN FIGURE 2.1 MEAN?

Response

Response is the intervention during or immediately after a disaster to meet the immediate needs of the communities affected by it. This phase, ideally, should be of short duration, but could also be protracted depending on the nature of the disaster. Appropriate disaster response depends on the assessment of the impact that helps the senior management of the private and public institutions to make informed choices. Disaster response should be made based on the assessed needs of the affected communities and not on the perceived needs, that have been perceived from a distance. For an effective and timely response, assessment of the needs is very important just as proper diagnosis is needed for an effective medical intervention for a disease. There are unique sets of data now available with NASA that help estimate the number of people exposed to a particular disaster anywhere in the world. Within a short span in May 2008, two catastrophic natural disasters struck: the earthquake in the Sichuan Province of China; and the cyclone Nargis in Myanmar. The international relief and development agencies, the UN and the media had the data from NASA that was needed to assess the possible number of people likely to be exposed to these disasters (Source: NASA's Socio Economic Data and Application Center).

It has often been experienced that the NGOs tend to prioritize the needs of the disaster affected people based on the organization's distinctive competence, e.g., an organization with a distinctive competence on nutrition may identify this as the priority issue, which may be valid, but in this process, other equally important needs are neglected.

It is, therefore, advised that after a major disaster, a multidisciplinary gender-balanced team consisting of generalists and experts on food and nutrition, water, sanitation and hygiene (WATSAN/WASH is a relatively new lexicon in disaster management), temporary shelter should make the needs assessment. It should be done even at the risk of losing critical time, which can be justified by an appropriate response catering to the immediate needs of the communities affected by the disaster. However, the humanitarian needs assessment should be done as soon as feasible after a disaster. Though disaster affects everybody, but the poor and the vulnerable are the worst affected. Hence special

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emphasis should be given to assess the needs of the women, the children, the aged, the women headed households, the disabled, and the people living with HIV/AIDS (PLWH/A).

There are essentially two types of people affected by any disaster: one who reach the relief providers by their own reach; the others whom the relief providers have to reach. The second category of people is generally the more vulnerable, the less privileged, the 'excluded communities'. They consist of women headed households, households with PLWH/A, the aged and other 'social misfits' like substance users.

The Voluntary Health Association of India (VHAI) assessment team, after the Orissa Super Cyclone, could reach a fishing village in the Astaranga block within a week after the occurrence of the disaster. This village was very close to the sea. Wading through waist-deep water with dead animals still floating the village could be reached. This village lost 12 people and the loss could have been higher, but a school building that saved many lives. Both formal and informal need assessment techniques were used. A fisherman told in an informal dialogue with the author, "If you want to help us, give us a boat and net and a tarpaulin sheet to protect our children and women from rain, sun and the morning dew. Mother sea is waiting for us. Your presence after this would no longer be necessary." No words can express the resilience shown by the poor communities more so after the Orissa Super Cyclone. Incidentally, this was the starting point of VHAI taking up a recovery program among the fishing communities (Source: Author during needs assessment after the Orissa Super Cyclone in 1999).

At times, after disaster, it becomes necessary to quickly determine the nutritional status of children below five years and the children in the age group of more than 6 years. The nutritional status of less than 59 months old children is an internationally accepted indicator to assess the food security of people both in peace time and after a disaster. Children are supposedly exclusively breast fed up to six months. It is, therefore, expected that the children up to that age should not have problems of nutrition, unless born grossly under weight (though it is still a matter of great concern in the poor communities). The impact of lack of nutrition becomes evident six months onwards. In a disaster, quick nutritional assessment of children from six months onwards to 59 months is done using the method of measurement of Mid Upper Arm Circumference (MUAC) by a specially designed colored tape. Measurement of the arm between the elbow and shoulder. The tape has three colors: red, yellow and green. While measuring the MUAC, if the position of the tape is in red, the child is severely malnourished; if yellow, moderately malnourished; and if green, normal.

The most commonly used indicator that reflects the nutritional status of children of 6 years and above is Body Mass Index (BMI). The measurement of BMI is very simple

and quick, a weighing machine and a tape are the only tools required. BMI = Weight in kilograms divided by the square of the height in meters [BMI = Weight in kg / H X H in meters].

A nutritional assessment in Shikarpur tea estate in the Jalpaiguri District of West Bengal was conducted by the Child In Need Institute (CINI) in July 2007. This is the oldest and the biggest tea estate in the district. During its best days, a private airport nearby was in operation to serve the purpose of the estate. This garden had been closed since June 2006. The total sample size was 402 children in the age group of six months to 59 months. 93.6% of the children were scheduled tribe and 6.3% were scheduled castes. The graph below depicts the nutritional picture:



Sex-wise distribution of MUAC for under five years children

Fig. 2.3 Sex-wise distributiosn of MUAC for under five children

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The graph depicts the measurements for MUAC done with children between 6 to 59 months. Amongst the 402 children, 204 were boys and 198 girls. 54% boys and 57% girls were suffering from Grade III malnutrition (MUAC > 12.5), 26% boys and 24% girls were suffering from Grade II malnutrition (MUAC < 13.5 and > 12.5 cm), 22% boys and 17% girls were suffering from Grade I malnutrition. What is significant to note is that none of the 402 children registered normal nutritional status (MUAC <16 cm).

BODY MASS INDEX: FOR CHILDREN BETWEEN 6 YRS. AND 14 YRS.

The BMI (Body Mass Index), a measuring tool prescribed by WHO, was used to measure the nutritional status of children in the age group of 6–14 years. Children's weight (in kg) against height (in meter) was measured and categorized into various nutritional grades. BMI = Weight in kg divided by height in meter.



Sex-wise BMI amongst 6-14 yrs. children

Fig. 2.4 Sex-wise BMI among 6-14 years children

The graph depicts the BMI amongst children in the age group of 6–14 years. A total of 228 children (females: 124, males: 104) were measured and weighed. The BMI amongst 6–14 years shows that 60% of the boys and 55% of the girls are suffering from chronic energy deficiency III (BMI <16), 16% of the boys and 14% of the girls are suffering from chronic energy deficiency II (BMI < 16–17), 13% of the boys and 23% of the girls are suffering from chronic energy deficiency II (BMI < 16–17), 13% of the boys and 23% of the girls are suffering from chronic energy deficiency I (BMI < 17.5–18.5), 11% of the boys and 5% of the girls registered normal weight (BMI 18.5–24.9) and 3% of the girls were overweight (BMI 25–29.9) (Source: Author who supervised the study).

This example is an illustration from real-life experience of how quickly the nutritional assessment of children, adolescents and women could be done in order to take an informed decision on the need of nutritional rehabilitation after a disaster.

This assessment reiterates what has been described earlier explaining the relationship between the impact of a disaster and poverty and vulnerability. The tea estate labor communities depended on the estate for generations for all their basic needs like livelihood, health, education, ration, place of stay, drinking water and fuel. The only skill they acquired was associated with tea production. They are primarily scheduled tribe. They had no capacity to cope with the major shock of closure of the garden. Therefore, within a year of the closure, the nutritional status of under five children and adolescents had reached such an alarming stage. It is a matter of national shame that there are four Anganwadi Centers in the surveyed area run under the Integrated Child Development Scheme (ICDS), which is claimed to be the largest development program in the world! It is also worth mentioning here that the best indicator of household food security or insecurity is the under five nutritional status.

Rehabilitation

This is a medium to long-term set of activities that aim at putting the disaster affected communities back to productive activities that they were engaged in, prior to the disaster. Since this is a medium to long-term measure and is initiated after the immediate response phase, it allows the government and the private sector the necessary time to plan. Ideally a rehabilitation plan should integrate a disaster risk reduction component for future exigencies, if any.

A case study of a successful rehabilitation program after the Orissa Super Cyclone:

(Source: Author, who planned and implemented the program) This is an example of a public-private partnership. The financial resources for this came from the Prime Minister's Relief Fund with a condition that no political party should have any involvement in this program.

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Coastal Orissa was hit by a Super Cyclone on the 29th of October 1999, in which the wind velocity reached up to a maximum of 350 km per hr¹. The cyclone affected 14 relatively more prosperous districts from Puri to Paradip. The tidal waves during the cyclone reached a height of 15 m. The total mortality was reported to be 10,000 people. As mentioned earlier, for each dead person, 3,000 people are severely affected. As a result of cyclones, there was hardly any house with roof along the long coast, other than the cement concrete ones, which were few and far between. All the sources of water along this stretch and within one km of the shore were contaminated. The international communities and the adjoining states provided overwhelming support to the affected state and the communities.

The worst affected were the fishing communities, who lived closest to the sea. The biggest hurdle initially was to reach the affected communities, because the highway and the state roads were breached at many places because of the cyclone and the heavy rains that accompanied the cyclone. The magnitude of the devastation was so big that the state and district administrations took some time to reach the people. The problem was further compounded by the looting of foodgrains on the highway, not by the cyclone affected people, but by the local antisocial elements. These led to anger among the affected people.

In this context, the Voluntary Health Association of India (VHAI) decided to initiate a post-cyclone recovery program with the most vulnerable and the worst affected people. It named this initiative 'Aparajita' which means 'the unconquered woman'. Aparajita soon set up three offices in Puri, Jagatsingpur and Kendrapara, not in the district headquarters, but close to the affected people. For the first 5 months, the Kendrapara office was situated in a small room of a damaged school building right in the middle of a severely affected village. The affected population was getting rations from the government and the civil society organizations, but this consisted of only rice and dal with other essential ingredients, like cooking oil and salt. Aparajita, in order to supplement the food people were having, decided to provide assorted vegetable seeds worth INR 10 per family for 10,000 affected families covering the worst affected parts of the three districts. People responded to this with enthusiasm; they not only spread it in their fields, but also on the floors of what were their homes once. It surprised the Aparajita team when all the people receiving this, paid back half the cost to Aparajita. This significant gesture from the people that they were no beggars, but dignified people, may be in need of support at that juncture, paved the way for one of the best post disaster recovery programs anywhere in the world. A woman, who had no opportunity of formal education, from one of the villages, said after the seeds germinated and plants came up: "When I saw that the seeds I spread on the floor of what was my home before the cyclone, germinated and plants sprang up, I felt life has not stopped, why are we waiting for relief? We must stand on our feet". India has witnessed many disasters but the resilience of the people of Orissa, more so of the poor and vulnerable has been unparalleled. When the VHAI team reached a fishing village in the Astarang Block of Puri District wading through waist deep water with bloated dead animals floating on the water, a fisherman said in an informal meeting with the author, "If you want to help, give us a boat and net and a tarpaulin sheet to protect our children and women from the morning dew and sun in the day. Mother sea is waiting for us. We would not need you after this." This small village lost 12 people in the cyclone! Such was the resilience of the poor and the vulnerable.

Aparajita decided to initiate the livelihood program with the objective of putting the cyclone affected people back to the productive activities they were engaged in, prior to the cyclone. It was mutually decided between the VHAI team and the communities after a series of informal interactions with the affected communities that the support from VHAI would not be a dole. All the people, who received financial support, would repay 50% of the input cost to a community fund under the control of the people, for future, from the benefits of the productive activities. They also came up with a repayment schedule. 2500 riverine fishermen were supported apart from many others including women dry fish vendors. All of them had one thing in common: they were all very poor.

Fishing is a group activity. It was decided that a group of 5 people would be receiving a boat and net: the total cost at that time was INR 16,000. The VHAI team was criticized by the powerful people in the state for working with riverine fishermen, because there was no money in it. The team did a detailed study of the practices among the fishermen that existed in the pre-cyclone period. It revealed that one of the 4 to 5 team members of a team owned the boat and another member owned the fishing net and others in the group had no ownership on the means of production; they were daily wage earners. The two men having access to the means of production would separately take loans from the local fish traders in the beginning of the season with high interest rate and with a condition that all the good quality fish will be sold to the traders, depriving the fishermen access to the consumers. Hence, they did not know the market price of their catch. It became known to the VHAI team from the analysis of the past practice that the success of the recovery program would depend on the composition of the group: no two members of the group should come from one family or one extended family. This initiative had the opportunity of ensuring equitable share of the means of production and hence the benefit, and the 2,500 fishermen could be freed from the bondage of the local fish traders. One day, a group of 5 in Jagatsingpur caught fish which to their utter surprise fetched them INR 7,800 in the

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local market. Within 10 months of the program's implementation, the poor and vulnerable, who were supported by the VHAI team, created a community asset of INR 4.5 million. It is worth mentioning that the communities had the complete control of the savings from the beginning. The VHAI team decided to pass over the responsibility to the local communities. The relationship continued, but was of a very different nature; the communities shared their success stories and the status of the community fund on a time to time basis. Within two years the savings touched 10 million. The money from the savings was used to enlarge the boats, energize these; the women dry fish vendors were trained by a Kakinada-based civil society organization specializing in the hygienic and improved techniques of drying fish. This group currently sends truck loads of dry fish to various parts of the country. It is worth mentioning here that Aparajita worked with the same program with the same philosophy in three districts: Puri, Jagatsingpur and Kendrapara. The success narrated was achieved in one district only.

This example once again iterated that humanitarian response and development are not mutually contradictory. The same area was severely flooded in the next monsoon. Not one died of floods, because the people were prepared to cope with the exigency. This is an example of the integration of disaster risk reduction in a post disaster recovery program.

WHAT IS THE LEARNING FROM THIS THAT COULD BE REPLICATED ELSEWHERE?

- The staff assigned to Kendrapara decided to stay with the cyclone-affected people for the initial four months.
- His place of stay was a meeting point of the affected people, the members of the local self-governance bodies (the Panchayati Raj Institution) and other stakeholders.
- He translated the theoretical training imparted into practice.
- In his own initiative, he identified 15 boys and girls from the poor and affected communities to support him.
- These volunteers, being all from the area, took time in forming the groups of 5 ensuring that not more than one from a family is a member of the group.
- The people participating in the program had a say in every decision made.
- It was ultimately the peoples' program and not of Aparajita.
- The volunteers on their own formed a monitoring committee of 5 from among them, who ensured quality and was given the authority to stop the payment for any unsatisfactory work.
- There was a perfect balance of the efforts in initiating a process and the efforts of reaching the target.
- Each and every person knew the budgeted amount, the cost involved, and therefore, was able to decide allocation for making the boat and the net.
- Savings was an alien concept, but once decided it was always under the control of the poor people.
- Through this program, the fishermen were released from the bondage of the local fish merchants.
- There was a huge growth of 'Social Capital' in the course of program implementation. The target of the construction and distribution of 500 boats with the required nets to 500 groups of 5 each could be achieved in two ways:
 - 1. To construct the boats bringing skilled people from anywhere they existed and to buy the net from vendor(s) and distribute these to the 500 groups.
 - 2. To follow a set of sub-objectives to reach the target like:
 - (a) Formation of groups in a way that no more than one from a family is represented in the group;
 - (b) To discuss in detail with the fishermen about the size of the boat for a group of 5, the quality and size of the net;
 - (c) To find out from the fisher folk: who all could build the boats, how many of them would be needed and which place would be the most suitable for boat making;
 - (d) Discuss with them who all would provide the food during boat construction;
 - (e) Accompany a selected group of people to the saw mills to select the type of wood and to find the cost involved;
 - (f) Discuss with the group on the repayment schedule and its management; and
 - (g) Find from them which is the most auspicious time to float the boats.

Which of these two methods have better chances of sustainability the target being the same?

The lower triangle in the Figure 2.5 represents the efforts in reaching a target and the upper triangle represents the efforts in initiating a process that leads to the same target. As evident from the figure, in the initial phases, more effort is made to initiate the process and at a later stage most of the effort is aimed at reaching the target. When there is a proper balance between the efforts of initiating a process that leads to



Fig. 2.5 A balance of efforts in reaching a target and in initiating a process leading to the completion of target / task.

the target and the efforts of completing the target, the program has better chances of sustainability. Ideally, the people for whose benefit the program is, should ensure the completion of the task within the planned period.

This is an example of how the seeds of construction could be embedded in large-scale destruction.

Reconstruction:

This is a medium-term activity, where the damaged physical infrastructure is rebuilt thus ensuring that the people affected by a disaster start living a 'normal life' once again. This could include repair and rebuilding of roads, schools, hospitals, electricity and telephone connections, housing, drinking water sources.

A CASE STUDY OF A SUCCESSFUL RECONSTRUCTION AFTER FLOOD

The case study being described now is not only a successful reconstruction program, but also a case study of 'good governance' in disaster response. In September 1980, a devastating flood swept through the tribal villages of the Gudari Block of the present Rayagada

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district of Orissa. This is an area, which is generally prone to drought and is home for the tribal population, mostly the *Sauras* and the *Kondhs*, who have been exploited by the local upper-caste money-lenders. The small scheduled cast community living in the midst of the tribal villages was used by the upper caste as an instrument of exploitation. The Oxfam East India Office based at Calcutta (as was known those days) decided to work in 17 villages helping people rebuild their houses with cash for work. It became known to the team sent there, that, though the tribal people had been living in their villages for generations, did not have the legal rights on their homestead land. Except the team leader and an accounts person, all others stayed with the tribal communities in the flood damaged houses. They soon saw the unjust social practices going on, which were heavily biased in favor of the landowners. In this social context, there were obviously two options to the team: 1. to confront and address the social issues in the process of house reconstruction program, the mandate of the team; and 2. to help the tribal communities to rebuild their houses in the old site, where the homestead land did not legally belong to them. The team decided to choose the first option, knowing well that they might have to stay longer than the planned six months for the completion of the program.

The Orissa State Special Relief Commissioner and a member of the Board of Revenue was overseeing the reconstruction program on behalf of the state. It was because of his and the local subdivisional magistrate's proactive support that within two months of this team's presence in the area, all the 352 tribal families were provided with 242 sq. vards of homestead land each with legal entitlements. The tribal communities, in spite of sharing the same food and house with the team members, were initially not convinced about the purpose of the team. They were also misled by the exploitative forces apprehending that the team's presence may have a permanent impact on the existing power relations. But, once they received the land and the land rights, they wholeheartedly came forward. The team discussed in detail the program cost budgeted per house (which in 1980 was INR 1,750): one man and one woman from each household would be paid minimum and equal wages to reconstruct their houses in the new site. The only scheduled caste village in the area would be excluded by imposing certain conditions for receiving money for house reconstruction that would not be acceptable to them. The income earned by the two members of the family in six days of this program was confirmed by them to be more than two months of the wages paid to them by the land-owning class. It was at this juncture that the concept of savings for future exigencies was introduced and the communities involved in the program happily accepted it. The house model that was accepted was actually from the one laid on the ground. All this did not happen in a day. It took a number of village meetings to come to such a consensus. Because people knew the budgeted cost of each house, they were able to split this into wage and the cost of materials like timber, door frame, etc. When they realized that the cost of wood and the door frames in the front and the back would

eat up a considerable portion of the budgeted cost leaving less for wage, they decided to reuse the salvaged door frame from the damaged houses as the back door.

Gudari was revisited after 20 years of the completion of the program. " ...the ravages from the floods are still evident: sand covers the top soil, keeping it barren. But the economy has moved on — the barter and the *jajmani*, the dominance of the Brahmin culture of exploiting people, with their pro landlord bias, has been replaced by a currency exchange". An elaborate discussion reveals that the people fought tooth and nail to disband (an existing exploitative) the system and establish equal and minimum wages. The concept of savings was alien to them. The communities saved Rs. 150,000 during the implementation of the program and 20 years later "most of the money was still under circulation — meeting the health exigencies, buying fodder and food grains".

This is a 'good practice' of a post-flood reconstruction program. What were the key elements of success?

- The team members with language ability lived with the people for 10 months. They caught the pulse of the people.
- The unjust social practices were addressed and not pushed under the carpet. The team laid equal emphasis on the process leading to achieving the target of the reconstruction of 352 houses instead of the over arching practice of being driven by target alone.
- There was a vision of converting an emergency reconstruction program to a long-term development one.
- All the major decisions were taken after detailed discussions and through consensus building.
- The local customs and traditions were respected.
- This was a peoples' program and not of the team. The people owned it.
- The communities, with whom the team worked, saw that the team sided with the poor and vulnerable.

WHAT ARE THE TAKE AWAYS FROM THIS CASE STUDY?

• This was an example of 'good governance' — all the 704 women and men involved in the implementation of the program were aware of the budget per house and hence were able to take conscientious decisions at all stages of the program.

- There was a perfect balance of efforts of initiating a process that would finally lead to the completion of target and the completion of target before the next monsoon.
- 'Social Capital' was developed (Social Capital from the perspective of sustainable development means the social resources upon which people can draw support. This can be achieved from horizontal connectedness between individuals of shared interests and is based on trust and reciprocity).
- Important social messages were provided while implementing the program like: minimum wage, equal wage irrespective of gender identity, importance of thrift for future exigencies, the right of the poor to homestead land, etc.
- People were paid six days of wages every week and it was they who collected their wage from all the involved and deposited in the bank, contrary to the usual practice of deduction at source.
- The rule of the land was strictly adhered to though most villages were on the fringe of forests, but nobody was allowed to cut trees for house reconstruction.
- It was a peoples' program the completion of the program before the onset of monsoon was their responsibility.
- Post-disaster house reconstruction is not a priority of the poor, it is justified only if this is a medium term income generation for them.
- Salvaged materials form the damaged houses, if reused, can bring down the cost of houses by 15 to 20%.

In Latur, an agency known for its philanthropic work in the country and also abroad (name withheld), was entrusted by the government to reconstruct one village. The new site was hardly 200 m away from the temporary shelter where people, for whom houses were being built, stayed. The houses looked almost complete when the author visited the site. When asked if people living so close knew which particular house was meant for whom, the reply was 'no'. Not only that, the person in charge of the program said, "Have you gone mad? In that case, they would ask for some or the other alteration and addition. There would be a lottery to decide who owns which house". The institution constructed a barrack but not houses (Source: Author, unpublished report on Comparison between Uttarkashi and Latur Earthquakes).

After the Gujarat earthquake, it became very difficult for the non-state agencies to implement the much advertised public-private partnership for house reconstruction program. This was primarily because in this program, the village was treated as a homogenous unit, which it was not. There were poor, not so poor and better off people

in a village. As a result, it was difficult to satisfy everybody with a common design of the house to be reconstructed. Different sets of people had obviously different expectations from the state and the non-state actors.

Development

Development means a state, where the country and / or the communities have the capacity to absorb the macro and the micro shocks with its own resources. Indian economy has been growing at such a rate in the last decade or so that it is now being considered to become a superpower soon. India is bracketed now with Brazil, Russia and China and together they are known as the BRIC Countries. The country has enough food reserves that can meet the food requirements even if a large portion of the country is adversely affected by disaster causing crop losses as has happened in 2009 when 252 districts of the country were declared drought affected by the government.

Prevention

The term 'prevention' means the activities and physical measures taken by the state and the communities likely to be affected by a disaster to reduce its adverse impact on life, property, infrastructure, health and environment. Construction of flood and cyclone shelters, early warning systems on drought, cyclone, flood, *tsunami*, tornado and other natural disasters, which can be forecasted, training of important stakeholders on disaster management are the examples of prevention.

Mitigation

Mitigation means the long-term measures undertaken to protect and/or strengthen the existing vulnerable elements to minimize the adverse impact of natural hazards, technological hazards and environmental degradation. The National Disaster Management Act and the implementation of this act at the grassroot level, The National Building Code of 2005 and its strict adherence, particularly in Zone V and Zone IV of the seismic zoning map of the country are examples of mitigation measures. The National Cyclone Risk Mitigation Project of the Government of India, the Climate Change Adaptation Program of the Government of India, are some of the examples of mitigation measures.

Preparedness

Preparedness means a continuous cycle of planning, organizing, training, and exercising activities to ensure the enhancement of capacities of the communities, the civil society and the government, in order to prevent and protect against, and respond to recover

from the effects of the natural and the man-caused disasters. This means that disaster preparedness needs to be planned at three levels: the state or union territory, the civil society and the communities in the known disaster prone areas. It has been the experience of the author that out of these three institutions, understandably the local civil society is the least prepared, because it has to mobilize the resources from the international donor agencies for responding to a disaster. The impact of a disaster is less in a country, society and community that is prepared to cope with it. To cite examples: The 6.4-intensity earthquake in Latur, Maharashtra killed 9,748 people; whereas the technically much more powerful Los Angeles earthquake of 1971 killed 55 people. Similarly, the 1991 cyclone in Bangladesh made millions of people homeless and killed 140,000 people; whereas Hurricane Andrew, which hit the Florida Coast, killed 41 people³. What made the difference? Is it because of the underdevelopment of the countries and communities involved in the examples and thereby having low capacity to cope with a high-impact disaster using its own resources?

In view of the magnanimity of the problems related to disaster management, development players and executioners worldwide in the last 10 years or so had been groping with the idea of increasing the capacity of the poor to cope with disasters thereby reducing its impact to life, property and livelihood. This snowballed into the present-day concept of Disaster Risk Reduction (DRR). The concept of DRR was possibly first introduced (to the best of the knowledge of the author) in Oxfam's Field Workers Handbook with a chapter on "Capacity and Vulnerability" analysis. Over the years, the relationship between hazards (H) turning in to disasters (D) and vulnerability (V) and coping capacity (C) has been established as $D = (H \times V) / C$. Of the three factors in the equation, hazards would continue to take place whether natural or man-caused. The vulnerability could be lessened, but it would take a long time and would require a targeted antipoverty program. However, the capacity of the poor and vulnerable could be enhanced in a relatively short period to "live with hazards". The core value in the community-based disaster risk reduction is communities, however poor and vulnerable they may be, they have the collective power and wisdom to minimize the impact of a disaster upto some extent.

The Rationale for Disaster Risk Reduction

- Disasters affect the poor people the most.
- Absolute levels of disaster risks are increasing due to various pressures including climate change. Economic losses associated with disasters globally almost doubled in real terms between the 1960's and the '90's.

- Disasters pose significant and growing threats to development. They challenged the prospect of achieving the 'Millennium Development Goals' of the United Nations and was ratified by most countries of the world.
- Competing priorities and scarce resources mean that the poor people/poor countries will not be able to dedicate the same resources as the rich people / rich countries; however, there are cost-effective practices and policy choices within the reach of the poor people / poor countries that could significantly lower the risk.
- The national governments, donors and the international communities have not done enough to tackle disaster risks, because the cost associated with reducing the risks is immediate and the potential benefits are medium to long-term.
- Appropriate livelihood resilient to disaster risk reduces the vulnerability of the affected people.
- The integration of DRR in all the development and humanitarian policies and planning is imperative.
- Estimates suggest that globally 25% of the world's landmass and 75% of its population is at risk of some form of disaster (Source: DFID website).

In initiating a community-based DRR or integrating a DRR concept in a postdisaster recovery program, the author, on both occasions, posed a simple question to an assembly of people in the villages affected by disaster, "You suffered a lot in the last disaster. Thinking in retrospect, what could you have done individually or collectively prior to the disaster to minimize your sufferings?" Responding to this, people, both women and men, came up with brilliant ideas. This was the beginning of a very successful community-based DRR program. Step 1 was to form a Village Disaster Committee ensuring representation from all the sections of the society including representatives of the local self-governance body (panchayat) and the majority of the village was to be involved in the selection of members. It is necessary to reiterate that sufficient time was to be invested in the first step, and the institutions or organizations, both public and private, must keep pace with the communities and definitely should not expect the communities to keep pace with them. Step 2 was the formation of task forces, each for a particular purpose, e.g., for evacuation to a safe place in the case of floods or cyclones. Step 3 was to know the village better through PLA exercise. This exercise helped all the people in the village to know their village better; like the most vulnerable areas in the village geographically, the women headed households, houses having pregnant and lactating women, disabled and old people. Step 4 was the preparation of a detailed social map of the village by the community. Step 5 was the training of the task forces on issues related to their assigned jobs, e.g., the technique of rescuing people from drowning. Step 6 was the preparation of the community based disaster preparedness plan. A plan must have a budget including sources of required resources to implement it. Step 7 was regular drills conducted by the task forces to keep them ready to act in case of an exigency.

A CASE STUDY OF A SUCCESSFUL COMMUNITY BASED DISASTER PREPAREDNESS PROGRAM

In the year 2000, the whole of South Asia experienced heavy rains caused due to a depression during the late monsoon period, i.e., from the middle to the third week of September. West Bengal and Jharkhand bordering West Bengal received almost close to the average annual rainfall in four days. As a result of this, and coupled with huge discharge of water from the dams, the districts of Birbhum, Murshidabad, Nadia and North 24 Parganas in West Bengal were severely flooded and the dam waters reached the state through Birbhum, a drought prone region of the state. Bangladesh, during the same period, received heavy rains, which made all the rivers of Bangladesh flow above the water levels of the rivers of West Bengal. Because of this, the water from West Bengal could not be absorbed by the rivers across the border, which is what normally happens. This resulted in stagnation of water for more than 6 weeks mostly in Nadia and North 24 Parganas districts. The total death toll reported by the government was 1,500, a figure considered very high for a disaster like flood.

The Inter Agency Group (IAG) on flood, an informal association of the international and national civil society organizations including UNICEF and DFID, became actively and collectively involved in the immediate phase of the disaster. By the time the immediate phase was over, the earthquake-hit Gujarat attracting the attention of the international community. As a result, there was very little recovery work done by the CSOs in West Bengal after the flood.

CARE India West Bengal Office was a very active member of the IAG. CARE India, at that period, was implementing a microfinance program in collaboration with the grassroot level communitybased organizations, one of which was working in Nadia. As per the approved plan of action, this Micro Finance Promotion Institution (MFPI) was to receive a revolving loan fund of INR 1.9 million, which they got. Though there was a risk involved, this was for the first time that the women's groups were provided money after a disaster, which could be used for the purpose the members felt most appropriate for them at that juncture. The revolving loan was very well utilized (75% was used for agriculture after the flood and 25% for reconstruction and repair of houses). The repayment of the loan with mutually agreed interest rate was received a week before the deadline.

The Kolkata office of UNICEF initiated in collaboration with the IAG, an innovative program, the "community-based disaster preparedness (CBDP)", initially with five partners in three districts. The CBDP was integrated with the existing CARE India's micro finance program and women were the engineers in implementing this program. The fundamental objective of the preparedness plan was to minimize the loss of life, livelihood, property and sufferings due to flood; in other words, helping people to live with flood. Any disaster preparedness should consist of hardware and software. Hardware in flood preparedness could be: the early warning systems, housing stock, tools for rescue and evacuation, flood shelter, etc., and the software could consist of: the formation of disaster task forces, identification of possible shelters, savings in the form of food, fodder, fuel and cash, creating awareness on preventive and simple curative health.

Short and Long-Term Objectives of CBDP

The short-term and medium-term objective of CBDP was the development of a community-based and owned disaster preparedness plan, the implementation of which would enhance the capacity of the poor and vulnerable to the coping of disasters and thereby reducing the human and economic losses associated with disaster.

However, there were a number of long-term aspects involved, such as the change of agricultural practices, flood resistant housing, alternative livelihood in the flood prone regions, inclusion of the community based disaster plans with the panchayat level development plan of the local self governance bodies (PRI).

The Framework of Developing CBDP

The CBDP had the following four core components:

- Developing a village/gram panchayat (3 to 4 villages depending on the population form a panchayat) level community based disaster preparedness plan.
- Initiating the implementation of the plan.
- Documenting the process leading to the disaster preparedness plan.
- Integrating the community based disaster preparedness plan with the gram panchayat / block contingency plans.

The distinctive features of CBDP were:

- Need-based approach
- People-centered
- Flexible

- Participatory
- Cost-effective
- Well-defined concept
- Formation of task forces
- Task-oriented shared activity
- Micro-level planning
- Developmental and rights based
- Replicable and sustainable

The Focus of CBDP

The community based disaster preparedness plan focused on the most vulnerable group of people: the poor rural women, the panchayat members and the rural community at large. At the same time, it emphasized on using the indigenous knowledge and skills of people collected over generations of experience.

Phases of CBDP

The evolution of the village-level preparedness plan had four major phases:

- Pre-disaster phase
- On disaster phase (rescue and emergency relief phase)
- Post-disaster phase (relief and recovery phase)
- Long-term measures (introduction of sustainable livelihood based on seasonal chart)

Key Components of the CBDP

- A community based disaster preparedness plan with budget, workplan, roles and definite roles and responsibilities assigned.
- A budget for each activity planned.
- A village survey done using vulnerability parameters.
- Various maps, charts and other documents created to support the plan.
- Implementation schedule prepared for the whole calendar year.



Source: Bani Saraswati, Sreema Mahila Samity, Nadia



The Outcome

The physical outcome was a community based disaster preparedness plan approved by the Gram Sansad (the smallest unit of grassroot level planning in West Bengal with 1000 voters). The plan consisted of the following:

- A plan
- Work calendar
- Budget
- Roles and responsibilities
- Village survey
- Resource map
- Seasonality chart of crops, rainfall and migration

Tools used for the preparation of disaster preparedness

- Baseline survey
- PLA exercises
- Focused group discussions (FGD)



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Source: Bani Saraswati, Sreema Mahila Samity Fig. 2.7 Women developing the social map



Source: Bani Saraswati, Secretary of Sreema Mahila Samity

Fig. 2.8 Women constructing temporary flood shelter



Fig. 2.9 Women storing community food for at least three weeks at a higher level

in the eventuality of a flood

The following Table 2.1 depicts the activity charts of the CBDP from a real-life experience Source: Author, planning and implementing the program

 Table 2.1
 Pre-Planned Activities in the Event of Possible Flood

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Who will do		Family SHG Village community Panchayat Govt Voluntary Organization	Family SHG Village community Panchayat Govt Voluntary Organization	Family SHG Village community Panchayat Govt Voluntary Organization
Quantity			15	10 days
Solution	reparedness	To increase awareness, impart training, information gathering and dissemination	Identification of possible shelters	To store food
Problems	Pre-Flood P	Lack of awareness, information and skills	Temporary shelter	Food
S		01	02	03

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Who will do		Family SHG Village community	Panchayat Govt	Voluntary Organization	Family	ыс Village community	Panchayat	Govt	Voluntary Organization	Family	SHG	Village community	Panchayat	Govt	Voluntary Organization
Quantity		10 days			10					Boat:10,	Raft: 100				
Solution	reparedness	Food distribution	Raising the height of the tube-wells and purification of drinking water					Making use of	boals, nauasanu rafts						
Problems	Pre-Flood Pre-Fl									Transport and	communication				
SI		02			03					40					

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Quantity						Halogen: 50 Bleaching:	500 gm / family										
Solution	reparedness	Distribution of clothing				Distribution of Halogen tablets	and bleaching powder				Setting up of	health centers and storing of	medicines on	high lands			ities
l Problems	Pre-Flood P	Clothing									0 Medical Help	and Doctor					Post Flood Activ
S		08				60					-						

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Quantity																	
Solution	reparedness	Renovation of damaged	Repairments of damaged roads and contsruction of new roads					Making the pollution-free environment through mutual cooperation									
Problems	Pre-Flood Pi Shelter						Transport and communication						Pollution				
SI		01				02						03					

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Who will do		Family	SHG Village community	Panchayat	Govt	Voluntary Organization	Family	SHG	Village community	Panchayat	Govt	Voluntary	Ulgaliizatiui Eamily	SHG	Village community	Panchayat	Govt	Voluntary	Organization
Quantity																			
Solution	Preparedness	With the help	medicines				Through the	cooperation	organizations				Coodit and	Grant					
Problems	Problems Pre-Flood F Medical Treatment				Seed for	Agriculture					Choutage of	fund							
SI		04					05						2	8					

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Remarks																	
NGO																	
Govt														100000			
Panchayat			200	16000			1225	750			960						
Village Community												1600					3000
SHG Involved	ern				600												
Family	ring Patt	3000			600	006			1800						127500	3000	
Total Cost	Cost Sha	3000	200	16000	1200	006	1225	750	1800		096	1600		100000	127500	3000	3000
Materials Qty & Rate in Rs		50 Bamboos @ Rs.60 /-	10 Kg. Rope @ Rs. 20/-	40 Tarpauline (25 X20)' @ Rs.400/-	20 Labor @ Rs.60/-	15 Bamboos @ Rs.60/-	35 Plastic sheet (6X8)' @ Rs.35	30 Tin Pc. @ Rs.25/-	30 Labor @ Rs.Rs. 60/-		3 Pipe 8 ft. @ Rs.40/-	5 Pipe 8 ft. @ Rs.40/-		4 boat @ Rs.25000/-	@Rs.150/-	50 Bamboos @Rs.60/-	50 Labor @Rs. 60/-
Requirements	of Flood	10				30					e	5		4	850	25	50
Activity	atory Stage	Temp. Shelter				Temp. Toilets				Drinking Water	Tube- wells		Transport	Boat, etc.	Mud Vessel	Raft	
SI	Prep	01				02				03			04				

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Sustainability of the outcome

Disasters do not strike the same area every year. The sustainability of the CBDP depends on the formation and capacity building of six to seven task forces with specific tasks, e.g., a task force responsible for evacuation. They should know the following:

- Which part of the village is most likely to be submerged first.
- Which families have old and invalid disabled members and pregnant and lactating mothers.
- Which are the places from where the people should be evacuated.
- What items should people carry during evacuation etc.

Table 2.2 Learnings from the CBDP Planning Processes

For the implementing agency	For the communities
1. The staff understood the value and power of collectivization of the poor.	1. Vulnerable people discovering that they had/ have the potential to cope with floods.
2. Increased sensitivity of the agency to the needs of the most vulnerable.	2. Evolution of a spirit of mutual support.
3. There is potential in each community however poor they might be, and the implementing agency should know how to make use of this.	3. Moving away from fatalistic attitudes and learning to live with disaster.
4. Practical experience should be the starting point of any planning.	4. Usefulness of PLA activities; people for the first time knew their village so well.
5. Planning should emerge from the people; only then they would own it.	5. Vulnerability could be reduced through preparedness.
	6. There were a number of resources available within the village, which they were not aware of so long.

Table 2.3	The	Success	Indicators

SI.	Objective	Success indicators
1	To reduce the loss of life and property due to floods	• 80% of the families had storage of at least 10 days of food.
		• 80% of the families had essential medicine in stock and kept regular contact with the local health providers.
		• 80% of the families identified safe temporary shelter in case of flood.
2	Awareness about disaster and preparedness plans.	90% of the families were aware of the adverse effects of disaster and were prepared to cope with it.

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SI.	Objective	Success indicators
3	To bring back the affected population to their normal life.	80% of the families confirmed that they would restart their lives and livelihood as immediately as feasible.
4	To safeguard themselves through capacity building.	90% of the families had increased their coping capacity or had expressed interest in this.
5	To link up the government to mitigate the impact of disaster.	80% of the women's groups developed effective linkages with the panchayat, government institutions like the meteorological department, the block development office, the health and irrigation departments etc.

WHAT HAS BEEN THE IMPACT OF THE PILOT?

At the community level

The stakeholders in the state were closely monitoring the outcome of the pilot. One of the CARE India's micro finance program partners said that this was not a program, but had taken the shape of a movement. A radio channel dedicated half an hour everyday for one whole year to spread the outcome. In an interview with the relief minister of the state, the minister said, "So far we have responded to disasters. From now on we would manage a disaster". The panchayat and the Rural Development Department of West Bengal felt that if poor women could develop and implement disaster preparedness plans, they could also develop micro plans for decentralized development planning, a program that the department was planning for the state.

The area where the CBDP pilot was implemented with greatest success, was affected adversely by a flood in the year 2004. A team of international donor agencies, including the director of UNICEF, representatives of the IAG under the leadership of the author, visited the area for two days during the flood. The team went from village to village in boats; none of the people, who had taken shelter in pre-fixed locations, asked for any material assistance even after knowing the composition of the team. They instead apprised the team on how the learnings from the CBDP processes helped them to save their and their cattle's lives and save the little belongings they had in their houses. They also informed that they had enough food saved to meet the food needs for three weeks. It was interesting to hear from them that they had handled many rumors like "more water is coming". This was corroborated by the executive engineer, Irrigation Department based at the district that he received countless telephone calls from the women's groups to know about the truth to the rumors.

At the policy level

The extract from the budget speech of the Minister–in–charge of Home (Civil Defence), Government of West Bengal, March 2005:

- The civil defence has taken up a project on CBDP with the assistance of UNICEF. The key concept of CBDP is to reduce the impact of any disaster by increasing the capacity of the community and reducing its vulnerability.
- 165 disaster prone blocks and few municipalities have been identified.
- UNICEF has agreed to support the NGO network for facilitating the CBDP project objectives.
- All key officials of the department of civil defence will be sensitized on CBDP.
- The IAG consisting of international agencies and their partners will be closely associated with this project in terms of capacity building and training.
- UNICEF has agreed to provide capacity building of the civil defence department.
- Support will also be provided by them on GIS mapping of vulnerable areas with assistance from the Kolkata Metropolitan Development Authority (KMDA).

(Source: Pages 1 and 2 from the budget speech in respect of demand no. 27 for the Year 2005 – 2006)

Chapter

3

Causes and Effects of Various Types of Disasters

3.1 WATER AND CLIMATE RELATED DISASTERS

FLOOD

Flood is the most regularly occurring disaster in India. On an average, around 5,000 people die and more than 51,000 villages are affected every year due to floods. Ironically, flood has now become a disaster, though all ancient civilizations grew on the flood plains of major rivers and flood was then a boon. The nature of floods and its impact on life and livelihood have undergone significant changes over the years. This is primarily due to man-caused interventions on the free flowing rivers and encroachments of the river banks by the poor and vulnerable, who have no other option but to live in geographically vulnerable locations. It is estimated by the DFID Delhi Office that one third of the world's poor is concentrated in the Ganga–Brahmaputra–Meghna river basins.

Floods in India could be attributed, in part, to the heavy precipitation within a short duration but more to the unsystematic and uncoordinated discharge of water from the large and the medium dams (India has the second highest number of dams in the world after China) and breaches in the river embankments. The dam burst in Banka district of Bihar in the late 1990s damaged more houses than the Latur earthquake. The floods in Bihar, Uttar Pradesh and West Bengal are primarily caused by the water originating from Nepal and China. It has been estimated by scientists that more than 80% of the water that flows into Bihar, originates in Nepal and similarly more than 90% of the

water that flows into Bangladesh, flows through India. The Ganges acts as the drainage of all the rivers of Bihar and Eastern Uttar Pradesh and the accumulated water flows into Bangladesh through Malda in West Bengal. The Aska town in Orissa in 1989 had 17 feet of water due to heavy precipitation and unplanned and uncoordinated simultaneous discharge from the medium size dams in the area. Most severe floods, apart from the ones caused by the breaches of embankment, most common in Northern Bihar and upper Assam, occur during the late monsoon period. This is because by September, all the dams, rivers, rivulets and other water bodies are full with water and the soil is completely saturated with water. In such a situation, heavy rains within a short duration are bound to inundate the agricultural land and flood the villages and towns. The states of Assam, Uttar Pradesh, Bihar, West Bengal, Orissa, Andhra Pradesh, Punjab and Haryana are the ones most prone to floods. However, as of today, any part of the country can experience flood including the areas known for battling with recurrent droughts like Kalahandi, Rajasthan and Gujarat.

India, like most countries of the world, has tried to contain floods by structural measures like dams, embankments, dykes etc., but it is evident from the increasing damage to life and livelihood and the frequency of floods in India that these structural measures have not succeeded in mitigating floods. The United States of America after spending more than 16 billion US Dollars for flood protection, no longer uses this terminology. Consequently, it has dismantled more than 1000 dams because they have not served the purpose for which they were constructed. The Kosi embankment in North Bihar is a classic example of the failure of structural measure in containing floods⁴. Extensive and intensive studies by Dr. Dinesh Kumar Mishra and the documentary film by Arvind Sinha titled "Between the Devil and Deep Water" reveal that the people living outside — for whom this project was made. In the Bihar floods of the year 2000, 8.2 million people were affected. 800,000 hectares of land was affected, half of which was under the crops. The economic loss to public property was estimated at a staggering INR 20 billion (Source: Bihar Report _Final June 2005 by the World Bank).



Fig. 3.1 Temporary shelter in an embankment during the Kosi flood in Bihar Source: Arvind Sinha



Fig. 3.2 Children on the embankment in Bihar Source: Arvind Sinha



Fig. 3.3 Bihar flood of 2008 Source: Shishir Das, VHAI

Do recurrent floods affect women and men equally?

A study was done by the geography department of Guwahati University in 17 most recurrently flooded villages of Assam. It was revealed from the study that the number of women above 55 years was far less compared to that of men in these areas, though women have a much longer life expectancy (Source: Author, commissioning the study). Since the sample size was small, it would not be prudent to generalize that in the recurrently disaster affected areas, life expectancy of men is higher than that of women; but it could possibly be concluded from this study that the impact of disasters on women's health is far greater than those of men.

Technically, with the advancement of technology, floods should be forecasted so that the people living in the flood prone areas could proactively reduce the impact of the disaster. But this does not happen in reality. Between the years 1980 and 2000, 156 million people in India have been exposed to floods. The primary reason for this is that the nature of the floods in recent times has drastically changed. The major floods are a combination of heavy precipitation in the catchment areas of the rivers, uncoordinated release of water from medium and large dams, bursting of dams and breaches of the embankments of rivers.

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The satellite imageries [Figs. 3.4(a) and (b)] of the September 2 floods in Bihar provide valuable information. The map [Fig. 3.5] in green shows that the flood in Bihar is not caused due to the high precipitation in Bihar alone. The catchment areas of most rivers of Bihar, if not all, include Nepal and consequently floods are caused by the water that reaches the state from Nepal. The other satellite imagery in red shows that all the water that flows through Bihar is drained by the Ganges and this goes into Bangladesh through the Malda district of West Bengal. To provide early warning is a very critical aspect of flood preparedness and it requires: 1) continuous monitoring of satellite imageries, 2) well developed flood information sharing between the governments of Nepal and India and reaching of this information immediately to the district and down to the blocks likely to be affected, and 3) networking between the key civil society actors and organizations of the two countries. This water would ultimately flow into Bangladesh. Hence cross border civil society engagement in case of cross border rivers can significantly reduce the impact of floods in the downstream of such rivers.



Terra MODIS, September 2, 2008

Fig. 3.4 (a) Satellite image of 2008 Bihar flood



Dartmouth Flood Observatory Map, September 2, 2008

Fig. 3.4 (b) Satellite image of 2008 Bihar flood

The map (Fig. 3.5) shows that the three mega cities of the country: Delhi, Kolkata and Mumbai, and the capital cities of Ahmadabad, Chandigarh, Guwahati, Hyderabad, Jaipur, Lucknow, Patna, and Thiruvananthapuram are prone to floods. The industrial towns in Gujarat, Maharashtra, Andhra Pradesh are in the risk zone of floods. Integrating this with the Geographical Information Systems (GIS) maps and the grid population maps available, it is possible to identify the districts, blocks and gram panchayats prone to floods and the number of people in each of these units and the total people living in the flood hazard zone of India.

DROUGHT

A drought is a situation caused due to an extended period of rain deficiency. Generally, drought occurs when a region which could be as big as a country or a smaller unit like a block, receives below average rainfall. Droughts can have substantial impact on the eco system and agriculture of the affected region. Although droughts can persist for



Fig. 3.5 Map showing flood prone areas of India Source: <u>www.mapsofindia.com</u>

a long period of time, even a short intense drought can cause significant damage and harm the local communities. On 21 August 2009, the Government of India declared 252 districts as drought affected. This declaration was based on the rainfall received against the normal rainfall up to that period. An area is declared by the government as drought affected when the rainfall is less than 25% of the average annual rainfall for that area. It is declared severely drought affected when the deviation of rainfall from the normal is more than 50%. In a study conducted by the Oxfam Kolkata office on "The Resource Potential of South Bihar (before Jharkhand became a state)" in 1999, 125 years of rainfall data was analyzed. Six out of 125 years had rainfall less than 25% and this deficiency was first observed in 1965 (Source: Author, who planned and executed the study as team leader). Yet, every year this part of the country is apparently drought affected. What is this drought then? Droughts are of three types:

- Meteorological When rainfall is 25% less than average.
- Agricultural When the rainfall is not conducive to the growth of the monsoon crop particularly paddy; even a short duration of no rain during the critical phase of the growth of paddy can significantly reduce the productivity.
- Hydrological When water bodies dry up in the surface and in the aquifers under the surface.

In India, the western parts of Orissa, Madhya Pradesh, Jharkhand, Chhattisgarh, Western Rajasthan, regions of Andhra Pradesh bordering Orissa and Madhya Pradesh, parts of Maharashtra and western West Bengal are prone to recurrent droughts.

Drought is a slow onset disaster; hence it is predictable. The satellite imageries, the rainfall data, the increase in the cost of food in the local market, the migration of able bodied men and the GIS maps and grid population maps together are the tools to predict drought. This information is of great value to the government and the non-government agencies to plan appropriate responses to mitigate the effects of drought.

In 1988, on the request of the Oxfam Bhubaneswar office, Child In Need Institute (CINI), Kolkata conducted a nutritional assessment of children below 6 years and of women in the tribal pockets of Ganjam and Gunupur after three years of consecutive rain deficiency. The study team actually measured the food intake of a family in a day and converted it to calorie intake per person per day. They used the Mid Upper Arm Circumference (MUAC) measurement to assess the nutritional status of children below 6 years and measured the Body Mass Index (BMI) of mothers. The study revealed:

- 55% of the children were severely malnourished.
- 80% of the mothers were at risk during pregnancy because of low height and weight.
- Per capita intake of food was about 60% of what is prescribed i.e., 2400 kcals.

This nutritional status of children was compared with the primary data collected by the study team using the same method, for the children of Kalahandi district in a "normal" year. The comparison provided a revealing picture; the nutritional status of the children below 6 years, of Kalahandi in a normal year was lower than that of the tribal areas of Ganjam and Gunupur after three years of consecutive drought (Source: Author, commissioning the study by CINI).

The blue colored parts of the map (Fig. 3.6) are the drought prone areas of India. As evident from the map, a very large area of the country, from Jammu & Kashmir in the north to Kanyakumari in the south and from Rann of Kuchh in the far west of the country to West Bengal in the east of the country is prone to drought. As described in the context of floods, a very detailed data on the population and the administrative unit from the district down to the gram panchayat can be made readily available to the planners to take up prevention, mitigation and preparedness measures.


Fig. 3.6 Map showing drought prone areas of India Source: <u>www.mapsofindia.com</u>

CYCLONE

Cyclone is a type of rotating storm that occurs over the oceans and seas near the tropic. The rotation is clockwise in the Southern Hemisphere and anti clockwise in the Northern Hemisphere. A tropical cyclone is a storm system characterized by a large low pressure center and numerous thunderstorms that produce strong winds and heavy rains. India, with a 7,517 km coastline has the second highest number of people in the world exposed to tropical cyclone. The coastline along the Bay of Bengal is the most cyclone prone region of the world. Therefore, the east coast of India with very high density of population is more prone to tropical cyclones than the west coast. However,

on June 9, 1998, a devastating cyclone hit the west coast in the Kutch district of Gujarat killing a large number of migrant salt pan workers. Cyclones strike in India in May-June and October–November coinciding with the onset and the retreat of monsoon. Coastal Andhra Pradesh, Tamil Nadu and Orissa and Sunderban in West Bengal are the major cyclone prone areas of India. The Orissa super cyclone in October 1999 has been the worst cyclone in the recent past. The wind velocity during this cyclone was as high as 350 km per hr. Cyclones are generally accompanied by sea surges, when the sea level rises up to 7 m. Cyclones are also associated with heavy rains. The factors which may lead to the formation of cyclones are:

- Right place and right temperature is needed for the formation of cyclones.
- The place must be within plus minus 5° to plus minus 15° latitude from the equator over the oceans and seas.
- The surface temperature of the ocean/sea needs to be 26.5° or above.
- A low air pressure system (depression) with convection current starts to gather clouds.

Figure 3.7 shows the form zation of cyclone at the right place at the right temperature over the sea or oceans.



Fig. 3.7 Formation of cyclone.

Cyclones are easy to predict. The Ind ian Meteorological Department (IMD) is continuously monitoring with its radars for any low pressure developing in the atmosphere above the ocean. With the advancement of technology, it is possible to predict the intensity of the cyclonic storm and the coastal area to be hit by any potential cyclone. Yet, between the years 1980 and 2000, 350 million people in India have been exposed to cyclones. The reasons for this could be many: the cyclone forecasts do not reach the most vulnerable people living closest to the sea shore on time; people, even if warned, do not take this seriously; there may not be a safe place in the vicinity for people to take temporary shelter; many people do not have the legal entitlement of the land they have in their possession, and they are afraid that if they leave the place for safer areas others may grab their land if the forecast proves wrong.

The map (Fig. 3.8) shows that the large belt along the east coast of India is prone to cyclone and the west coast in the south and north is also prone to cyclone. Two mega cities, Kolkata and Mumbai are situated in the cyclone prone map of India. Many



Fig. 3.8 Map showing cyclone prone areas of India Source; <u>www.mapsofindia.com</u>

industrial towns located along the east and the west coasts, state capitals and towns are also located in the cyclone hazard zone. It is worth a mention that in Andhra Pradesh, the cyclone hazard zone extends farthest into the mainland away from the sea.

Tornado

By definition, tornado is a violent and dangerous rotating column of air in contact with both the surface of the earth and a cloud (Source : Free Wikipedia). It is also known as a twister because of its rotational character. It can be of any shape and size, but the typical tornado has the shape of a condensation funnel, the narrow end of which touches the earth. Tornados are found to occur in all the continents except Antarctica. However, a vast majority of tornados occur in North America. It has been observed that most tornados have wind speeds of less than 175 km per hr and are less than approximately 250 ft wide. Generally, these dissipate quickly after travelling a few km. However, the most extreme tornados can attain a speed of 450 km per hr, stretch over more than 3 km across and can stay on the ground for more than 100 km. The

stronger tornados have the power of throwing moving cars, even trains into air; rip the buildings of their foundations. The tornados can be detected before or as they occur by the pulse–doppler radar, and hence, can be forecasted like cyclones with the likely velocity and the destructive zone.

HAILSTORM

A thunderstorm that reaches the ground is known as hailstorm. Hailstones can grow up to 6 inches and can weigh more than 0.5 kg. Stones larger than 0.75 inches can cause damage to houses with tin or thatch roofs, automobiles, standing crops, and livestock. Hails are formed in strong thunderstorm cloud, particularly those with intense upward drafts, high water content, large water droplets and where a good portion of the cloud is below the freezing point. The growth of hail is maximum when the air is near a temperature of minus 13°C. In Canada, hailstorm is one of the most expensive hazards.

CLOUDBURST

An extreme amount of precipitation normally lasting no longer than a few minutes but capable of creating destructive floods is known as cloudburst. These descend from very high clouds with the rate of rainfall equal to or greater than 100 mm per hr. In case of severe cloudburst, more than 2 cm of rainfall may occur in a matter of few minutes causing extensive damage to human lives, housing, infrastructure, livestock and crops. On August 5, 2010, around midnight, the cold deserts of Ladakh and Leh were rocked by severe mudflows due to the worst cloudburst in recent times that killed more than 200 people and injured 300. A large number of people were also reported missing (officially 800).

LIGHTNING

It is an atmospheric electrostatic discharge accompanied by clouds that is generally accompanied by a thunderstorm. Because of this discharge, lightning can travel at a speed of 220,000 km per hr and can attain a temperature upto 30,000°C. If lightning strikes humans or trees, both will die instantly. Scientists have studied the root cause of lightning and have come to the conclusion that the ice inside the cloud at high altitude is the cause of development of lightning. It causes forcible separation of positive and negative charges in clouds thereby facilitating the process of the development of lightning.

EXTREME HEAT AND COLD

Heat and cold waves have become a part of extreme weather events causing enormous loss of lives, human discomfort and ailments. The World Meteorological Organization

(WMO) assessed for the Year 2007 that the surface temperature of the Northern Hemisphere was the second warmest on record at 0.63°C above a 30 year mean (1961 to 1990) of 14.6°C. The Southern Hemisphere temperature was 0.20°C higher than the 30 year average of 13.4°C. A heat wave is a hot period lasting from a few days to some weeks. Severe heat waves can kill people from hyperthermia; can cause severe damage to crops. According to the Indian Meteorological Department (IMD) the extreme heat waves of the Year 2007 in India were the fourth warmest on record since 1901. The maximum anomalies were observed in the western parts of Uttar Pradesh, Harvana, Punjab and Jammu & Kashmir. Heat waves were also observed in the coastal areas of Andhra Pradesh. The heat waves raised the temperature of the central region of the country by 5°C-7°C killing 72 people. In the same year, the whole of north India was under severe cold wave in the month of January that claimed more than 72 lives, particularly in Uttar Pradesh. The cold wave resulted in the dropping of temperature to less than $3^{\circ}C-5^{\circ}C$ of the average temperature and in the major town of Uttar Pradesh, the temperature was close to 5°C. The cold wave also prevailed over Jammu & Kashmir during the second week of March killing more than 60 people.

AVALANCHE

By definition, Avalanche is the rapid movement of snow down a slope triggered either naturally or by human activity. This occurs typically in the mountain terrain. An avalanche can mix air, water with the descending snow. The destructive potential of an avalanche is rated in the logarithmic scale as that of an earthquake, but in this case, it consists typically of five categories. India, because of the Himalayas, is one of the most avalanche prone countries of the world. The available statistics show that between 1980 and 2009, India had:

•	Number of events:	73
•	Number of people killed:	3,532
•	Number of people affected:	69,637
•	Economic damage in US Dollar	807,489,000

3.2 GEOSCIENCES RELATED DISASTERS

EARTHQUAKE

An earthquake (also known as a tremor) is caused due to the release of energy in the earth's crust that causes seismic waves. The occurrence and intensity of earthquakes are measured with a seismometer. The intensity of the earthquake is measured on the Richter scale. The Richter scale assigns a single number from 1 to 10 in the ascending order to quantify the amount of seismic energy released by an earthquake. This scale

from 1 to 10 is in geometric progression with a common ratio of 10. This means that the seismic energy released in an earthquake measured at 6 on the Richter scale is 10 times higher than that of 5 and is 100 times higher than that of 4 on the Richter scale. The energy release of an earthquake is closely related to its destruction power. The difference of energy released due to an earthquake between 4 and 5 on the Richter scale is 31.6 and between 4 and 6 is 1000.

The following table describes the typical effects of earthquakes of various magnitudes near the epicenter. Epicenter is the point on the surface of the earth or the sea bed directly under which an earthquake takes place. This table should be studied with extreme caution, since the intensity and thus the ground effects depend not only on the magnitude, but also on the distance to the epicenter, the depth of the earthquake's focus beneath the epicenter, and the geological conditions (certain terrains can amplify seismic signals) (Source: US Geological Survey).

Richter magnitudes	Description	Earthquake effects	Frequency of occurrence (Globally)
Less than 2.0	Micro	Micro earthquakes, not felt	About 8,000 per day
2.0-2.9	Minor	Generally not felt, but recorded	About 1,000 per day
3.0-3.9	Often felt, but rarely causes damage	49,000 per year	
4.0-4.9	Light	Noticeable shaking of indoor items, rattling noises. Significant damage unlikely	6,200 per year
5.0-5.9	Moderate	Can cause major damage to poorly constructed buildings over small regions. At most, slight damage to well-designed buildings	800 per year
6.0-6.9	Strong	Can be destructive in areas up to about 160 km (100 miles) across in populated areas	120 per year
7.0-7.9	Major	Can cause serious damage over larger areas	18 per year
8.0-8.9	Great	Can cause serious damage in areas several hundred miles across	1 per year

 Table 3.1
 Intensities of Earthquakes, their Effects and Probable Frequency of Occurence

 Source: US Geological Survey

Richter magnitudes	Description	Earthquake effects	Frequency of occurrence (Globally)
9.0-9.9	Devastating in areas several thousand miles across	1 per 20 years	
10.0+	Epic	Never recorded; see below for equivalent seismic energy yield	Extremely rare (Unknown)

When a high-intensity earthquake epicenter is located offshore or near the sea, the sea bed sometimes suffers sufficient displacement to cause a *tsunami*. Due to the immense volumes of water and energy involved, the effects of *tsunamis* can be devastating.

The December 26, 2004 *tsunami* that originated due to a high-intensity earthquake (9 on Richter scale) under the sea in Indonesia on the Sumatra Andaman hill range took more than 230,000 lives across 11 countries, including India. This *tsunami* had a devastating impact in Tamil Nadu and in the Andaman and Nicobar islands along the Indian Ocean coast. *Tsunami* waves reached up to a height of 10 m and hit the coast with tremendous energy. *Tsunami* waves move along the sea bed and the movement is, therefore, not detectable till it reaches the shore, unless instruments are placed on the sea bed to detect it.

Equivalent Energy Release by Earthquakes:

- A 3.5 Richter scale earthquake releases energy equivalent to the energy released in the Chernobyl nuclear disaster in Russia.
- A 5 Richter scale quake releases energy equivalent to the Nagasaki atomic bomb explosion.

The Indian subcontinent is highly prone to seismic activities because of the Himalayas. The Himalayas were formed 40 to 50 million years ago by the collision of the Indian Plate against the Eurasian Plate. The mountain building process is on-going because the Indian Plate is continuing its push against the Eurasian Plate at the rate of 2 cm per year (annual growth rate of human nail). Because of this continuous process, the Isostatic equilibrium under the Himalayas has still not been reached making it prone to the release of pressure from time to time. Even with the advancements in science and technology, earthquakes are still not predictable. The whole country, however, has been mapped to an ascending scale of I to V. It means that the scale five areas are more prone to high-intensity earthquakes.

The portion of the map (Fig. 3.9) in red shows the areas under Grade V of the seismic zone, which are seismically most active zones with the history or likelihood of high-intensity quakes. As evident from the map, the whole of North-east, the northern Bihar and Uttar Pradesh bordering Nepal, the hills of Uttarakhand, parts of Himachal Pradesh

bordering Jammu & Kashmir, Kutch district of Gujarat, Andaman and Nicobar Islands and Kashmir fall under Zone V. All the state capitals of the north-eastern states with the exception of Tripura, fall under Zone V. The Uttarakhand Himalayas is one of the most seismically active zones in the world. The region has experienced tectonic movements, because two regional tectonic features are present all along the entire Himalayan belt. Most parts of Alaknanda valley are in seismic zone V. Several hydropower projects in the region warrants investigation in terms of seismotectonic activity.



Fig. 3.9 Map showing earthquake prone areas of India Source: <u>www.mapsofindia.com</u>

State / Union Territory	Name of district
Andaman and Nicobar Islands	Andaman, Nicobar
Arunachal Pradesh	Lower Subansiri, Tawang, Tirap, Upper Siang, Upper Subansiri, Changlang, Dibang Valley, East Kameng, East Siang, Lohit, Papun Pare, West Kamang, West Siang
Assam	Dhubri, Cachar, Hailakandi, Karimgaunge, North Kachar Hills, Barpeta, Bongaigoan, Darrang, Upper Dhemaji, Dibrugarh, Goalpara, Golaghat, Jorhat, Kamrup, Karbi Anglong, Kokrajhar, Lakhimpur, Morigaon, Nowgaon, Sibsagar, Tinsukia
Bihar	Araria, Darbhanga, Kishenganj, Madhepura, Madhubani, Purnia, Saharsa, Sitamarhi, Supaul, Muzzaffarpur,
Gujarat	Kutch
Himachal Pradesh	Solan, Una, Bilaspur, Chamba, Hamirpur, Kangra, Kullu, Mandi
Jammu & Kashmir	Anantnag, Baramula, Pulwana, Srinagar, Badgaon, Kathua, Kupwara
Manipur	Bishnupur, Chandel, East Imphal, Thoubal, Ukhrul, Churachandpur, West Imphal, Tamenlong, Senapati
Meghalaya	Janintia Hills, East Garo Hills, Ri-bhoi, South Garo Hills, West Garo Hills , West Khasi Hills
Mizoram	Aizal, Champai, Kalasib, Lawngtlai, Langlei, Mamit, Saitha, Serchhip
Nagaland	Phek, Zurheboto, Dimapur, Kohima, Mokokchung, Mow, Tuensang, Workha
Uttarakhand	Bageshwar, Chamoli, Pauri, Pithoragarh, Tehri Garhwal

 Table 3.2
 Districts in Earthquake Hazard Zone V (Source: Vulnerability Atlas of India – 2nd Edition)

Delhi and Mumbai metropolis fall under Zone IV of the seismic zone map of the country along with the capital town of Patna, eastern parts of Uttar Pradesh bordering Nepal, Himachal Pradesh, and Sunderbans in West Bengal. Central India is a seismically stable region of the country. Although earthquakes are not predictable even with the advancements in science and technology, but the above information is readily available. The planners, the architects and town planners, the construction engineers, and nthe

urban local bodies must take this readily available information into cognizance while planning, sanctioning and constructing any building both for commercial as well as residential purposes in this zone. The civil engineers must adhere to the ethics of an engineer and the building code to construct buildings which can withstand the impact of a quake (up to 7 on the Richter scale). It goes without saying that nuclear installations should not be constructed in Zone V.

The scientific community has a much better knowledge of the outer space than of the internal constitution of the earth. It has been observed globally that the deeper one goes down in a mine, the higher is the temperature of the surrounding rocks. This has led scientists to believe in the prevalence of high temperature beneath the surface of the earth. Based on secondary sources, like the seismological data available from the major and minor tremors, the velocity of the compressional wave also known as the primary and shear wave; known also as secondary waves originating from the tremors, the scientists believe that the interior of the earth is as below:



Fig. 3.10 Possible constitution of the interior of the earth

Figure 3.10 depicts the possible constitution of the interior of the earth. The top layer is the solid silicate crust. The center consists of a metallic core and between the core and the crust is a zone of oxide and sulphide.

Figure 3.11 shows a section of the interior of the earth as revealed by the earthquake waves. There are five layers: the crust, the upper mantle, the lower mantle, the outer core and the inner core. The thickness of each of these is:

Crust	30 km
Upper mantle	725 km
Lower mantle	2171km
Outer core	2259 km
Inner core	1221 km
Total thickness	6401 km



Fig. 3.11 Section of the earth

The earth is a dynamic object. In 1912, Alfred Wegner, a German geophysicist, based on a widely recognized fact that Africa and North America appeared to fit perfectly like a jigsaw puzzle, collected fossils and rocks from both sides of the Atlantic and concluded that these two continents were once one which subsequently drifted away. This paved the way to the modern concept of plate tectonics. The present theory of plate tectonics comprehensively explains "How the earth works". According to this theory, the earth's outermost layer is broken into seven large rigid pieces: the African, the North American, the Eurasian, the Australian, the Antarctic and the Pacific plates. There are a few smaller plates also, like the Philippine plate and the Indian plate. These plates are moving in different directions at different speeds (from 2 cm to 10 cm per vear — the rate at which human finger nails grow). Scientists were baffled by the discovery of algae and fossils that survived only in the sea on the upper reaches of the Himalayas. The geoscientists concluded that the Himalayas were formed due to the collision of the Eurasian plate with the Indian plate uplifting the rocks under the Tethys sea to a height of 9 km. The Himalayas are still rising because the Eurasian plate is continuously pushing itself under the Indian plate. Because of this, Nepal is losing land equivalent to two football grounds in size per year. The power generated in this collision is understandably extremely high. Many large-scale earthquakes have occurred because of the collision of the two plates. The figure below is an example of an earthquake due to the collision of plates:



Collision of tectonic plates

Fig. 3.12 Collision of tectonic plates causing earthquakes

Figure 3.12 depicts the collision of the oceanic plates with the continental plates. Most of the major earthquakes in Japan, North and South America, Andaman and Nicobar Islands, Nepal and the north-eastern states of India were due to the collision of tectonic plates.

In geology, a fault is referred to as a planer fracture or discontinuity in the volume of rocks, across which there has been significant displacement either horizontally or vertically. The rapid energy release associated with such a movement is the cause of most earthquakes in the world: Latur earthquake of September 30, 1993 at 03.56 hours is one example of an earthquake caused due to the presence of a fault line under the surface and rapid movement of rocks along the line. The Latur earthquake challenged a section of scientists, who believed that central peninsular India was free from an earthquake hazard. Though the intensity of this earthquake was only 6.4, the mortality was high because it was (a) a shallow depth earthquake at a depth of 12 km (b) most people were sleeping inside houses at the time of the quake and (c) because of the housing stock in the area: the walls of the houses were made of stones of varying sizes and shapes without proper cementing and the roofs were thick and heavy made of cement and concrete.



Fig. 3.13 Vertical faults responsible for earthquake

Figure 3.13 shows how a vertical fault takes place under the surface of the earth. Two blocks of rocks, as shown in the figure (position A), on either side of a fault plane F moves relatively downwards along the fault line (position B). This process releases sufficiently high energy to shake the surface of the earth near the fault line. Many earthquakes are caused by such an activity under the surface of the earth. There are other types of faults like inclined fault, hinge fault, etc.

VOLCANO

A volcano is an opening or a rupture in the surface of the earth that allows molten magma, ash and other gases to escape from under the surface of the earth. Generally volcanoes are found where tectonic plates either converge or diverge. The Mid-Atlantic Ridge has volcanoes caused due to the pulling apart of tectonic plates, whereas the pacific "Ring of Fire" has examples of convergent tectonic plates.

Table 3.3 Volcanoes of India

Mainland India	
Name	Last eruption
Deccan Traps	65 million years ago
Andaman Islands	

Name	Elevation in feet	Last eruption
Barren Island	1163	2009
Baratang	93	2005
Narcondam	2329	Holocene geological age

From around the beginning of 1980s, the scientists believed that a large meteorite that struck Mexico was responsible for the mass extinction of dinosaurs. But a recent study by Gerla Keller suggests that volcanoes might be responsible for the mass extinction of dinosaurs. A severe volcanic eruption in the Deccan Plateau between 63 and 67 million years ago might have been the cause of the extinction. The Deccan Plateau is now a seismically stable landmass.

MUDFLOW

The rapid movement of a large mass of mud formed from loose soil and weathered rocks is known as mudflow. Heavy precipitation and snowmelt flowing through the weathered bed rock is the primary cause of mudflow. Mudflows can attain a speed of roughly 50 km per hr. It is unstoppable and has massive weight that can cause widespread damages to the human life and the life of the cattle, buildings and other infrastructure and agriculture. The mudflow of December 14, 1999 in Vargas, Venezuela killed between 10,000 and 30,000 people and 85,000 people had to be evacuated. This mudflow led to complete destruction of the state infrastructure. The areas at the risk of a mudflow are:

- Areas prone to wild fires and land subjected to human modifications destroying natural vegetation.
- Areas where landslides have occurred before.
- Slopes of hills subjected to human interventions for the construction of roads and buildings.

In terms of the volume of material, the largest historic landslide was the historical eruption of Mount St. Helena in 1980 in Washington where the volume of material was 2.8 km³.

LANDSLIDE

Landslides are caused by the movement of masses of rock or debris over land or under the sea/ocean. Huge under-sea landslides can cause a *tsunami*. Landslides are rapid movements of landmass or debris along a natural or manmade slope. Landslides occur when the gravitational force on a landmass along a slope exceeds the resisting force like friction. The main causes of landslides are:

- Gravity.
- Sharp changes in groundwater table.
- Earthquakes, volcanic eruptions or other vibrations.
- Unscientific and unsystematic constructions on the hill tops.

Although landslides, a high impact and sudden natural or man-made phenomenon, receives far less attention compared to other high impact disasters, like earthquakes, cyclones, *tsunamis* and floods, the mortality due to this in 2005 was 30,000 globally.

Landslides are predictable. With the help of satellite imageries, GIS maps scientists are now able to pinpoint the possibility of landslides anywhere in the world.

DAM BURST

The Morvi Dam failure of August 11, 1979 was the worst dam burst in independent India causing death of 1,500 to 15,000 human lives in the low lying areas of the industrial

town of Morvi in Gujarat, about 5 km below the dam. The Manchu–2 dam on the river Manchu burst due to excessive rain. The spillway capacity of the dam was designed for 5663 m³ per second, but the actual observed during the intense rainfall was 3 times of what was designed, which caused the dam to collapse. While reconstructing the dam, the spillway capacity was increased four times to prevent any future recurrence.

In 1961, the Khadakwasla and Panshet Dams, both situated near Pune in Maharashtra, collapsed due to heavy rains causing death of 1000 people each. The Banka Dam burst in the Banka district of Bihar in the late 1990s caused more number of house collapse than the Latur earthquake.

SOIL EROSION

Soil erosion in India is a major concern: almost 130 million hectares of land (about 45% of the total geographic area) is affected by serious soil erosion. Soil erosion in the hilly tracts causes severe landslides and floods. Indiscriminate mining, querving and other activities all lead to opening of hills — faces to erosion. This results in high sedimentation in the reservoirs and rivers, lessening considerably the water storage and carrying capacity respectively. Different parts of the country — north, south, west and east are all subjected to soil erosion of varying degrees. However, a high level of erosion is seen occurring in the central zone and worst in the east zone; the south zone is least affected. Agriculture being the most important occupation of India is ruthlessly affected by soil erosion. A systematic study was conducted by M.K. Dutta, Swapnanil Barman and S.P Aggrawal using topographic sheets and remote sensing satellite imageries spanning from 1988 to 2008 in a GIS environment of Majuli island (the largest riverine island in the world) in Assam. The study concluded that the landmass of the island has reduced between this period, from 706.14 km² to 484.34 km² due to erosion. The average rate of erosion covering the entire period of study was 8.76 km² per year. At this rate, Majuli will completely disappear from the map in the next 50 to 55 years. Currently, river erosion in Orissa is the largest factor in displacing human habitation; more than the mining activities in the state. Almost all of the coastal belt of the state of Orissa, the relatively more prosperous region, is threatened with river erosion. River erosion is the top priority of the Government of Arunachal Pradesh. As a district. Bahraich in eastern Uttar Pradesh is one of the worst erosion affected districts of India. The human interventions with the free flowing rivers have been one of the prime reasons for river erosion. Rivers reaching the plains have a tendency to oscillate sideways. This is more at the tail end of a long river. This oscillation multiplies when the free flow of the river is controlled by building structures to contain the flow.

A CASE STUDY OF EROSION IN MALDA, WEST BENGAL

The Ganges has been ertoding vast tracts of land in the Malda district, because the western bank of the river is the Rajmahal Hills. This eastward movement of the river has been accelerated after the construction of the Farakka Barrage (the river has moved by 30 km), which has devastated life and livelihood of more than 1 million people, mostly Muslims and the scheduled castes. River erosion takes place twice: once when the discharge of the river is at its peak; and again when the water recedes. An island measuring 190 sq km has been formed inside the river Ganges near Malda, but people living there neither belong to the state of West Bengal nor to the state of Jharkhand. According to the Survey of India, this is a 'disputed' land, because the Ganges was the dividing line between the undivided Bihar and West Bengal.



Fig. 3.14 River erosion in Malda, West Bengal

Source: Photo courtesy Rini Bhattacharya from her unpublished article: A Development Mural



Not all affected by river erosion were economically poor. Many had large landholdings and some had large mango orchards, but are now engaged in exploitative unorganized sectors for livelihood. The example here is just the tip of the iceberg. River erosion is eroding vast lands in many parts of India and is affecting the lives, property and livelihood of a large section of the population, yet, this has not been included in the Relief Code of the country. Major earthquakes often change the course of major rivers. The high-intensity earthquake of 1950 in Assam, changed the course of the Brahmaputra river which had a devastating impact on Majuli, the largest river island in the world.

CLIMATOLOGY

The science of 'average weather' of the atmosphere was defined in the past as climatology. In modern days, climatology encompasses the study of the hydrosphere, the cryosphere, the biosphere, the surface of the earth and the interactions between these components. The atmosphere has been going through rapid changes, which are unprecedented in human history. However, geoscientific evidences indicate that such changes have occurred in the earth in geological time. Climatology indicates that the concentration of greenhouse gases is increasing, ozone layer in the stratosphere is being depleted and the chemical composition of the atmosphere is losing its ability of cleansing itself through oxidation. Climatology today embraces the study of all these characteristics, components, interactions and feedback. The scientists and the Intergovernmental Panel on Climate Change (IPCC) have been referring to the global climate change as a 'climatological catastrophe'.

METEOROLOGY

It is the interdisciplinary scientific study of the atmosphere. The advantage of the study of the meteorological phenomena is measurable events. The variables in the earth's atmosphere that are included in the study of science are temperature, pressure and water vapour. The study of these variables and the use of computers achieved the breakthrough in weather forecasting precisely and accurately in three coordinates: time, geographic location and intensity.

Each form of science has its unique set of instruments. Rain was the first variable that was measure by a rain gauge. Temperature is measured by a thermometer, pressure by barometer, wind by anemometer, and humidity by hydrometer. Weather forecasting is the application of science and technology for a future time in a given location.

HYDROLOGY

Hydrology is the science of the movement, distribution and the quality of water on the earth and other planets. There is enough water on the earth, but it is not distributed

across the globe in quantity and quality. The water that gets stored under the surface of the earth is termed as groundwater. The indiscriminate use of groundwater by humans is causing grave consequences in many parts of the world. As a result, the economic value of water in the later part of the 21st century is going to attain the value of oil in the last two centuries. According to the New Internationalist March 2004 issue, "by 2000, 5% of the water resource was under the private hands, expansion opportunities are estimated at trillion Dollars". However, the basic principles of water justice should be accepted by the state, the market and the communities:

- Water is essential for the entire biosphere, not just humans.
- Water is a gift of nature and hence cannot be turned into a commodity and cannot be owned.
- Water is an exhaustible resource and hence needs to be conserved.
- Access to safe water is a basic human right.

The following are the applications of hydrology:

- Determining the water balance of a region.
- Determining the argicultural water balance.
- Mitigating and predicting flood, landslide and drought risk.
- Real-time flood forecasting and flood warning.
- Designing irrigation schemes.
- Providing drinking water.
- Designing dams for water supply or hydroelectric power generation.
- Predicting geomorphologic changes, such as erosion or sedimentation.
- Assessing the impacts of natural and anthropogenic environmental change on water resources.
- Assessing contamination risk and establishing environmental policy guidelines.

GEOGRAPHIC INFORMATION SYSTEM (GIS)

A geographic information system (GIS), geographical information system, or geospatial information system is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographically referenced data. In simple terms, GIS is the merging of cartography, statistical analysis, and database technology.

Therefore, in a general sense, the term describes any information system that integrates, stores, edits, analyzes, shares and displays geographic information for informed decision making. GIS applications are the tools that allow users to create interactive queries, analyze spatial information, edit data, maps, and present the results of all these operations. Geographic information science is the science underlying the geographic concepts, applications and systems.

GIS technology can be used for:

- Earth surface based scientific investigations.
- Resource management.
- Reference and projections of geospatial nature, both man-made and natural.
- Asset management and location planning.
- Environmental impact assessment.
- Urban planning.
- Logistics.
- Population and demographic studies.
- Statistical analysis.
- Disease surveillance.

Examples of the use of GIS are:

- GIS may allow emergency planners to easily calculate emergency response times and the movement of response resources in the case of a natural disaster.
- GIS might be used to find wetlands that need protection strategies regarding pollution.
- GIS can be used to track the spread of emerging infectious disease threats. This allows for informed pandemic planning and enhanced preparedness.

GIS Techniques and Technology

Modern GIS technologies use digital information, for which various digital data creation methods are used. The most common method of data creation is where a hard copy map or survey plan is transferred onto a digital medium using a computer-aided design (CAD) program, and geo-referencing capabilities. Heads–up digitizing is becoming the main avenue through which geographic data is extracted. This technique of digitization involves the tracing of geographic data directly on top of the aerial imagery instead of the traditional method of tracing the geographic form on a separate digitizing tablet (heads–down digitizing).

3.3 INDUSTRIAL, NUCLEAR AND CHEMICAL DISASTERS

INDUSTRIAL DISASTER

The Bhopal gas leakage, also known as the Bhopal Gas Tragedy, is considered as the world's worst industrial disaster. The city of Bhopal with a population of about 1 million (1991 Census) experienced the worst industrial disaster of the last century. On the midnight of December 3, 1993, 40 tonnes of the deadly methyl isocyanate (MIC)

accidentally leaked out of the Union Carbide Corporation's pesticide manufacturing plant in Bhopal. The disaster immediately killed about 8,000 people and caused multisystemic injuries to more than 500,000 that would take a very long time and many generations to heal. The death toll rose to 16,000 in the subsequent years. The symptoms of the patients treated in the government hospitals immediately after the disaster were predominantly breathlessness, eye infection, and gastrointestinal diseases. The highly toxic gas had been absorbed in the blood stream of people exposed to MIC causing severe damage to reproductive and immune systems. The toxins also caused fetal poisoning. Because of these, the toxins would be passed on to generations.

The worst affected due to this disaster were the low-income people living in slums and on the pavements, who were engaged in the informal sector for their livelihood. Since MIC is heavier than air, the lethal toxins released from the factory soon settled close to the surface of the earth. Because of this, the children and people sleeping on the floor inhaled the gas more than others. People, who ran to get out of the effects of the toxins, inhaled it more than those who escaped in cars.

The people of India, immediately after the disaster, responded angrily against the multinational and demanded strong punishment against the perpetrator, the Union Carbide. The civil society individuals and organizations converged at Bhopal and tried to do as best as they could in such a massive disaster. The capacity of the state-run hospitals were far too inadequate compared to the number of people exposed to the gas and thereby the number of people needing medical attention. This resulted in the proliferation of the private clinics. In either of the case, doctors prescribed antibiotics and life savings steroids based on the individual's understanding of the cause, because Union Carbide Corporation refused to divulge the exact composition of the lethal gas. Institutions, like the WHO could have been of great help in this situation, but they were conspicuously absent.

Though there are some studies, though grossly inadequate, on the medical impacts of the exposure to MIC, conducted by the Indian Council of Medical Research (ICMR) and Medico Friends Circle, a civil society initiative, the social impact of the disaster has not been systematically documented. There are no records of the number of women who had natural abortion because of fetal poisoning or the number of women denied marriage due to the exposure.

NUCLEAR DISASTER

A disaster caused due to radiations is defined by the International Atomic Energy Agency (IAEA) as an event that leads to significant consequences to the people, the environment and the facility. The prime example of this is the Chernobyl disaster in 1986, which occurred in Ukraine. It caused the death of 56 people directly and approximately 4,000 people additionally dying of cancer-related disease. Nearly 350,000 people of Ukraine, Belarus and Russia were forcibly resettled away from the disaster. The disaster damaged

around 7 billion USD worth of property. It has been reported worldwide that from 1952 to 2009, there have been 98 disasters caused due to radiations and almost two-third of them were in the United States.

3.4 ACCIDENT-RELATED DISASTERS

Forest Fire

Forest fire, caused by nature or humans, is the most common hazard in the forests. It not only destroys the forest wealth, but also the biodiversity, the ecology and the environment. During long summer months without rain, the forests littered with dry leaves and twigs can burst into flames with the slightest spark. The Garhwal Himalayas have been burning regularly during the last few summers causing enormous loss of vegetation cover in the region. The eastern Himalayas are less prone to forest fires compared to the west.

MINE FLOODING AND FIRE

Two out of the 10 worst worldwide mining disasters in terms of mortality in the last century took place in Dhanbad, Jharkhand. On May 28, 1965, 375 miners died due to a coal mine fire in Dhanbad. On December 27, 1975, in a coal mine in Chasnala near Dhanbad, 372 miners were trapped inside the mine whose roof caved in. As a result, 7 million gallons of water per minute entered into the mine killing all the 372 trapped miners. The coal belt of Jharia in the Jharkhand state is a huge storehouse of coke coal in the country with 23 large underground mines and 9 large open cast mines. Though the mining activity in the area started in 1894, it peaked in 1925 under the control of private owners. In 1916, the first fire in the mine of this region was detected. Coal is formed from organic matter and is high in carbon content. This, when exposed to certain conditions such as temperature, moisture, oxygen, etc., tends to ignite and burn spontaneously. This combustion could be a natural process or may be triggered by other causes including human activities. Once a coal seam catches fire and is not controlled in the initial phase as happened in the Iharia coal belt in Iharkhand, it could burn for tens to hundreds of years. Air, water and land are affected by this pollution; land can ultimately become unsuitable for agriculture. The smoke from these fires contain oxides and dioxides of carbon, nitrogen and sulphur causing several lung and skin diseases. Respiratory diseases, like chronic bronchitis and asthma, are common in this region. A huge population of the state of Iharkhand was bearing the brunt of unscientific exploitation of coal by the private owners till coal mining was nationalized.

STRUCTURAL COLLAPSE

Two of the worst 20 structural collapses in the world occurred in India. On August 28, 2003, at least 25 people, including 23 school children were killed due to the collapse of a bridge in Daman. A school bus, a number of vehicles and pedestrians were thrown into the swirling river due to this. On December 2, 2006, at least 30 people were killed when a 150 year-old bridge, which was being dismantled, collapsed on a moving train near Bhagalpur in Bihar.

On October 29, 2005, a small rail bridge near the town of Valigonda in the south of Hyderabad was swept away by a flash flood. The 'Delta Express' train traveling over the bridge at night derailed at the broken section of the railway line killing at least 114 people and injuring more than 200 people.

On September 27, 2010, a roof collapsed in the weight lifting arena of the Jawaharlal Nehru Stadium, New Delhi, only 6 days before the Commonwealth Games were scheduled to begin. Many participating nations delayed arrival of their teams causing anxiety to the organizers of the Games.

ASTEROIDS AND COMETS

Ever since the earth was formed 4.5 billion years ago, it has been hit by these extra celestial bodies. There is paleontological evidence that cosmic collision has played a significant role in the mass extinction of earth's fossil records. These objects therefore, without any doubt pose a threat to the earth. Such collisions, depending on the size of the objects colliding with the earth, has the potential to cause massive damage at local and global scales. Comet Shoemaker–Levy 9 broke into 21 pieces, some as large as 2 kms in diameter, and crashed into the atmosphere of Jupiter. Had these fragments hit the earth instead, there would have been a global catastrophe.

ROAD, RAIL AND AIR ACCIDENTS

According to the World Health Organization, in its first ever Global Status Report on road safety, India has the dubious distinction of having the worst road accident rate worldwide: 130,000 deaths annually. This number is more than the annual casualties of all the natural disasters taken together. In 2009, the death toll due to road accidents in the country was 14 per hr. According to the National Crime Research Record Bureau, the death toll due to road accidents have passed the mark of 135,000 annually.

Rail accident is almost a regular phenomenon in the country and takes place all over. According to the information from the Indian Railways, from the year 1981 to 2009, around 4,575 people were killed due to rail accidents.

The worst air accident of an Indian Airliner was caused due to a bomb explosion over 33,000 feet on the Montreal–London–Delhi Air India flight named after emperor

Kanishka on June 1985. The plane exploded over the Irish airspace killing all 329 people on board. On May 22, 2010, the Air India express flight from Dubai crashed outside the Mangalore airport killing 158 people on board.

STAMPEDE

An act of mass impulse among a crowd of people collectively running in no clear direction can be termed as stampede. Anything perceived by the crowd of people as unusual can cause human stampede and it mostly happens during religious festivals. There are many examples of large number of deaths due to this:

- May 1994: 270 pilgrims were killed in the holy city of Mecca.
- January 2005: 270 pilgrims were killed near a remote temple in Maharashtra.
- September 2008: 147 pilgrims were killed at the Chamunda Devi temple in Jodhpur.
- November 20 2010: 368 people were killed during a water festival in Phnom Penh.

URBAN FIRE

Urban fire is perceived by the urban poor, especially those living in the slums, as the most dreaded disaster. Metropolitan cities, like Mumbai, where 54% of the total population lives in slums with the density of population as high as 100,000 per km², and Kolkata, where one-third of the population lives in the 5,500 slums with very high density of population, fire can cause serious damage to the hutment, lives and livelihood of the poor. In spite of the fact that there has been rapid urbanization in India, the fire fighting capacities in the country have not developed proportionately. This has been evident time and again. There have also been a number of incidents of fire in hotels, night clubs and theatre halls in the urban areas, both in India and outside the country with devastating consequences.

3.5 BIOLOGICAL DISASTERS

HUMAN EPIDEMIC

A human epidemic is an infectious disease that spreads through the human population across a large region, across continents or even worldwide. There has been recorded history of human epidemics throughout the history of the world such as smallpox, plague, tuberculosis etc. The more recent epidemics include H1N1 and HIV. HIV started spreading in the world in the beginning of the year 1969. The virus that causes AIDS is currently the most widespread epidemic in the world: the infection rate is as high as 25% in southern and eastern Africa. According to the estimate by the UN population research, AIDS can kill 36 million people by the year 2025. India has now the second largest number of people living with HIV and AIDS after South Africa.

HIV/AIDS prevention and care in Manipur: Response to Human Epidemic (Source: Author implementing the program in the capacity of the Regional Representative of Oxfam GB)

This is another example of a Public-Private Partnership.

In 1994, Oxfam GB, in collaboration with the British Council and the National AIDS Control Office of the Government of India, initiated a "Continuum of Care" program among the people living with HIV/AIDS (PLWHA) in Manipur State of the north east of India. This was probably the first care program among PLWHA. At that time, neither the state nor the communities knew how to cope with this human epidemic. As a result, people were dying in the streets and jails. The epidemic was caused due to injectable drug use among the most productive and reproductively active age group. Many of the drug users were initially drug peddlers. The location of Manipur, being close to the Golden Triangle, was the prime reason for drug smuggling.

According to the 1991 Census, Manipur had a population of about 1.2 million. In 1994, the estimate by various institutions including the government put the number of drug users in Manipal to 75,000. It was estimated that one in every four persons in Manipur was prone to the disease, which included the sexual partners, often multiple, of the drug users. The disease, initially spread from one drug user to another because of the use of the same syringe for injecting drugs.

Since the drug peddlers were also using drugs, and the state police was responsible for controlling drug peddling, the PLWHA could not declare their HIV / AIDS status in the open. Their family members were also hiding it, thereby complicating the issue of the prevention and care of the people already showing symptoms of HIV / AIDS. Since agriculture and other home-based productions depend entirely on muscle power, the economic impact was already being felt by the communities.

To implement the program and to monitor its outcome, an advisory body was constituted, with the principal secretary of health of the Manipur Government as the Chair and the Director of Health Services of the state as the Convener. The other members of the advisory and monitoring team were the representative of three government hospitals in the state capital. The technical support was provided by the British Council. There was one opportunity in the external environment: most people in high positions in the state had one or more HIV positive person in their extended families. They were, therefore, empathetic towards the families of PLWHA and were also keen to ensure the prevention of HIV transmission and the care of people with HIV/ AIDS.

There was a systematic awareness generation about the disease at all levels: among the doctors and the nursing staff of the three government hospitals, among the people in the villages and small towns, among the village leaders, among the women, and in particular, among the school and college-going students. Oxfam GB had two local partners of high repute, who were primarily responsible for the mass awareness program. After six months of the implementation of the program, a number of young boys and girls shook hands with the author, who was responsible from Oxfam GB in implementing the program, saying, "I am HIV positive". The program was called 'continuum of care', which meant care at home, in the community, in the hospital, then back to the community and home. The hospital authorities in all the three government hospitals happily agreed to provide a space near the reception for the NGOs. Any HIV positive patient coming from any part of the state would report to this kiosk and the volunteers would take him/her to the appropriate place for treatment. When an HIV positive patient was discharged from the hospital, he / she would be handed over to the kiosk with full instructions of how to take care at home.

This program was run for three years. NACO replicated this model in two states: Maharashtra and Tamilnadu.

The 2009 outbreak of H1N1, a new strain of influenza A virus, created serious concern and WHO alert was raised to the highest level. Nearly 30,000 confirmed cases were reported worldwide.

CATTLE EPIDEMIC

The worst cattle epidemic in the recent times occurred in the United Kingdom, locally known as mad cow, disease, a lethal central nervous system disease. This epidemic was first reported in 1986. Within 7 years of this epidemic, more than 50% of the cattle herds in the UK: 160,000 in number, were affected by this. This raised a fear that the disease might be transmitted to humans. Fortunately, around 1996, only 10 cases of human transmission were recorded. More recently, in 2002, the rapid spread of foot and mouth disease in Korea forced the authorities to destroy 165,000 animals causing the farmers to lose around 200 million USD.

PEST ATTACK

It is estimated that India loses 18% of its crop yield valued at INR 90,000 crore every year due to pest attack. This is in spite of the fact that India's pesticide production is the second highest in Asia and twelfth globally. In the Year 2010, the tea output in Assam, which accounts for 50% of the tea production in the country, was dropped by 30 to 40% due to pests. The pest causing enormous loss was identified as 'Tea Mosquito' which was never seen before in the tea plantation history of Assam. It was attributed to the excess rains in the month of June 2010.

3.6 DISASTERS CAUSED DUE TO SOCIAL, ETHNIC AND RELIGIOUS CONFLICTS

The Assam Holocaust in 1983 — An Ethnic, Linguistic and Religious Conflict (Source: Author, from his involvement in planning and implementing the response):

Assam, a north-eastern state of India, is a cauldron of many ethnic, linguistic and religious communities. In states, like Assam, Tripura and Meghalaya, the aftermath of the Partition of Bengal and the subsequent migration of the Bengali speaking people had a permanent impact on the demography of these states. The migration of the Muslims from the then East Bengal has historic roots. This part of the land was annexed by the British only in 1826, prior to which these areas were ruled by the kings. With the British Rule came the tea estates and the railways. For running the tea estates, a large workforce was brought in from the Chota Nagpur plateau of what is now Jharkhand and the tribal belts of Orissa (in the 1981 Census this number was 2.5 million). The British also brought the railways; the workforce was brought in from out of the state. In both of these industries, the white-collar jobs were the prerogative of the Bengalis. The basic reasons for the agitation of the survivalists and the secessionists in the region were identity and self rule. The population of Assam in 1971 was 15 million, which shot to 23 million in 1991; there was no census in 1981 because of popular pressure.

From 1978, there was a popular movement in Assam led by the students to revise the voter lists and in the process, delete the recent 'immigrants' from the list. The movement gathered momentum with the support of the Assamese intelligentsia. With numerous strikes and other forms of agitation, Assam was literary at the mercy of the powerful students union from 1978 to 1985. The Muslims of Assamese origin lent their wholehearted support to the issue of Assamese Identity. In such a situation, the then Prime Minister of India declared assembly elections in the state. Assam had been a melting pot of various linguistic and ethnic groups and the stress developed over the years needed a reason to explode and the declaration of elections provided it. What happened in 1983 was mayhem with brutal killing of people from all ethnic, linguistic and religious identities. Nellie has become synonymous with the worst brutality — killing of children of the Bengali Muslims. The Assam holocaust took at least 10,000 lives and consequently vertically split the communities in religious and linguistic identities. Muslims had to bear the brunt of the holocaust and this included the Assamese Muslims in spite of their wholehearted support to the cause of Assamese identity.

A large number of internally displaced people took shelter in public buildings like schools and were together based on their ethnic and religious identities. The immediate needs of these people were met by the state. The women and children were the worst sufferers. The women in the temporary shelters were so mentally shaken that even the

slightest noise would scare them and they would hold their children close to them. It was critically important for the mental health of women to provide psycho–social counseling. The men in the camps had access to the outside world and hence they had the opportunity of venting out their grief and fear with their peers, which women did not have.

The Oxfam East India office based at Kolkata decided to initiate a recovery program in such a highly tense and unsecured situation, where no one from one ethnic or religious identity trusted anyone from other social or religious identity. Since the Assam students' movement was primarily against the Bengalis, it was even more difficult for a Kolkata based organization to be accepted by all. The recovery program, therefore, had to be implemented with utmost caution and sensitivity. It was soon realized that though Muslims were the worst affected, there would have to be work initiated among the socially and politically dominant community — the Assamese Hindus. It was equally important that the people living in temporary shelters go back to their respective villages and restart their lives. To help women come out of their fear psychosis, it was important for them to get involved in productive activities. The tradition of Assam that every Assamese woman (both Hindu and Muslim) is an expert weaver, provided an opportunity to Oxfam to start a weaving program with the women in groups. For each 15 women a loom was provided and initial raw materials were provided to start a productive activity, which proved a successful recovery program. This work was first initiated with the dominant class not far from Gauhati, as was known those days.

In the meantime, productive activities, like agriculture and fishing were started with the other affected communities. But, for the first six months or so, each community was under the impression that Oxfam was working for them only. It was after six months, when the situation slowly started coming to normal, they were brought together in an effort to peace building.

Ethnic Conflict in Kokrajhar, Assam in 1996 (Source: Author, who planned and implemented the response):

This is an example of a Public-Private Partnership.

The Kokrajhar district of Assam is situated in the lower part of Assam bordering the Cooch Behar district of West Bengal. The district had a history of ethnic conflicts, but the worst of these took place in 1996 between two tribal communities: the Bodos and the Santhals. The Bodos are the 'sons of the soil,' whereas the Santhals had been brought by the British from the Santhal Parganas as tea garden laborers. After the closing down of the tea gardens, the Santhals chose agriculture as their livelihood by clearing the forest areas and started living there. They were better agriculturists than the Bodos and hence were better off compared to an average Bodo. This, coupled with the tension of the locals versus the outsiders, was the cause of conflicts.

As a consequence of the 1996 conflict, 50,000 Santhals had to leave their homes and start living in cramped, damp and unhygienic temporary shelters provided by the

Government of Assam. The affected Bodo community took shelter in public buildings. When a large number of children, mostly under five, were dying everyday due to diseases related to undernourishment, the District Commissioner contacted the East India Office of Oxfam GB for immediate assistance. This was promptly responded to. The author next day visited Kokrajhar to meet the DC in his office. He looked helpless not knowing how to combat the high mortality of children in the camps. He promised to provide all the necessary support and accordingly deputed a young officer from the Assam Administrative Service to take care of us and to provide the necessary logistics support. With the kind assistance of a Kolkata-based non-profit organization with distinctive competence on nutrition, a nutritional rehabilitation of the children was immediately initiated. Selected women from the camps were trained by the NGO in the preparation of a low-cost 'nutrimix' using the materials available in the local market. There was no time for baseline data collection, because the response needed to be immediate without any further delay and the situation was extremely tense. This was essentially a nutrition supplementation program; the supplement was to be provided to the children twice a day, three hours before the major meals. The total calorie intake was 750 kcals per day. The Government of Assam took the responsibility of transporting the materials to the camps, meet the cost of fuel for the preparation of the mix and provide honorarium to the women. It is a matter of pride for the author to mention that within a week of initiating this nutrition supplementation program, the mortality of children was brought down to almost zero. As a long-term benefit, the women in the camps were aware of the importance of supplementary food and its preparation.

The situation in Kokrajhar at that time was very tense. The author witnessed the killing of two people in broad daylight: one a businessman, in the main Kokrajhar market, and another on the way to the relief camps. To be able to work with the more vulnerable children from the Santhal communities, it was decided to also work with the children of the dominant Bodo community who took temporary shelter in public buildings.

A very senior officer of the Assam state administration from Guwahati requested the author to meet him in the capital. He profusely thanked Oxfam GB for the program in a difficult situation and wanted to know from the author, the possible permanent solution to the problem. The root of the problem was complex; it became even more difficult to resolve it because of the Supreme Court verdict that no one could be given entitlement of the land in the reserve forest. The Santhals were living for generations in the reserve forest without any right on the land. The indigenous Bodo community would not agree to any large-scale rehabilitation of the Santhal community and such land was also not available at the disposal of the government and even if it was, the Santhals, who had converted the forest land into agriculture land, for generations would not easily move out. However, it was very kind of the government to acknowledge and appreciate the efforts of an international relief and development organization.

GUJARAT RIOTS IN 2002

On August 27, 2002, the pilgrims returning from Ayodhya by Sabarmati Express train were burnt in the Godhra town of Gujarat. As a result, 58 people, mostly women and children were killed. This ghastly incident triggered a large-scale communal riot in 16 out of 25 districts of the Gujarat State. There is a history of riots in Ahmedabad; the post-Godhra violence has been the worst killing 1044 people, of whom 790 were Muslims; 223 persons were declared missing. By March 27, a month after the riots, more than 100,000 people were in the relief camps mostly run by the civil society organizations with the support of the government. The state government clamped curfew in the state for three weeks from the day of the riot. Gujarat is famous for readymade garments. Mostly, the poor from both the communities are engaged in making garments. There is an interdependency of people from both the communities in this sector: the cutting of the cloth is done by one community and the other community stitches it. Loss of livelihood over a protracted period created serious problems for the poor in both the communities. The animosity between the two communities was so high that there was no meeting ground for them. The only meeting point of the two communities in the rural areas was apparently the milk collection centers of the National Dairy Development Board, but this meeting point was not creatively utilized to bring the two communities closer. The author visited Gujarat after the curfew was lifted. He visited Naroda Patiya in the city of Ahmedabad, one of the worst affected areas. Survivors narrated horrifying incidents of rape and other sexual abuses to terrify a particular community. As everywhere else, the women and children had to bear the brunt of the riot. People living in the relief camps still had a traumatized look even after weeks of the violence. After a gap of 7 vears, the government declared the missing persons as dead, therefore the number of people killed in the Gujarat communal violence increased to 1267.

Chapter

4

ENGINEERING AND TECHNICAL ASPECTS OF Disasters

4.1 DISASTERS CAUSED DUE TO ENGINEERING AND TECH-NICAL FAILURE

Engineers respond to the needs of the individuals or the society or the state by constructing or creating something and for performing a given function, following a set of guidelines based on the education received. What is critically important is that the device or structure created should perform the function for which it is designed, without fail. Though philosophically nothing is permanent, still engineers must take into cognizance all the factors in the design to avoid all possibilities of failure, more importantly catastrophic failure. Improvement of the structural designs making these as failure proof as far as possible, could be made through a systematic analysis and study of the engineering disasters occurred across the globe. The Haiti earthquake of January 12, 2010, of magnitude 7 on the Richter scale with its epicenter at 25 km west of the capital Port–au–Prince, killed 220,000 people and made 1.5 to 1.6 million people homeless.

Though Haiti and its neighboring Dominican Republic had a long history of high intensity earthquakes, the buildings constructed by both the public and the private sector did not take that in cognizance. Some professionals, mainly the civil engineers across the globe termed this as an engineering disaster rather than a natural one. A properly engineered structure does not necessarily have to be extremely strong or expensive. It has to be properly designed to withstand seismic shocks up to an acceptable limit.



Fig. 4.1 The Haiti earthquake Source: American Red Cross In the Year 1998, New Heaven: Yale University Press published a book, *Seeing Like A State* by James Scot, which according to its reviewer, "is extraordinarily well written and well argued tour through the various damages that have been done by centrally planned social engineering projects of the 20th century". He calls these projects, "high modernism". He argues that a bureaucratic planner with a map does not know the best; the local practical knowledge by the person on the spot is very important and hence the locus of decision-making must remain with those, who have the craft to understand the decision. In other words, he is arguing in favor of decentralized inclusive development plans against the existing centralized planning.

Humans, for all their genius and amazing achievements, are still far from infallible. The Titanic, considered unsinkable, sank ramming into an iceberg. There was no design flaw; the impact and its consequences could have been less devastating without the human error. On March 12, 1928, St. Francis Dam in the north of Los Angeles in USA burst, sending 47,000.000 cubic meter of water flooding into Santa Claria Valley. A 10-storey wall of water rolled down the Santa Claria riverbed at 29 km per hr. The next morning revealed an unbelievable catastrophe: the town of Santa Maria lay buried under 20 feet of mud and debris. Parts of the neighboring Ventura county were under 70 feet of mud. Incidentally, this happened the day before the engineer, who constructed the dam, was to inaugurate it.

The primary causes for engineering disasters are considered to be:

- Human factors including 'ethical failures',
- Design fault,
- Materials failure,
- Extreme conditions or environment, and
- Combination of all the above.

Often, a deficiency in the engineering ethics is found to be one of the root causes of an engineering failure. An engineer, as a professional, has the responsibility and accountability to his clients, to his profession and to the general public to perform his roles in as conscientious a manner as possible. (The author is a product of an engineering institute of highest repute: IIT). Usually, this entails acting in a manner far more than the bounds of law. An ethical engineer avoids conflicts of interests, does not misrepresent her/his knowledge to accept jobs outside expertise, acts in the best interests of the society and the environment and completes the assignment in a professional manner.

Kosi embankments on the River Kosi in Bihar were built in the late 1950s to protect people and agricultural land from repeated floods. The first breach of the embankment took place in 1963 within years of completion of a much hyped development program in the post-independence India. The Chief Minister of the state at that time had passed on the responsibility to rats and foxes making holes in the base of the embankments and thereby weakening it. In 1968, the embankment breached at five places in the Darbhanga district of Bihar, which was caused due to a very high flow of 913,000 cusecs of water ever recorded in the river. But, an enquiry by the chief engineer – Floods, of Central Water and Power Commission revealed that the failure was once again due to rats and foxes (Source: discussions with Dinesh Kumar Mishra and his publication '*Between the Devil and Deep Water*').

The primary objective of the Farakka Barrage completed on almost the tail end of the river Ganges in the early 1970s was to improve the navigation of the Kolkata Port by diverting the water through a feeder canal. Looking at the long-term impact of the project on the environment and the population, it seems that the engineers involved in designing it did not take the following into consideration or grossly underestimated these:

- Such a long river at the tail end would have a natural tendency to oscillate sideways.
- The suspended sediments load at the site would be very high: currently it is 729 million tons per year.
- Blocking the water with such huge suspended sediment load would mean formation of islands on the upstream, not far from the barrage (currently there are 24 islands of varying sizes).
- Formation of such islands may change the main course of the river either to the east or to the west.
- The western side of the river near the barrage is the hard Rajmahal Hills, and therefore, there would be high possibility of erosion at the eastern side of the river, which is the soft alluvial soil (the main course of the river has shifted by 30 km towards the East), and last but not the least.
- Would the barrage really increase the navigation facility of the Kolkata Port?

Both these projects need serious social and technical auditing by national and international experts without conflict of interests to learn from the past and use the knowledge in future. There may be many such examples in India: these two are mentioned as cases in point.

There is a saying among a section of social activists, "Technology creates more risks". This risk, according to them, includes genetically modified agriculture. Technology however, cannot be blamed. It is an individual, a group, a corporate or a government or the policy-makers of the government that can be blamed, if at all, for using technology for short-term gains, which has the potential for a long-term adverse impact.

4.2 EARTHQUAKE ENGINEERING

Earthquake engineering is the scientific field of limiting the seismic risk to an acceptable level thereby protecting the society, infrastructure and environment from an earthquake. Traditionally, earthquake engineering has been narrowly defined as the study of structure and geo-structure subject to seismic loading, thus considered as the subject of structural and geo-technical engineering. However, the tremendous human and financial losses due to the recent earthquakes led to the expansion of the subject encompassing disciplines from wider fields of civil engineering and social sciences. The main objectives of earthquake engineering are:

- To foresee the potential risks of a strong earthquake on the urban and peri urban areas and on 'civil' infrastructure (the term 'civil' differentiates between military and civil infrastructures).
- To design, construct and maintain structures to withstand earthquake shocks up to the expected level and in compliance with the National Building Code.

Even the best engineering institutes of the country teach earthquake engineering at the postgraduate level, even though most civil infrastructures are built and supervised by undergraduate civil engineers. After the massive infrastructure damage in Haiti, all major newspapers expressed serious apprehensions that more than 20% of the buildings in Delhi would be seriously damaged in case of a high-intensity earthquake.

Learning from the wisdom of communities living in the earthquake prone areas seems to have become a matter of the past. If there is a recurrence of the magnitude of the 1950 earthquake of Assam in the north-east, the fatality would be manyfold today compared to 1950, because the traditional housing stacks in the region have been replaced by cement concrete buildings with very little efforts of making these resilient to the recorded earthquake shocks; and also because there has been a huge growth of population.

4.3 COASTAL ENGINEERING

By definition, coastal engineering is the study of the ongoing processes at the shoreline and construction within the coastal zone. This zone is a dynamic area of natural change and of increasing human use. The dynamism has increased and will continue to increase because of global warming and the consequent rise of the sea level across the globe. Though the coastal zone occupies 15% of the total geographic area of the world, it supports two-third of the world's population, which puts incredible amount of pressure on the global ecosystem.

The coastal regions support important economic, transport, recreational and residential functions, all of which depend upon the coastal region's physical characteristics, appealing landscape, natural resources, rich marine and terrestrial biodiversity. These resources are the foundations of the present and future generations of the coastal residents globally. The value of the coastal zones for the humanity, and the enormous pressure on it provides strong incentives for greater scientific understanding and to ensure effective coastline engineering practices towards an efficient and sustainable management. The field of coastal engineering involves the aspects of near shore oceanography, marine geology and civil engineering combating erosion of the coast. Numerous devices, both hard and soft structures, have been devised to stop the erosion processes. Hard structures include those erected perpendicular to the shoreline to slow the transport of sand, and soft structures include the traditional beach nourishment by putting fresh sand on the eroding beach brought from outside.

4.4 TECHNOLOGY AND DISASTER MANAGEMENT

If "Technology creates more risks", then modern technology is also extremely useful in disaster management. One of the tools that is found most useful is the Geographic Information System (GIS). It is a computer system capable of integrating, studying, analyzing and displaying geographically referenced information. This technique can be used in different phases of disaster management starting with the required planning before the event takes place. Disaster management involves an immediate response phase. The GIS can assist the decision-makers understand the extent of the damage in terms of the geographic area and the population affected by a disaster. In other words, GIS can identify locations and the number of people needing immediate assistance. A few specific examples of geospatial technology supporting disaster management are as follows:

- Rapid identification of potential shelters or the number of tents required in keeping with the sphere standard.
- Identification of a suitable location for logistics support.
- In case of a persistent disaster, like bushfire, flood, drought, the GIS can model the speed and direction to provide warning to people living in the potential danger zone.
- GIS can produce maps and imageries of the event for the decision-makers to take informed choices in different phases of disaster management.
4.5 QUANTITATIVE RISK ASSESSMENT

Immediately after a disaster, the stakeholders, globally, nationally and locally, look for quantitative data to assess the extent of the problem. Quantitative assessment of a disaster attains significant importance. A quantitative assessment, essentially, is an analysis that uses numerical value to inform the extent of the immediate consequences of a disaster and the possible longterm impact. The quality of this analysis depends on the accuracy and completeness of the collected data and the model used to gather the data. Quantification clearly has certain limitations: it does not measure all human experiences due to disasters. The most commonly used tool for quantitative assessment of a disaster is geospatial analysis: for example, using GIS technique, the information of distance, area and volume within the geographical boundaries can be made readily available. However, it is suggested by experienced experts on humanitarian responses, that participatory analysis, an analysis by the people themselves affected by a disaster should be used to validate the quantitative assessment using GIS technique.

4.6 POLLUTION CONTROL AND MONITORING

In February 2007, a report by the Intergovernmental Panel on Climate Change (IPCC), representing 2,500 scientists, economists and policymakers from more than 120 countries of the world, said that humans have been the primary cause of global warming. Hence, the situation demands a reversing.

A pollutant, by definition, is a waste material that pollutes air, water and soil. The factors that determine its severity are: the chemical nature, concentration and persistence. About 400 million metric tons of hazardous waste is generated globally every year, as suggested by an estimate.

Air pollution is primarily caused by vehicular emissions. The principal stationery sources include chemical plants, coal fields, power plants and oil refineries.

Soil pollution takes place when chemicals are released either intentionally or accidentally. The most significant soil contaminants are hydrocarbon, heavy metals, and pesticides.

Water pollution is caused by the drainage of untreated waste water from industrial and commercial waste either intentionally or through spills.

To protect the environment from further damage from the adverse effects of pollution, the Kyoto Protocol, an international treaty on global warming was ratified by 141

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countries of the world. Many countries before and after ratification of the protocol enacted legislation to regularize pollution due to various sources.. Sensors have been developed to measure the extent of pollution and are used on a continuous basis to monitor the levels of pollution.

Chapter 5

Environmental Aspects of Disasters

5.1 INTRODUCTION

A very prominent cause of environmental degradation in India, for that matter in other developing countries, could be attributed to the rapid growth of population, which adversely affects the natural resource base and environment. The concept of sustainable development faces strongest challenge from the spiraling population growth. The presence of natural resources can facilitate the process of socio-economic growth, more so of the poor, who are entirely dependent on the natural resource base for their survival, let alone their growth. India occupies only 2.4% of the total geographic area of the earth, but supports nearly 18% of the total population. This, coupled with rapid and unplanned urbanization, development of infrastructure, like roads and rails, poor agricultural practices and overgrazing, have all contributed to the degradation of the environment. Out of 328.73 million hectare (Mha) of the total geographic area of the country, 146.82 Mha have been subjected to various forms of land degradation caused due to water and wind erosion, alkalinity and salinity and water logging. An estimate suggests that anything from 4.2 to 12 billion tons of top soil deposited over millions of vears is lost annually due to water and wind erosion. Soil is a non-renewable natural resource that supports life on the earth. Major rivers, like the Ganges, Brahmaputra and Kosi carry large amounts of eroded soil that gets deposited on the bed of the river downstream, reducing the water carrying capacity considerably and thereby causing flooding.

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Out of India's approximately 4,000 towns and cities, only very few have partial wastewater treatment facilities. More than 100 cities dump the untreated sewerage and partially cremated bodies directly into the Ganges. As a result of this, when the river enters the holy town of Varanasi, it contains 60,000 fecal coliform bacteria per 130 millimeter of water, which is 120 times more than what is considered safe for bathing. Four miles downstream, with inputs from 24 gushing sewers and 60,000 bathers per day, the concentration of fecal coliform bacteria is 3,000 times above the safety level (Source: *The Economist*, December 11, 2008).

Punjab, today, has become a hot bed of water pollution. The Buddha *Nallah*, a rivulet that goes through the Malwa region of the state after passing through the highly populated and industrialized Ludhiana district before draining into the Sutlej river, is a very important case in point. Recent studies suggest this to be another Bhopal in the making. A study by the Punjab Pollution Board in 2008 revealed that in the villages along the *Nallah*, calcium, magnesium, fluoride, mercury and two dangerous pesticides are present in the groundwater much above the permissible limit.

Air pollution, moreso in the metropolitan cities, caused primarily due to vehicular emission, has been responsible for serious health impact in the urban towns and cities. The most common diseases due to this are: eye infection, cough and pharyngitis. In Bangalore city, around 50% of the children suffer from asthma.

The economic value of water is going to increase manyfold in the coming years. In some urban pockets and cities of Africa, there have been serious conflicts on the issue of water, due to refugees fleeing their countries for civil war and settling temporarily in those towns and cities. The demand for water due to increased crop production through groundwater irrigation is causing overdraft of groundwater, meaning more discharge than recharge of groundwater. In the State of West Bengal post 1971, there was a significant change in the agricultural practices. Additional crops were introduced, which were water intensive, the source of water was groundwater, resulting in arsenic contamination of groundwater. In the decade of 1980s, the state recorded the highest agriculture growth in the country, but this growth was not sustainable. The groundwater in the most populated and the rice bowl of the South Bengal districts became contaminated with arsenic much above the permissible level. The contamination was not bound by the international border. Bangladesh's groundwater also became contaminated with arsenic. The arsenic poisoning of the drinking water in Bangladesh and India was the worst public health issue according to the WHO. The arsenic in drinking water is caused due to over extraction of water. This is no longer a problem of West Bengal; arsenic contamination of groundwater has extended to Bihar, Uttar Pradesh and Chhattisgarh.

5.2 A CASE STUDY OF ARSENIC CONTAMINATION IN WEST BENGAL⁵

When the first deep tube-well for drinking purpose was bored in the 24 Parganas district (what is now North 24 Parganas) in 1962, the villagers protested, "It's the devil water coming". The scientific communities laughed at their stupidity, but later on discovered that the groundwater in the district was contaminated with arsenic. Arsenic is a heavy toxic metal. It gets deposited in nails, hair, urine and skin. Medical records show that people affected by continuous and protracted drinking of the arsenic contaminated water suffer from skin irruption, lesions, swelling of palms and soles, pigmentation and liver disorders. The first case of arsenic contamination was detected in the School of Tropical Medicine, Kolkata in 1983. The initial response from the State of West Bengal was that of denial of the problem, blaming those, who were trying to bring the issue into public domain as "agents of mineral water".

West Bengal, in the decade of the 80s of the last century, recorded the highest agricultural growth among all the states of the country. Single cropped areas were transformed into multiple cropped. New crops introduced were water intensive, dependent on groundwater. In the process, the overexploitation of groundwater has been the prime reason of arsenic in groundwater. The political party in power attributed this agriculture growth to the land reforms in the state. Land reform was their agenda for building a mass electoral base in rural Bengal. Possibly, this was the reason for denial by the state power. The first official reaction from the state was from the Chief Minister of West Bengal after 14 long years of detecting the first case of arsenic poisoning. According to *The Statesman* of February 6,1997, the West Bengal Chief Minister admitted that about 4.5 million people of the state spread over 8 districts were exposed to arsenic poisoning and 200,000 people were suffering from arsenic induced diseases.

After arsenic contamination was found in West Bengal in the Gangetic alluvial belt, soon the contamination was found in Bangladesh along the Meghna River. The situation in Bangladesh soon became very acute and according to the World Health Organization (WHO), arsenic in drinking water in Bangladesh and West Bengal was the biggest public health issue in the world.

Studies reveal that the impact of arsenic contamination has a direct relationship with nutrition. As a result of this, arsenic lesions were visible in women earlier than men, of the same household. Because of lack of documented evidence, the number of natural abortions among the arsenic affected women did not and is still not brought to public notice. Initially, when people were unaware of the issue of arsenic and its impact on men and women, there had been many cases of desertion of women by their husbands. Experiments in Hungary showed that the impact of arsenic in human body is reversible upto a point with the supply of arsenic free drinking water.

The Bangladesh Government and the civil society there reacted immediately after geo-scientists sent alarm bells on the issue. A lot of work was immediately undertaken both by the state and the civil society. The initial focus was to identify the sources of arsenic in drinking water followed by an awareness program among the people living in arsenic prone areas. For the removal of arsenic, the hardware was developed by various institutes in India, primarily by Jadavpur University and the Bengal Engineering College, one of the oldest engineering colleges in India. Neither the state of West Bengal nor the civil society of the state tried to use the software developed in Bangladesh and the hardware developed in India to combat the situation.

5.3 APPLIED ECOLOGY, ENVIRONMENTAL CHEMISTRY – TOXICOLOGY – GEOLOGY – REMOTE SENSING – ECONOMICS

APPLIED ECOLOGY

An integrated science of the ecological, social and environmental aspects of natural resources management is applied ecology. The various aspects of applied ecology consist of management of factors that are indispensable for the survival and well being of life on earth like: agro–ecosystem, biodiversity and biotechnology. A substantial change in any of these factors has the potential of catastrophic consequences to life on earth.

ENVIRONMENTAL CHEMISTRY

The scientific study of chemical phenomena that naturally occur on the earth are environmental chemistry. In other words, this involves the study of how the uncontaminated environment works. Environmental chemistry is used to assess:

- Contamination of land by the release of heavy metals from the industries.
- Contamination of groundwater from the leaching of nutrients by agriculture.
- Contamination caused due to pollutant run off in the urban areas.

ENVIRONMENTAL TOXICOLOGY

The field of science concerned with the harmful impact of the various biological and chemical agents on living organisms is environmental toxicology. The study of the

uncontrolled use of pesticides in the west during the 60s of the last century established environmental toxicology as an independent subject.

ENVIRONMENTAL GEOLOGY

The science of application of the principles of geology known as environmental geology will assume greater importance in the very near future because of climate change. The study involves the interactions between the geological environment including the biosphere, the lithosphere and the hydrosphere with humans. The study of environmental geology includes: management of geological and hydrological resources like fossil fuel, both surface and groundwater, land, defining exposure of natural hazards on men and women and managing industrial and domestic waste disposal.

ENVIRONMENTAL REMOTE SENSING

Remote sensing, as the name suggests, is the technique of gathering information from a distance without touching, and therefore, without any physical contact with the object. The modern usage of the term refers to aerial photographs taken either from aircrafts or satellites using aerial sensors to detect objects on the earth's surface, in the atmosphere or in the ocean. The remote sensing data can be obtained from areas, which are dangerous or inaccessible to reach otherwise. This data has multiple usages, like monitoring the melting of ice in the Arctic and Antarctic regions, the depth of oceans, monitoring deforestation, etc.

ENVIRONMENTAL ECONOMICS

Environmental economics is the science concerned with environmental issues and its interface with humans. In other words, it is essentially the science to find a lasting solution of harmony between the environment and the humans. It is the science of economics concerned with the most efficient and lasting use of environmental resources. The environment provides the raw material for economic activities and hence the interdependence of the environment and economic activities is the key to sustainable economic growth of a country.

Chapter 6

URBAN DISASTERS

6.1 INTRODUCTION

Demographers throughout the world, at the end of the last century, estimated that in the new millennium, for the first time in human history, nearly 50% of the world's population will be living in urban areas⁶. Analyses of the urban growth suggest that the less developed countries are urbanizing faster. Rapid urban growth in some parts of the world would be the consequence of war and famine; in Africa for example. However, urbanization is nowhere more important than the fast growing cities of the Indian subcontinent. Three of the most vulnerable cities in the world are Mumbai, Kolkata and Delhi. A very large population in these three cities lives in informal settlements with a high risk of health hazards, floods, earthquakes, fires and eviction.

The Yokohama strategy in the International Decade for National Disaster Reduction (IDNDR) conference in 1984 and the Habitat Global Forum's Plan of Action for Safer World following from the Summit in Istanbul in 1996 had expressed serious concerns in reducing the urban risk of disasters. Unfortunately, most governments, signatory to these declarations, have made very slow progress in their efforts in reducing the urban risks. There could be many reasons for this:

- Competing priorities of the countries may have compelled less attention to this.
- Disaster risk reduction needs immediate resources, the potential benefits are long term.
- The problem is often perceived as too big to handle.
- Lack of political will.

- The populations living in unorganized settlements with livelihood from the unorganized sectors have less power to influence the politics of the state or the country.
- The urban poverty and vulnerability are bottomless pits: it is difficult to reach the end of the tunnel.

6.2 SELECTED CITY SPECIFIC VULNERABILITY

CUTTACK

Cuttack is the financial capital of Orissa and the past capital of the state. It lies between two major rivers: the Mahanadi, the largest river of the state, and Kathajodi. The city is protected by high embankments on either side. The beds of both these rivers are at a level higher than the city and hence Cuttack is like a bowl prone to severe water logging during the monsoon months. Cuttack is prone to cyclones: the Orissa Super Cyclone in the Year 1999 severely damaged the city. The subsequent heavy rains caused serious water logging that stayed for weeks causing serious health hazards. During the heavy flow of water in the rivers on either side of the city, if any of the embankments crack, a major portion of the city would be washed away.

CHENNAI

Tamil Nadu has witnessed several disasters: cyclone and storm surge, *tsunami* in the coastal belt, monsoon flood and landslide. Increased urban population with poorly constructed infrastructure subjects cities to higher level of risk from disasters like flood, cyclone and *tsunami*. The whole metropolis of Chennai falls within Zone III of the seismic map, but the city has been prone to cyclonic wind combined with heavy rain, monsoon flood, flooding due to sea water during high tide in rough weather conditions and *tsunami* in recent times. With the increase in the sea level due to global warming, the Marina Beach is under threat.

Delhi

Delhi, the capital of India with a population of 11,680,000 (2001 Census) is located in Zone IV of the seismic map of India. Delhi is the second most populated city in the country. The city is located on the west bank of the river Yamuna and is surrounded by the seismically very active Himalayan ranges and the Aravalli Hill range. The catastrophe of the Haiti earthquake prompted a lot of discussion among the structural engineers of the country about the safety of the buildings in our large cities. According to Prof. Mandeep Singh of the School of Planning and Architecture, Delhi, "Until the Gujarat earthquake of 2001, earthquake-resistant building design was not even

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a subject in undergraduate civil engineering courses". He also estimated that 10 to 20% of the population of the city lives in vulnerable buildings. This is a huge number of people living under threat. Delhi is also flood prone, particularly the trans Yamuna areas.

GUWAHATI

North east India is seismically one of the six most earthquake prone zones in the world: the other five are Mexico, Taiwan, California, Japan and Turkey. Because the North east is located between the Indian and Eurasian tectonic plates, there is always a possibility of tremor in the region. There is recorded history of many quakes and quake-related disasters in the North east. Generally, the earthquakes in the Himalayan colliding zone are low depth up to a maximum of 20 km, and therefore, are of more destructive power like the recent Sichuan earthquake in China. Because cement concrete houses have replaced the traditional housing stock in the cities of North east, a recurrence of the 1950 intensity earthquake could kill many more people now in comparison to 1950.

Kolkata

Kolkata is the third largest city in the country with a population of 4.58 million (2001 Census) and a population density of 25,000 persons per km². The city also supports a floating population of 5.5 million people (Source: Kolkata Municipal Office website). One-third of the total population of Kolkata lives in 5,500 slums. The city of Kolkata is 9 m above the mean sea level; the sea is hardly at a distance of 60 km. Kolkata has a long history of disasters. An event in 1737 that might have killed 300,000 people around Calcutta (as was known in those days) was thought initially to be caused by an earthquake; but is now believed to have been caused by a cyclone. Cyclones affected the city in June 1848, October 1864 and in November 1971. A high-intensity earthquake in the Sumatra Andaman Hill with its epicenter in Andaman or under the sea close to Andaman, has the potential of a *tsunami* that can hit the Sunderbans and consequently its waves could reach Kolkata. The city, therefore, is prone to cyclones apart from floods, fire and health epidemics and there is possibility of being hit by *tsunami*. Arsenic contamination much above the WHO-specified limit has been found in groundwater in many places in south Kolkata.

Мимваі

Mumbai is the most populous city in the country and is the fifth most populous city in the world with a population density of more than 27,000 people per km². Officially, the Mumbai slums accommodate 54% of the total population with the density of population as high as 100,000 per km². Mumbai is the financial capital generating

5% of India's Gross Domestic Product (GDP) and 25% of the industrial output of the country. According to the WHO, the city is one of the 10 most vulnerable cities in the world in terms of flood, sea surge and tropical cyclones. The Mumbai flood of July 26,2005 took 1094 lives. In 24 hours, 994 mm of rainfall took place. Most part of the city is barely a meter above the mean sea level (MSL). Mumbai is also located on a fault line. Many atomic power plants are located in the Konkan region and Mumbai also houses nuclear research institutes, like the Bhaba Atomic Research Center and Tata Institute of Fundamental Research. Mumbai is also prone to tsunami: fortunately the 2004 tsunami spared the city of Mumbai. Such an important city is prone to recurring floods, sea water surge, health hazards and tropical cyclones. Any serious disruption in the city has the potential of retarding the economic growth of the country.

Ράτνα

Patna, the capital of Bihar with a population of 1,366,444, is located on the south bank of the river Ganges. Patna is unique because of its location at the confluence of 5 rivers: the largest being the Ganges, and the other four being Ghaghara, Gandak, Punpun and Sone. Civilization flourished here in the past because of these rivers bringing silt every year during the monsoon season and because of the waterways. Today, floods and associated health hazards have become a regular phenomena. The Zone V of the earthquake zoning map of India is not far from Patna. The 1937 earthquake devastated the Bihar-Nepal border. A similar earthquake, today, would multiply the mortality many times because of population growth and the multi-storeyed cement concrete houses built without an earthquake resistant design.

PORT BLAIR

According to the seismic zoning map of India contained in IS 1983–1984, the entire Andaman falls in Zone V, the most severe seismic zone. Andaman and Nicobar Islands are located near the boundary of the Indian tectonic plate and the Burmesh micro tectonic plate. The Indian plate is diving beneath the Burmesh micro plate, a process that in plate tectonics is known as subduction. In view of this, Andaman is prone to earthquakes and volcanic eruptions. In December 2004, an earthquake took place in the Sumatra – Andaman hill ranges and the subsequent *tsunami* wrecked havoc in the islands. Andaman has a history of many disasters; it is also exposed to severe water surge caused due to cyclonic storms.

Vizag

Visakhapatnam is a major industrial and port city, the third largest city on the east coast after Kolkata and Chennai, with a population of approximately 1.3 million people and one of the fastest growing industrial hubs in the country. It is the home for the Eastern

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Naval Command of the Indian Navy. The town is also referred to as the 'Steel City' of the Coromandel Coast. The city, however, is highly prone to cyclones with a potential to cause huge damage to the industries and the people. The city is also prone to industrial disasters as seen in September 18,1997, when the liquid petroleum gas (LPG) facility of the Hindustan Petroleum Corporation exploded, requiring the evacuation of 10,000 people for several days from the area. Vizag is also prone to *tsunami*.

It is thus a matter of highest concern that all four mega cities of the country are prone to multiple hazards. Many state capitals, especially in the north-eastern states, with the exception of Tripura, and a number of industrial towns along the east and west coasts are also similarly prone to one or more natural hazards, a fact that should be borne in mind by the urban planners and the corporations and the promoters of industries.

Chapter **7**

CLIMATE CHANGE

7.1 INTRODUCTION

The most accepted definition of climate change is: "a change in the statistical properties of the climate system when considered over long periods of time, regardless of its cause". This type of climate change and its effect has been documented in the past"⁷. According to this definition, fluctuations over periods shorter than few decades, such as El Nino do not represent climate change.

Global warming is the continuing rise in the average temperature of the Earth's atmosphere and oceans. This is caused by increased concentrations of greenhouse gases in the atmosphere, resulting from human activities, like deforestation and burning of fossil fuels. This finding is recognized by the national science academies of all the major developed and developing countries and is not disputed by any scientific body of national or international standing.

The term 'Climate Change' is sometimes used specifically to refer to changes caused by human activity; for example, the United Nations' Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability". Climate change is synonymous with global warming. Parts of the climate system, like the oceans and ice caps respond very slowly to pressure creating climate change because of its large mass.

Phrases, like 'global warming', 'climate change', are being used by scientists, the United Nations and the key political figures of the world for quite some time now. These essentially mean warming of the earth's atmosphere that in turn increases the temperature of the world. Earth's atmosphere is comprised of many gases, collectively known as 'Greenhouse' gases. The Greenhouse gases are responsible for maintaining the average temperature of the earth at a comfortable 17°C and without the Greenhouse effect, the earth's temperature would have been minus 15°C⁸.

What are the apprehended and evidence-based impacts of global warming: an increase in global temperature will cause the rise of the sea level endangering people living in small islands, barely few meters above the sea level; it will change the amount and pattern of rainfall and probably expansion of deserts. It is expected that the warming will be the strongest in the Arctic-region, which would be associated with continuing retreat of glaciers. Other likely effects of the warming include more frequent occurrence of extreme weather including extreme heat and cold waves, droughts, heavy rainfalls in certain parts. All these would result in negative changes in agricultural yields. The changes will be so significant that the limit of human adaptation may be exceeded in many places while the limits for adaptation for natural systems would largely be exceeded throughout the world. Hence, the ecosystem services, upon which human livelihoods depend, would not be preserved.

The responses of countries to climate change include mitigation measures to reduce emissions, adaptation to the effects of climate change and geo-engineering efforts to remove the Greenhouse gases from the atmosphere. The main international mitigation effort is the Kyoto Protocol, which seeks to stabilize Greenhouse gas concentration to prevent a "dangerous anthropogenic interference". As of May 2010, 192 states had ratified the protocol. The only members of the UNFCCC that were asked to sign the treaty but have not yet ratified it are USA and Afghanistan.

Evidence of warming of the climate system includes observed increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising average sea level globally. The earth's average surface temperature rose by 0.74° C over the period 1906–2005. The rate of warming over the last half of that period was almost double that of the period as a whole. Compared to the pre-industrialization period, the carbon dioxide (CO₂) level of the atmosphere has increased from 280 parts per million of air (PPM) to 386 PPM: an increase of $37\%^{\circ}$. Although the winter of 2008–09 in USA and Europe was the coldest after many years, during the last 100 years, the world has warmed up by an average of 0.74° C. This may not sound a significant change, but 1°C change can cause catastrophe in the world. With 0.74° C increase in the temperature of the world, we are now faced with the melting of ice caps and land based glaciers causing the sea level to rise endangering many islands, metropolis and cities in the coastal belt.

Temperature changes vary over the globe. Since 1979, land temperatures have increased about twice as fast as ocean temperatures (0.25°C per decade against 0.13°C per decade). Ocean temperatures increase more slowly than land temperatures because

of the larger effective heat capacity of the oceans and because the oceans lose more heat by evaporation. The Northern Hemisphere warms faster than the Southern Hemisphere, because it has more land, and because, it has extensive areas of seasonal snow. More Greenhouse gases are emitted in the Northern Hemisphere as compared to the Southern Hemisphere; but this does not contribute to the difference in warming, because the major Greenhouse gases persist long enough to mix between hemispheres.

The global climate is changing. It has become no longer an environment issue alone; it is already affecting the lives and livelihoods of a significantly large number of people, moreso in the countries with low human development. Sea level is rising: due to melting of glaciers and expansion of warmer sea water, sea level rose by 15 cm (6 inches). Scientific models predict that by the end of the 21st century, the sea level may rise as much as 59 cm (23 inches). Densely populated coastal areas of the world and large cities, like Mumbai and Chennai, would be severely threatened. The evidence of climate change has already attained alarming proportion. The future, therefore, is bleak to say the least, unless concerted efforts are made by all countries to reduce the manmade cause that has contributed to this. Agriculture, the bedrock of economy of many countries of the world, particularly those with low human development, has become and would continue to be, in future, more and more unpredictable because of extensive flooding and drought and unpredictable rainfall distribution due to climate change.

7.2 PROBABLE IMPACTS OF CLIMATE CHANGE

- 1 Arctic ice is melting: There is scientific evidence that the thickness of Arctic Sea ice is half of what it was in 1950.
- 2. Glaciers are melting.
- 3. Heavier rainfall is causing extensive flooding in some parts of the world.
- 4. Extensive drought is increasing, erratic and unpredictable rainfall affects monsoon dependent agriculture, which, in turn, affects a very large population of the world from the perspective of livelihood and food security.
- 5. The frequency and intensity of tropical cyclones have changed.
- 6. More frequent extreme heat and cold waves.
- 7. Warmer temperature is adversely affecting human health and some killer diseases, like malaria have become rampant, new pathogens have appeared and those which were dormant have resurfaced with vengeance.
- 8. The rise of sea levels is threatening many coastal areas, like small island countries and large river deltas around the globe.
- 9. New pests and new crop diseases are severely affecting agricultural production causing more hunger in the world.

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- 10. Acute shortage of drinking water in some parts of the world in the very near future would occur.
- 11. Climate change has the potential to make living and livelihood impossible in some parts of the world in forthcoming years, causing larger numbers of refugees.
- 12. Possibility of extinction of many animal species.
- 13. Sea water is becoming more acidic.
- 14. The hills of Uttarakhand, Kashmir, North east India, and Darjeeling will become malaria prone in the next two decades (Source: Ministry of Environment, Government of India).

7.3 GREENHOUSE GASES

The 'Greenhouse Effect' is the process by which the absorption and emission of infrared radiation by gases in the atmosphere warm a planet's lower atmosphere and surface. The major Greenhouse gases are: water vapor, which causes about 36–70% of the Greenhouse effect; carbon dioxide which causes 9–26%; methane which causes 4–9%; and ozone which causes 3–7%. Human activity since the Industrial Revolution has increased the amount of Greenhouse gases in the atmosphere, leading to increased radiation from carbon dioxide, methane, troposphere ozone, chlorofluorocarbon (CFC) and nitrous oxide. The concentrations of carbon dioxide and methane have increased by 36% and 148% respectively since 1750. These levels are much higher than at any time during the last 800,000 years, the period for which reliable data has been extracted from ice cores. Less direct geological evidence indicates that carbon dioxide values higher than this were last seen about 20 million years ago.

Vulnerability of human societies to climate change mainly lies in the effects of extreme weather events rather than gradual climate change. Impacts of climate change so far include adverse effects on small islands, adverse effects on indigenous populations in high-latitude areas, and small but discernible effects on human health. Over the 21st century, climate change is likely to adversely affect hundreds of millions of people through increased coastal flooding, reductions in water supplies, increased malnutrition and increased health impacts.

7.4 RESPONSES TO CLIMATE CHANGE

MITIGATION

Reducing the extent of future climate change is called mitigation of climate change. The IPCC defines mitigation as "activities that reduce Greenhouse Gas (GHG) emissions,

or enhance the capacity of carbon sinks to absorb GHGs from the atmosphere". Many countries, both developing and developed, are aiming to use cleaner, less polluting technologies. Use of these technologies aids mitigation and could result in substantial reductions in carbon dioxide emissions. Policies include targets for emission reduction, increased use of renewable energy and increase in energy efficiency. Studies indicate substantial potential for future reduction in emissions.

ADAPTATION

Other policy responses include adaptation to climate change. Adaptation to climate change may be planned, e.g., by local or national government, or done privately without government intervention. The ability to adapt is closely linked to socio-economic development. Even societies with high capacities to adapt are still vulnerable to climate change. Planned adaptation is already occurring on a limited basis. The barriers, limits, and costs of future adaptation are not fully understood.

KYOTO PROTOCOL

The Kyoto Protocol is an international agreement setting targets for the industrialized nations to reduce Greenhouse gases. Although the protocol was agreed upon in 1997, it became a legally binding treaty on February 16 2005, after fulfilling the following two conditions:

- It had to be ratified by at least 55 countries.
- It had to be ratified by countries responsible for 55% of the combined emissions.

According to this treaty, the industrialized nations committed to reduce the combined emissions to 5% below the level of 1990, by the Year 2008 to 2012. The European Union countries were expected to reduce the combined emissions by 8%.

Chapter **8**

IMPACT OF DISASTERS

8.1 INTRODUCTION

Appropriate disaster response depends on the assessment of the impact that helps senior management of the private and public institutions to make informed choices. The possible immediate impacts of a disaster are:

Loss of Life

In the last two decades of the last century, more than half a million people were killed due to four natural disasters alone: floods, cyclones, earthquakes and droughts. Human loss is the most widely used indicator of the extent of a high impact disaster like flood, earthquake, *tsunami*, cyclone and civil war. This, however, reveals the tip of the iceberg of human suffering due to disaster: for every one person killed, 3,000 people are exposed to the hazards of natural disasters. In case of slow impact disasters like drought, HIV/AIDS, arsenic contamination in drinking water, loss of life alone cannot be the indicator of the extent of the impact: number of people affected and the geographical spread are the better indicators of impact.

LIVESTOCK LOSS

In case of a severe disaster, livestock losses can reduce the income and food security of people primarily dependent on livestock, for up to five years till stocks and herds are rebuilt. Disaster can threaten livestock in a given region in case of both slow and rapid onset of disaster. Persistent drought is possibly the most serious type of disaster: a serious drought in the Horn of Africa in 2000 caused death of more than 70% of livestock in some countries. In states, like Gujarat and western Rajasthan, in case of drought, the need of the poor cattle owner is not cash for work but fodder, which needs to be transported from a distance and hence this becomes beyond their capacity to access.

LOSS OF HABITATION

Loss of habitation is one of the major problems of the disaster-affected people after high onset disasters, like flood, cyclone, earthquake and *tsunami*. The Orissa Super Cyclone of October 26,2000 left no mud and thatch house standing along the coast from Astarang in Puri to Paradip port in Kendrapara district. The Gujarat earthquake of January 26,2001 fully damaged more than 100,000 houses in Kutch district alone. The Indian Ocean *tsunami* on December 26,2004 destroyed completely countless number of houses across the affected countries in Asia, including India. The Bihar flood of August 2008 destroyed more than 300,000 houses. The hurricane Katrina in USA left behind more than 40,000 completely damaged houses.

Figure 8.1 shows the extent of house damage in the Gujarat earthquake:

AGRICULTURAL LOSS

In 2007, agriculture accounted globally for employment to one-third of the total workforce of the world. In the same year, in India, agriculture contributed to almost 16.6% of the GDP and provided employment to 52% of the total workforce in the country. However, agriculture is heavily dependent on weather, climate, availability of water, distribution of the annual rainfall, and hence, is adversely affected by hydro meteorological disasters, in particular. As an example, in the Bihar flood of August 2008, 840,000 acres of standing crop was completely damaged. Before 2005, disaster relief and response in the country was the responsibility of the Department of Agriculture, Government of India. This was possibly because the impact of disasters was assessed by the loss of agriculture, apart from human loss.

LIVELIHOOD LOSS

It has been mentioned earlier that 52% of the total workforce of India is dependent on agricultural activities. Any serious disruption of agricultural practices due to disaster is bound to adversely impact the livelihood of the majority of the workforce in the country. All natural disasters, therefore, shrink the livelihood opportunity, moreso of the poor in the unorganized sector. For this reason, the think tank of the British Government





agency for International Development (DFID) in its development policy recognized the importance of looking for livelihood options for the poor, who are not dependent on the vagaries of weather. The author visited Gujarat four weeks after the 2002 riot. He observed how the riot had impacted the livelihood of the poor, both the Hindus and Muslims. Gujarat is famous for readymade garments. In this industry, which is decentralized and home based, there is a strong dependence on the poor from both the religions. As a result, immediately after the riot, there was a breakage of the conveyer process of making these garments, depriving the poor from both the communities of livelihood opportunities for months.

Additional Health Hazards and Malnutrition Particularly Among Under Fives

In the chaos that follows natural disasters, the risk of outbreak of communicable diseases is generally presumed to be very high. It has been observed globally, that the risk factor of epidemic is associated primarily with population displacement. The factors that influence the risk and consequently the deaths, are: availability of safe drinking water, sanitation facilities, the degree of crowding and the underlying health status of the displaced population like the nutritional status, level of immunity to vaccine-preventable diseases such as measles. The outbreak is less frequent in natural disasters than in the conflict affected population. Presence of a large number of dead bodies in the disaster affected areas may heighten the concern of outbreak of diseases. In spite of the absence of dead bodies due to natural disasters posing a risk for epidemic, the health officials and the media frequently exaggerate the threat. "When death is directly due to a natural disaster, human remains do not pose a risk of outbreak. Dead bodies only pose health risks in cases such as deaths from cholera and hemorrhagic fevers". (Source: John T. Watson, Michelle Gayer, Maire A. Connolly, Disease Control in Humanitarian Emergencies, Communicable Diseases Cluster, World Health Organization, Geneva).

The under-five nutrition is the best quantitative indicator of the well being or non – well being of a household. Figure 2.3 is a real-life example of the under-five nutrition of children in a closed tea garden after one year of the closure. This is also an example of how under-five nutrition can be quickly assessed using a simple method.

CONTAMINATION OF DRINKING WATER SOURCES

Lack of access to safe drinking water due to contamination caused by a disaster may lead to water-borne communicable diseases. This has been found most frequently in South Asian countries. The examples are: flooding in Bangladesh in 2004 led to an outbreak of cholera resulting in 17,000 cases; 16,000 cases of cholera epidemic in West Bengal in 1998 were attributed to preceding flood. In the waves of the floods in Orissa

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during July–August that affected the tribal areas of Koraput, Rayagada, Dasamantapur and Kalahandi districts, 184 deaths were reported by UNDP due to cholera epidemic. It has, however, been observed in recent years that people affected by a disaster know the importance of safe drinking water. After the Orissa Super Cyclone that ravaged the coastal areas of the Orissa State, there were no reported cases of the outbreak of any epidemic. It has been observed by the author that the agencies: both public and private, involved in the distribution of halogen tablets to disinfect drinking water, do not provide the necessary instructions about the use of these tablets. The tablets are given to the disaster affected people wrapped in paper. As a result, in no time, the chlorine coming in contact with air evaporates, thereby giving the disaster affected people a false sense of security.

A study was done by the Water and Sanitation Unit of Oxfam, Great Britain, after the 1998 flood in Bihar. It was observed by the team that the water of the tube-wells that were not completely submerged in the flood water had bacteria-free water, but the same water consumed by the people at home had 22 different types of bacteria. This was because of unhygienic storage and usage (Source: Author, who was in charge of the assessment of the response after the flood).

IMPACT ON CHILDREN: EDUCATION, SCHOOL DROP OUT

Children, especially the young, because of their physical, social and psychological characteristics, are less equipped to deal with the consequences of disasters. It was estimated by agencies working with a focus on children like Save the Children, that in the late 1990s, there were 66.5 million disaster-affected children globally. It was also apprehended that by the end of the first decade of the new millennium, this figure could rise up to 175 million. These figures are estimates without disaggregation by age, sex and other social contexts. In most circumstances, children are still grouped with women, thereby a real picture of vulnerability of children is often missing. But the impact of disaster persists on children well beyond the immediate phase, with long term negative impact on their well being.

In case when people are forced to live for a protracted period in relief camps or in a safe place away from their villages, the education of children gets seriously affected. In several places, the coping mechanism of the poor post disaster is to get children, mainly boys out of school and engage them in employment in the exploitative unorganized sector. Girls in their early teens are dropped out of school and are married off much before they attain the marriageable age.

Additional Burden On Women, Children, Aged And The Disabled

It is said that disasters work like magnifying glass: they magnify the ugly face of marginalization that a certain section of the society is subjected to. It is well known that

the 'real' disaster is often not the natural hazard itself, but the increased vulnerability of the poor and among them, the women, children, the aged and the disabled, who are the most vulnerable to a natural disaster. This is the reason why the distinction between natural and man-made is blurred. Women bear the brunt of any disaster because the gender-based inequalities interact with the social class, race, ethnicity, and age, putting them at high risk. Studies show that women, boys and girls are 14 times more likely to die in a disaster. As an example: in the devastating cyclone in Bangladesh in 1991, of the 140,000 dead, 90% were women. This pattern is seen all across the globe: an estimate suggests that two-third of all the displaced are women and children. Agencies involved in disaster management, both public and private, make the mistake of considering a village as a homogeneous unit, whereas even the smallest unit: a household is heterogeneous, composed of less equal women, children, elderly and the disabled. About 2% of the country's population is disabled and the country has more than 70 million aged, and 40% of them, according to Help Age India, live below the poverty line. After the Orissa Super Cyclone, the author heard horrifying experiences from the disabled survivors from the cyclone affected areas: how they were left to fend for themselves when others in the family were trying to save their lives.

ENVIRONMENTAL LOSS

Degradation of environment is both the cause and effect of a disaster. The biggest threat that the world is facing today, i.e., global warming, has been caused by changes in the environment. According to the News Release of June 2000 of the United Nations Environment Program, land degradation alone affected more than 1900 million hectares of land globally. The loss of potential productivity due to this was estimated to be equivalent to 20 million tons of grain every year. The problem of land degradation is most acute in Africa, where more than 65% of the region's agricultural land was found to be affected by soil erosion. But the problem is global.

LACK OF SAFETY AND SECURITY

In the parlance of disaster response, 'assistance' includes 'protection'. It has been observed in places where disaster affected people were forced to live in temporary shelters for long, the women suffer in the aspects of safety and security. In such a situation, the social norms tend to break down making women vulnerable. This was evident after the Latur earthquake, when people affected by it lived in temporary relief camps till their houses were rebuilt. A number of agencies including the Tata Institute of Social Science, Bombay had confirmed this. According to studies made by Swadhikar, an NGO working with tea garden laborers in the closed tea garden of Jalpaiguri district of West Bengal, more than 200 young girls were trafficked from Vernobari closed tea garden in a single year after closure.

8.2 ASSESSMENT OF DISASTER IMPACTS USING MODERN TECHNOLOGIES

There are unique sets of data now available with NASA that help estimate the number of people exposed to a particular disaster anywhere in the world. Within a short span in May 2008, two catastrophic natural disasters struck: the earthquake in the Sichuan Province of China; and, the cyclone Nargis in Myanmar. The international relief and development agencies, the UN and the media had the data needed to assess the number of people likely to be exposed to these disasters from NASA's Socio Economic Data and Application Center.

"The gridded population product we produce helps officials understand the density of the population in and around a disaster area," said Robert Chen, manager of NASA's Socioeconomic Data and Applications Center (SEDAC) and director of the Center for International Earth Science Information Network (CIESIN), part of the Earth Institute at Columbia University in New York. "The data set shows where people actually live in relationship to hazardous events." This data provided the valuable information that 25% of Myanmar's total population of 57 million resided in the coastal areas affected by the cyclone Nargis. To produce the gridded population data, two types of input data are collected: the state and local population for every country of the world and the Geographic Information System (GIS) on the boundaries of state provinces and countries. Integration of the population figure and the GIS data produces density estimates of any given area. This information is not only valuable to estimate the population affected by a disaster but also provides estimate of the aftermath like homelessness, the possible impact on health and sanitation, and drinking water.

Humanitarian aid should be provided based on the actual assessed needs of the people affected by a disaster and not by the perceived needs. However, the present approaches to humanitarian needs assessment often do not provide a coherent picture, particularly, in the initial phase when needs are evolving, and therefore they are unable to effectively inform the decision making processes for the most appropriate response at various stages after the disaster. Not only do these current practices often represent significant duplication of time, efforts and funds, they also provide a fragmented picture of need. This generally leads into running the risk of neglecting certain groups or / and leaving gaps in information that lead to an incomplete or ineffective response. The initial report from the assessment team visiting a disaster affected area should at least have the following:

- Severity of the disaster (without going into too much detail of the figures).
- Action already underway locally.
- The immediate priorities for external support.

- A forecast of possible future development including new risk.
- A time schedule of future reporting on the ground situations.

It is important at this juncture to understand the difference between data and information. Data are numbers, perception, facts or figures. Post disaster, too much data leads to an 'overload' situation. Information is the interpreted data which is meaningful, relevant and understandable by all and based on which, informed choices could be made.

Two examples of gaps in information that led to ineffective responses are:

- After the Bhuj earthquake in 2001, an International Relief and Development Organization (name withheld on purpose) mobilized from within its staff, a team of doctors and bought appliances to the tune of INR 2.5 million. But, by the time the team with the appliances reached Bhuj, there were no takers for this. The people who suffered injuries due to the quake, were already being treated in the nearby towns and in Mumbai.
- In a meeting with women in one of the villages of Bhuj, where the same organization provided immediate relief, the women told the review team that they were provided very good quality utensils for serving food. The more important needs of women at that point of time were cooking utensils instead. On further probing, the women told the review team that the staff from the organization spoke to men only in assessing the humanitarian needs (Source: Author who was a member of an International Lessons Learnt Review Team).

It has often been experienced that NGOs tend to prioritize the needs of the disaster affected people based on the organization's distinctive competence, e.g., an organization with distinctive competence on nutrition may identify this as the priority issue, which may be so, but many other equally important needs are neglected in the process.

It is therefore advised that after a major disaster, a multi disciplinary gender balanced team consisting of generalists and experts on food and nutrition, water, sanitation and hygiene (WATSAN / WASH is relatively a new lexicon in disaster management) and temporary shelter should make the needs assessment. It should be done even at the risk of losing critical time which could be justified by an appropriate response catering to the immediate needs of the communities affected by the disaster. However, the humanitarian needs assessment should be done as soon as feasible after a disaster. Though disaster affects everybody, but the poor and vulnerable are the worst affected. Hence special emphasis should be given to assess the needs of the women, children, the aged, women headed households the disabled and the people living with HIV/AIDS (PLWH/A).

There are essentially two types of people affected by any disaster: one who reach the relief providers on their arrival; the others whom the relief providers have to reach.

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The second category of people is generally the more vulnerable, less privileged, the 'excluded communities'. They consist of women headed households, households with PLWH/A, the aged and other 'social misfits' like substance users.

After the Orissa Super Cyclone, the Voluntary Health Association of India assessment team could reach a fishing village in Astarang block within a week after the disaster. This village was very close to the sea. The village could be reached wading through waist deep water with dead animals still floating. This village lost 12 people and the loss could have been higher: a school building saved many lives. Both formal and informal needs assessment techniques were used. A fisherman told in an informal dialogue with the author, "If you want to help us, give us a boat, a net and a tarpaulin sheet to protect our children and women from rain, sun and the morning dew. Mother sea is waiting for us. Your presence after this would no longer be necessary". No words can express the resilience shown by the poor communities. Incidentally, this was the starting point of VHAI taking up a recovery program among the fishing communities (Source: Author while making needs assessment after the Orissa Super Cyclone).

In the long term, disasters impact distinctly, the following:

- Economic sector,
- Social sector, and
- Health sector.

The *economic losses* associated with disasters have been described in the earlier chapters. It is worth reiterating that between 1991 and 2000, the total amount of disaster damage in Asia has been 400641.8 million USD, which is 51% of the total global loss. In India, 2% of the Gross Domestic Product has been eroded by disasters, according to UNDP. This is a staggeringly high amount of money, and therefore, ways have to be found to reduce the impact of disasters. Poor people get more entangled in the vicious cycle of poverty due to disasters and if they are exposed to recurrent disasters, their well being drops substantially after each disaster.

The *social losses* due to disasters are very difficult to fully assess because disasters have a long-term impact on the poor people. The worst sufferers in the social sector due to disasters are women and children. Experts have estimated that two-third of the world's internally and externally displaced people due to all types of disasters are women and children. Form the experience of development and humanitarian response workers, serious concerns have been expressed on the safety and security of women, when people affected by disasters are forced to live over a protracted period in temporary shelter, the social norms tend to break down making women vulnerable to sexual abuse, making them prone to sexually transmitted diseases like HIV. It is quite possible, moreso in poor households, that school going children are dropped out of schools and are made to work in the extremely exploitative unorganized sector. The migration of able bodied men in search of livelihood puts additional pressure on women to fend for themselves, the children and the old. The migrated men often return with sexual diseases and transmit those to their spouses without their knowledge. It is also apprehended that human trafficking may show a considerable increase due to disasters, more so if the population affected by it is already very poor and marginalized. Increased indebtedness, particularly of the poor, makes them more vulnerable. According to the Ganga Bhangan Protirodh Nagarik Action Committee, an NGO working with the issue of soil erosion by Ganga in the Malda district, the marriage age of girls has considerably decreased among the erosion affected population. Studies by the National Institute of Mental Health and Neuroscience (NIMHANS), Bangalore and others have shown an increase in alcoholism, divorces and suicide following major disasters¹¹. This by no means is an exhaustive list. There may be many other forms of social impact due to disasters.

The impact on health sector due to disaster has not so far received the attention that it deserves. Immediately after a disaster, the people affected by it are prone to both water and vector borne diseases. According to studies by Oxfam and other international relief and development organizations, globally 25 to 30% morbidity and mortality due to disasters is caused by diarrheal disease. However, in the last 10 years in India, the deaths due to water borne diseases after severe disasters like the Orissa Super Cyclone or floods in Bihar have been few. The flash flood of 1996 in Rajasthan killed 100 people but subsequently 1,000 people were killed by malaria. Rajasthan is not traditionally a malaria endemic area. People became prone to it when the malarial parasites grew in the water. This took both the government and the civil societies in the state by surprise. From the Indian perspective, it has been the experience of development and relief workers that disasters like floods and cyclones do not create additional health problems: it is the existing health problems that get magnified due to disaster. However, it is difficult to predict how many generations would suffer from the leakage of methyl isocyanate in Bhopal.

Chapter **9**

HUMAN RIGHTS IN DISASTER MANAGEMENT

Prime minister Manmohan Singh inaugurated the first India Disaster Management Congress two years after the 2004 *tsunami*, which was also attended by the United Progressive Alliance chairperson Sonia Gandhi. This is a testimony of the seriousness the present government in the country provides to disaster management. Subsequent to the 2004 *tsunami*, the world witnessed disasters, like the hurricane Katrina in the United States and the earthquakes in Pakistan and India. In all these disasters, there has been an underlying need for ensuring human security in disaster management through the protection of human rights and promotion of good governance.

Promotion of rights-based approaches to disaster management adds a new and important dimension to the existing studies relating to preparedness, relief and rehabilitation, and mitigation. A report prepared by the representative of the UN Secretary General on the Human Rights of Internally Displaced Persons after the 2004 *tsunami* noted that there was a lack of attention to human rights protection and that effective measures must be taken to address issues such as discrimination based on class, caste, ethnicity, gender, age and disability. The focus on rights-based approaches to disaster management is to ensure that an effective step for disaster management is no longer a discretionary initiative that may or may not be taken by the government; it is the right of the people affected by disaster to receive support from the government. Therefore, disaster management is the mandatory responsibility of governments.

The human rights framework ensures that efforts are constantly evaluated and made accountable to people affected by disasters and to the international community that financially supports disaster management throughout the disaster management cycle. Accountability becomes a core component in the rights-based approach. There is a need for transferring this framework into policies relating to disaster management. Another important aspect of the rights-based approach is to define human rights goals relating to disasters and disaster management policies, by providing timelines, indicators, and measurements to monitor the progress towards disaster preparedness, as well as dealing with potential violations of specific human rights.

Transparency in governance and accountability in the distribution of aid in disaster affected communities is vitally important for the protection of human rights. Transparency International, a well-known international agency monitoring transparency and accountability of countries throughout the world has noted, "corruption in the delivery of aid undermines the very spirit of humanitarian action". Disasters do not differentiate between men and women, but the consequences of disasters create different levels of vulnerability among men and women. For example, the Asia Pacific Forum on Women, Law and Development, in a report, noted many instances of human rights violations such as rape and other forms of sexual abuse against women in the aftermath of the 2004 *tsunami* in particular. There is a clear need for recognizing the human rights of women within the broader human rights disaster management interface. This is due to the vulnerability of women during disasters and post-disaster rebuilding.

Caste-based discrimination while distributing aid as well as implementing rehabilitation programs has been reported from many parts of the country after a disaster. The 2004 *tsunami* further exposed the deep-rooted historical divisions in society rendering the marginalized people more vulnerable even when the legal and constitutional framework in India prohibits such acts of discrimination. Large disasters pose significant challenges to governance; it is not always possible for governments in such situations to ensure rights based disaster response, since the primary priority of the state becomes addressing the aftermath of the disaster. There is a need for active participation by non-governmental organizations and the wider civil society with the state machineries.

The international relief and development organizations have developed after years of consultation among them, a minimum standard for disaster response: the *Sphere*; and framed a *humanitarian charter* in disaster management for ensuring transparency and accountability apart from the fact that all disaster affected people have the right to receive these minimum entitlements.

9.1 SPHERE STANDARD

An initiative was launched in 1997 by a large group of development and humanitarian relief organizations, key civil society actors and the Red Cross and Red Crescent movement. They together framed a *'humanitarian charter'* and defined the *'minimum*

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standard' to be attained in disaster assistance in each of the five key sectors: water supply and sanitation, nutrition, food aid, shelter, and health services. They not only framed it but also made a commitment to adhere to it while responding to any form of disaster. This process led to the publication of the first *Sphere Handbook* in 2000. It was developed in response to a growing concern of the issue of accountability and effective networking of relief and development agencies globally in disaster assistance. They also agreed on a humanitarian charter to be followed in disaster responses. Taken together, the humanitarian charter and the minimum standard contribute to an operational framework for accountability in disaster assistance.

"Sphere is based on two core beliefs: first, that all possible steps should be taken to alleviate human suffering arising out of calamity and conflict; and second, that those affected by disaster have a right to life with dignity, and therefore, right to assistance. Sphere is composed of three things: a hand book, a broad process of collaboration and an expression of commitment to quality and accountability."¹⁰

What is the Code of Conduct?¹¹

- The humanitarian imperative comes first.
- Aid is given regardless of the race, creed or the nationality of the recipients and without adverse distinction of any kind. Aid priorities are calculated on the basis of need alone.
- Aid will not be used to further a particular political or religious standpoint.
- We shall endeavor not to act as an instrument of the government foreign policy.
- We shall respect culture and custom.
- We shall attempt to build disaster response on local capabilities.
- Ways shall be found to involve program beneficiaries in the management of relief aid.
- Relief must strive to reduce the future vulnerabilities in disasters as well as meeting the basic needs.
- We hold ourselves accountable to those we seek to assist and those from whom we accept resources.
- In our information, publicity, and advertising activities, we shall recognize disaster victims as dignified humans and not hopeless objects.

This code of conduct is based on a core value that disaster affected people, however vulnerable they may be, have the potential capacity to come out of the adverse impact associated with a natural disaster and hence they should not be treated as passive recipient of doles, instead should be treated as active members in disaster management. It has, however, been observed in case of high impact disasters in particular that the code of conduct is easier to express but difficult to practice by the international relief and development organizations. After the Orissa Super Cyclone, a representative of an international donor agency (name withheld for obvious reason) was very annoved with the farmers of the coastal areas affected severely by the cyclone. He made all arrangements for tilling of field for the major agriculture, the monsoon crop. But, this coincided with the biggest festival of coastal Orissa, the Rajo. This festival lasts for three days, mostly around 13th/ 14th/ 15th June every year. The word 'Rajo' has a Sanskrit origin meaning 'menstruation'. It is believed by people that the mother earth has her menstruation during this period. The farmers, because of this, give a complete rest to the land. During this period, farmers do not even walk on their land with shoes on, let alone preparing the land for the next crop. The people of the coastal areas of Orissa, which had borne the brunt of the cyclone, observed this after the cyclone like any other year. Anyone with some knowledge of the Orissa culture and tradition would have kept this in mind while planning the disaster response. Similarly, another international agency, internationally acclaimed as a relief and development agency (name withheld purposely), brought in large number of non-local people contradicting "building disaster response on local capabilities" as agreed in the code of conduct. The word 'beneficiary' has a connotation of a donor and a recipient (passive) and hence, should be replaced by a word with essence of participation of people affected by a disaster (Source: Author, from his experience of Orissa Super Cyclone in 1999).

THE SPHERE MINIMUM STANDARD

The 'Sphere Minimum Standard' to be attained in disaster assistance in each of the five key sectors; water supply and sanitation, nutrition, food aid, shelter and health services, is a 344 page document available in the internet. The overriding principle of identifying these key sectors is: people affected by any disaster have the right to live in dignity and hence it is their right to have access to these key sectors. What is important about the Sphere is that it is not limited to the standard alone; equally important has been the process that led to a large number of international donors coming together to debate and agree to a minimum standard in disaster assistance. The key standards are:

- 1. Water: 7.5 to 15 liters per day per person depending on the climate, the type of food people cook, and the sanitary habits.
- 2. Toilet: A minimum of one toilet per 20 people and toilets should be not more than 50 meters away from where people live.
- 3. Nutrition: 2,100 kcal per person per day of which 10 to 12% of the total energy should constitute of protein and 17% of fat.

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4. Shelter: Initial covered floor area of a constructed temporary shelter should be at least 3.5 m² per person.

These are just some of the salient features of Sphere Minimum Standard. It is advised that aid workers go through this document fully and aid organizations must take steps to conduct training of its staff on the Sphere. The challenge, however, is to make disasteraffected people aware of the principles and the standards. It is worth reiterating that the Sphere standard comes from the core value that all disaster affected people have the right to be supported and this assistance is governed by a minimum standard. The National Disaster Management Authority of India under the chairpersonship of the Prime Minister of India is soon coming up with a minimum standard, which will be to be applicable to disaster response by the Government of India.

Chapter **10**

Disaster And Government's Response

10.1 HIGH POWERED COMMITTEE ON DISASTER MANAGEMENT IN INDIA

A High Powered Committee (HPC) under the chairmanship of Shri J.C. Pant, former Secretary to the Government of India, had been constituted by the Department of Agriculture and Cooperation on August 20,1999, to review existing arrangements for preparedness and mitigation of natural disasters, recommend measures for strengthening organizational structures and to formulate a comprehensive plan for natural disaster management at the national, state and district levels. It was decided, with the approval of the prime minister, to enlarge the terms of reference of the High Powered Committee to include both natural as well as man-caused disasters. It was further decided to include representatives from concerned ministries dealing with industrial, nuclear, biological and chemical disasters in the committee. (The author was a special invitee in two meetings sharing grassroot experience). This paved the way for the Government of India to enact the Disaster Management Act, 2005. Till 2003, disaster response used to be the responsibility of the Agriculture Ministry, Department of Agriculture and Cooperation, Government of India. This might have been because natural disasters affect agriculture most. However, since then, the responsibility of disaster response has been shifted to the Ministry of Home Affairs. As per the recommendations of the High Powered Committee, National Disaster Management Authority (NDMA) has been set up under the chairpersonship of the Prime Minister of India for effective disaster management in the country.

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According to the terms of reference of the order of August 20 1999, the mandate of the HPC was:

- To review existing arrangements for preparedness and mitigation of natural and manmade disasters, including industrial, nuclear, biological and chemical disasters.
- Recommend measures for strengthening organizational structures.
- Recommend a comprehensive model plan far management of the disasters at national, state and district levels.

The following were the members of the HPC:

- 1. Shri J. C. Pant, Ex-Secretary to the Government of India.
- 2. Shri SB. Jain, Secretary (Security), Cabinet Secretariat.
- 3. Shri Bhagat Singh, Additional Secretary and Central Relief Commissioner.
- 4. Shri P.R. Kelkar, Director General, Indian Meteorological Department.
- 5. Shri V.C. Thakur, Director, Wadia Institute of Himalayan Geology.
- 6. Prof. A.S. Arya, Professor Emeritus, University of Roorkee.
- 7. Shri Ramesh Chandra, Former Chairman, Central Water Commission.
- 8. Shri N. Vinod Menon, Professor, Disaster Management Yashwant Rao Chavan Academy of Development Administration.
- 9. Dr. V. K. Sharma, Professor, National Center for Disaster Management, Indian Institute of Public Administration.
- 10. Shri C.K. Dass, Secretary, Department of Relief & Rehabilitation, Government of Assam.
- 11. Shri Avdesh Sinha, Secretary, Revenue and Forest Department, Government of Maharashtra.
- 12. Shri G.C. Pathak, Relief Commissioner, Government of Uttar Pradesh.
- 13. Shri R.M. Premkumar, Additional Secretary, Department of Atomic Energy.
- 14. Shri V. Rajagopalan, Joint Secretary, Ministry of Environment & Forest.
- 15. Shri B.S. Lalli, Joint Secretary, Ministry of Defence.
- 16. Shri Sanat Kaul, Joint Secretary, Ministry of Civil Aviation, Rajiv Gandhi Bhavan, New Delhi.
- 17. Shri M.K. Shukla, Director General, Civil Defence.
- 18. Dr. Ira Ray, Additional DG, Directorate General of Health Services.
- 19. Shri Indra Ghosh, Executive Director(Safety), Railway Board, New Delhi.

- 20. Shri N.S.Samant, Deputy Secretary, Deptt. of Chemicals & Petrochemicals.
- 21. Shri Anil Sinha, Joint Secretary (NDM) and Addl. Central Relief Commissioner.
- 22. Shri K.K. Venkatachary, Study Director, Disaster Management Systems, ISRO Headquarters, Bangalore.

The High Powered Committee identified 31 types of disasters brought under 5 broad headings as:

1. Water and Climate Related Disasters

- a. Floods and drainage management
- b. Cyclones
- c. Tornadoes and hurricanes
- d. Hailstorms
- e. Cloud bursts
- f. Heat and cold waves
- g. Snow avalanches
- h. Droughts
- i. Sea erosions
- j. Thunder and lightning

2. Geological Disasters

- a. Landslides and Mudflows
- b. Earthquakes
- c. Dam failures / dam bursts
- d. Mine fires
- 3. Chemical, Industrial and Nuclear Related Disasters
 - a. Chemical and industrial disasters
 - b. Nuclear disasters

4. Accident Related Disasters

- a. Forest fires
- b. Urban fires
- c. Mine flooding
- d. Oil spills

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- e. Major building collapses
- f. Serial bomb blasts
- g. Festival related disasters
- h. Electrical disasters and fire
- i. Air, road and rail accidents
- j. Boat capsizing
- k. Village fires
- 5. Biological Disasters
 - a. Pest attacks
 - b. Cattle epidemics
 - c. Food poisoning

10.2 DISASTER MANAGEMENT ACT 2005

The Disaster Management Act 2005 defines disaster as: "a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence, which results in substantial loss of life or human suffering or damage to, destruction of property, or damage to, or degradation of environment, and of such a nature or magnitude as to be beyond the coping mechanism of the community of the affected area". This definition also puts people at the center and recognizes that communities likely to be affected by a disaster have certain coping mechanism in place. The Disaster Management Act 2005 is applicable to the whole country. According to this Act:

Disaster Management is "a continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary or expedient for:

- Prevention of danger or threat of any disaster;
- Mitigation or reduction of risk of any disaster or its severity or consequences;
- Capacity building;
- Preparedness to deal with any disaster;
- Prompt response to any threatening disaster situation or disaster;
- Assessing the severity or magnitude of effects of any disaster;
- Evacuation, rescue and relief;
- Rehabilitation and reconstruction" (Source: The Disaster Management Act 2005).
DISASTER MANAGEMENT ACT 2005 (AS PASSED BY THE HOUSES OF PARLIAMENT)

Purpose: To provide for the effective management of disasters in the country. The Act extends to the entire India and is applicable from December 26, 2005. There are 13 chapters in the Act and the full text is available on the internet.

CHAPTER I

It deals with the definitions of terminologies used in the Act like:

- "Central Government" means the Ministry or Department of the Government of India having administrative control of disaster management.
- Disaster means, "catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence, which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area".
- "Disaster Management" means a continuous and integrated process of planning, organizing, coordinating and implementing measures which are necessary. This consists of the following steps: prevention of danger or threat of any disaster; mitigation or reduction of risk of any disaster or its severity or consequences; capacity building; preparedness to deal with any disaster; prompt response to any threatening disaster situation or disaster; assessing the severity or magnitude of effects of any disaster; evacuation, rescue and relief; rehabilitation and reconstruction.

CHAPTER II

This chapter deals with the National Disaster Management Authority (NDMA), which was established for the purpose of this Act. The chairperson of the NDMA is the Prime Minister, *ex officio* and there are not more than 9 members. It will meet as and when necessary. In the absence of the Prime Minister, the vice chairperson will preside over the meeting. According to the provisions of this Act, the national authority shall have the responsibility for laying down the policies, plans and guidelines for disaster management for ensuring timely and effective response to disaster. The national authority will have the responsibilities to:

- 1. Lay down policies on disaster management.
- 2. Approve the national plan of disaster management.

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- 3. Approve plans prepared by the ministries or departments of the Government of India, in accordance with the national plan.
- 4. Lay down guidelines to be followed by the state authorities in drawing up the state plan.
- 5. Lay down guidelines to be followed by the different ministries or departments of the Government of India for the purpose of integrating the measures for prevention of disaster or the mitigation of its effects in their development plans and projects.
- 6. Coordinate the enforcement and implementation of the policy and plan for disaster management.
- 7. Recommend provision of funds for the purpose of mitigation.
- 8. Provide such support to other countries affected by major disasters as may be determined by the central government.
- 9. Take such other measures for the prevention of disaster, or the mitigation, or preparedness and capacity building for dealing with the threatening disaster situation or disaster as it may consider necessary.
- 10. Lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management.
- 11. The national committee will provide a guideline of minimum standard in disaster response to be followed by all states and union territories.

The national committee has constituted an advisory committee consisting of experts in the field with practical experience of disaster management to make recommendations on the various aspects of disaster management.

The central government has constituted a National Executive Committee to assist the national authority in performing its functions. The National Executive Committee consists of the following members:

- (a) The Secretary to the Government of India in charge of the ministry or department of the central government having administrative control of the disaster management, who shall be Chairperson, *ex officio*.
- (b) The Secretaries to the Government of India in the ministries or departments having administrative control of the agriculture, atomic energy, defense, drinking water supply, environment and forests, finance (expenditure), health, power, rural development, science and technology, space, telecommunication, urban development, water resources and the Chief of the Integrated Defense Staff, *ex officio*.

The National Executive Committee will:

- 1. Act as the coordinating and monitoring body for disaster management.
- 2. Prepare the national plan to be approved by the national authority.
- 3. Coordinate and monitor the implementation of the national policy.
- 4. Lay down guidelines for preparing disaster management plans by different ministries or departments of the Government of India and the state authorities.
- 5. Provide necessary technical assistance to the state governments and the state authorities for preparing their disaster management plans in accordance with the guidelines laid down by the national authority.
- 6. Monitor the implementation of the national plan and the plans prepared by the ministries or departments of the Government of India.
- 7. Monitor the implementation of the guidelines laid down by the national authority for the integration of measures for prevention of disasters and mitigation by the ministries or departments in their development plans and projects.
- 8. Monitor, coordinate and give directions regarding the mitigation and preparedness measures to be taken by different ministries or departments and agencies of the government.
- 9. Evaluate the preparedness at all governmental levels for the purpose of responding to any threatening disaster situation or disaster and give directions, where necessary, for enhancing such preparedness.
- 10 Plan and coordinate specialized training programs for disaster management for different levels of officers, employees and voluntary rescue workers.
- 11. Coordinate the response in the event of any threatening disaster situation or disaster.
- 12. Lay down guidelines for, or give directions to, the concerned ministries or departments of the Government of India, the state governments and the state authorities regarding measures to be taken by them in response to any threatening disaster situation or disaster.
- 13. Require any department or agency of the government to make available to the national authority or state authorities, such men or material resources as are available with it for the purposes of emergency response, rescue and relief.
- 14. Advise, assist and coordinate the activities of the ministries or departments of the Government of India, state authorities, statutory bodies, other governmental or non-governmental organizations and others engaged in disaster management.

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- 15. Provide necessary technical assistance or give advice to the state authorities and district authorities for carrying out their functions under this Act.
- 16. Promote general education and awareness in relation to disaster management.
- 17. Perform such other functions as the national authority may require.

CHAPTER III

STATE DISASTER MANAGEMENT AUTHORITIES

All states have State Disaster Management Authority (SDMA) under the chairpersonship of the Chief Minister and have members, not exceeding 9. The members of the SDMA:

- 1. The Chief Minister of the state as the chairperson.
- 2. Other members, not exceeding 8, are nominated by the chairperson.

The chairperson of the State Executive Committee shall be the Chief Executive Officer of the state authority. In the case of a union territory having Legislative Assembly, except the Union Territory of Delhi, the Chief Minister shall be the chairperson of the authority and in case of other union territories, the lieutenant governor or the administrator shall be the chairperson of that authority. The lieutenant governor of the Union Territory of Delhi shall be the chairperson and the chief minister shall be the vice-chairperson of the state authority.

A state authority may, as and when it considers necessary, constitute an advisory committee, consisting of experts in the field of disaster management and having practical experience of disaster management to make recommendations on different aspects of disaster management.

Responsibilities of the state authority are:

- 1. Develop the state disaster management policy.
- 2. Approve the state plan in accordance with the guidelines laid down by the national authority.
- 3. Approve the disaster management plans prepared by the departments of the government of the state.
- 4. Develop guidelines to be followed by the departments of the government of the state for the purposes of integration of measures for prevention of disasters and mitigation in their development plans and projects and provide necessary technical assistance.
- 5. Coordinate the implementation of the state plan.
- 6. Recommend provision of funds for mitigation and preparedness measures.

- 7. Review the development plans of the different departments of the state and ensure that prevention and mitigation measures are integrated in all plans and programs.
- 8. Review the measures being taken for mitigation, capacity building and preparedness by the departments of the government of the state and issue such guidelines as may be necessary.
- 9. Lay down guidelines for minimum standard in relief as recommended by the national authority.

The state authority must have a State Executive Committee with the following members:

- 1. The Chief Secretary to the state government will be the chairperson.
- 2. Four Secretaries to the government of the state of such departments as deemed fit by the state government.

The State Executive Committee has the responsibility for implementing the national plan and state plan and act as the coordinating and monitoring body for management of disaster in the state.

The State Executive Committee will perform the tasks as that of the National Executive Committee described earlier.

The State Executive Committee prepares a State Disaster Management Plan based on the guidelines prepared by the national authority, and after discussion with the district authorities, the peoples' representatives and the local bodies. This plan, once approved by the State Disaster Authority becomes the state plan. This plan must have the following:

- 1. The mapping of geographical vulnerability of different parts of the state to different forms of disasters.
- 2. Listing of measures to be adopted for the prevention and mitigation of disasters.
- 3. The way how the mitigation measures would be integrated with the development plans and programs of the various departments.
- 4. The plan for capacity building and preparedness initiatives.
- 5. The assignment of roles and responsibilities of different departments of the government in case of a disaster or in disaster like situations (in other words, how the government departments become proactive from being reactive in disaster management).
- 6. Updating and reviewing the state plan annually.

The state government will ensure required finances for implementing the state plans and take the responsibility of sharing the state plan with appropriate departments for them to develop their disaster management plans in line with the state plan.

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In case of a disaster, the State Disaster Management Authority directs the concerned department of the state, district authority or other authority to take appropriate steps for rescue, evacuation and provision of immediate relief to save human and cattle lives. The state shall make a department or an individual responsible for controlling the resources for relief, rescue and immediate relief. The state will coordinate with non-government organizations to ensure that their efforts are used in an equitable and non-discretionary manner.

CHAPTER IV

DISTRICT DISASTER MANAGEMENT AUTHORITY

Every state government shall establish a District Disaster Management Authority for every district. The District Disaster Authority shall consist of a chairperson and the number of members shall not exceed 7. The composition of the district authority shall be as follows:

- 1. The district magistrate, the collector, the district commissioner, as the case may be, shall be the chairperson.
- 2. The elected representative of the Panchayat shall be the co-chairperson. In case of tribal areas, as referred in the Sixth Schedule of the Constitution, the chief executive member of the district council of autonomous district, shall be the co-chairperson.
- 3. The designated officer in the rank of additional district magistrate, commissioner or collector, as the case may be, shall be the chief executive officer of the district authority.
- 4. The superintendent of police.
- 5. The chief medical officer of the district.
- 6. Two other persons nominated by the district.

The district authority shall act as the district planning, coordinating and implementing body for disaster management and take all measures for the purposes of disaster management in the district in accordance with the guidelines laid down by the national and state authorities.

The district authority shall perform the following activities:

- 1. Prepare a disaster management plan including a district response plan for the district.
- 2. Coordinate and monitor the implementation of the national and state policies, national, state and district plans.

- 3. Ensure that the areas in the district vulnerable to disasters are identified and measures for the prevention of disasters and the mitigation of its effects are undertaken by the departments of the government at the district level as well as by the local authorities.
- 4. Ensure that the guidelines for prevention of disasters, mitigation of its effects, preparedness and response measures as laid down by the national authority and the state authority are followed by all departments of the government at the district level and also by the local authorities in the district.
- 5. Give directions to different authorities at the district level and local authorities to take such other measures for the prevention or mitigation of disasters .
- 6. Develop guidelines for disaster management plans for prevention of disasters by the departments of the government at the districts level and by local authorities in the district.
- 7. Monitor the implementation of disaster management plans prepared by the departments of the government at the district level.
- 8. Finalize the guidelines for the departments of the government at the district level for purposes of integration of measures for prevention of disasters and mitigation in their development plans and projects and provide necessary technical assistance.
- 9. Monitor the implementation of measures.
- 10. Review the state of capabilities for responding to any disaster situation in the district and give directions to the relevant departments or authorities at the district level for the up-gradation of their skills.
- 11. Review the preparedness measures and give directions to the concerned departments at the district level or other concerned authorities.
- 12. Organize and coordinate specialized training programs for different levels of officers, employees and voluntary rescue workers in the district.
- 13. Facilitate community training and awareness programs for the prevention of disaster or mitigation with the support of local authorities, governmental and non-governmental organizations.
- 14. Set up, maintain, review and upgrade the mechanism for early warnings and dissemination of proper information to public.
- 15. Prepare, review and update district level response plan and guidelines.
- 16. Coordinate response to any threatening disaster situation or disaster.

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- 17. Ensure that the departments of the government at the district level and the local authorities prepare their response plans in accordance with the district response plan.
- 18. Lay down guidelines for, or give direction to, the concerned department of the government at the district level or any other authorities within the local limits of the district to take measures to respond effectively to any disaster.
- 19. Advise, assist and coordinate the activities of the departments of the government at the district level, statutory bodies and other governmental and NGOs in the district engaged in the disaster management.
- 20. Oversee the construction in any part of the district to ensure that the standards for prevention and mitigation recommended are strictly adhered to. If not, direct the concerned authority for compliance of the standards.
- 21. Identify buildings and places that could be used as relief camps in case of a disaster, and make arrangements for drinking water and toilets.
- 22. Preposition the relief and rescue materials in the district or ensure that such materials are ready to access in a short notice in case of a disaster.
- 23. Communicate regularly with the state authority for providing updates on various aspects of disaster management.
- 24. Encourage grassroot level civil society organizations for their involvement in disaster management.
- 25. Ensure that disaster management drills are carried out periodically.

Every district will have a disaster management plan in line with the national and state plans. This plan will be approved by the state authority. The district disaster plan must include all the facets of disaster management as in the state plan.

CHAPTER V

This chapter deals with the details of the measures by the Government of India for disaster management. Subject to the provision of the Act, the central government shall take all measures deemed necessary for the purpose of disaster management in the country.

CHAPTER VI

LOCAL AUTHORITIES

Subject to the directions of the district authority, a local authority shall:

- 1. Ensure that its officers and employees are trained for disaster management.
- 2. Make plans of utilizing the resources at its disposal for disaster management in

a way that the resources are readily available in case of a disaster.

- 3. Ensure that all construction projects within its jurisdiction conform to the standard and specification as laid down by the national, state and district authorities.
- 4. Carry out relief, rehabilitation and reconstruction activities in the disaster affected areas in accordance with state and district plans.

CHAPTER VII

NATIONAL INSTITUTE OF DISASTER MANAGEMENT (NIDM)

The central government shall constitute an institute called the National Institute of Disaster Management and prescribe the number of members for NIDM. There shall be a governing body of NIDM constituted by the central government from among the existing members of the NIDM. Subject to the provision of this Act, NIDM shall function within the broad policies and guidelines laid down by the national authority and be responsible for planning and promoting research in the area of disaster management, documentation and development of national level data based on all aspects of disaster management. The NIDM shall:

- 1. Formulate and implement a comprehensive human resource development plan covering all aspects of disaster management.
- 2. Provide assistance to the training and research institutes, including the state training institutes, for research programs and training of all stakeholders including the peoples' representatives, the civil society, the corporate sector and government functionaries.
- 3. Provide necessary support to the state training institutes and the state disaster authority for the formulation of state strategies and policies on disaster management.
- 4. Develop educational materials on disaster management for academic and professional courses.
- 5. Promote awareness among stakeholders including college or school students, teachers of these institutions, technical personnel and others who could be involved in multi-hazard mitigation, preparedness and response.
- 6. Undertake, organize and facilitate study courses, conferences, lectures and seminars within and outside the country to promote disaster management.

CHAPTER VIII

NATIONAL DISASTER RESPONSE FORCE

There shall be a National Disaster Response Force constituted for the purpose of specialist response to a threatening disaster situation or disaster. The general superintendence,

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direction and control of the force shall be vested and exercised by the national authority and the command and supervision of the force shall vest in an officer to be appointed by the central government as the Director General of the NDRF.

CHAPTER IX

FINANCE, ACCOUNTS AND AUDIT

The central government shall constitute a fund, to be called the National Disaster Response Fund, for meeting any disaster. Contribution to this fund of the central government, after due appropriation made by the parliament may be augmented by an individual or institution. The National Disaster Fund shall be made available to the National Executive Committee for emergency response, relief and rehabilitation in accordance with the guidelines of the central government.

The state government shall constitute the State Disaster Response Fund and the State Disaster Mitigation Fund. Similarly, the district authorities establish for the purposes of this Act, create the District Response Fund and the District Mitigation Fund.

The state government shall ensure that the funds established are available to the state authority. This fund shall be made available to the State Executive Committee to be used for the purpose for which such funds have been created. Similarly, the state government shall create funds for all the districts of the state to be made available to the District Executive Committee.

CHAPTER X

OFFENCES AND PENALTIES

Any officer of the central government or the state government or a person authorized by the national, state or district authorities, who without reasonable cause, obstructs or refuses to comply with the direction given by the state, district authorities, on conviction, shall be punishable with imprisonment for a term which may extend to one year or with fine, or both. If such obstruction or refusal to comply with the directions results in loss of lives, the concerned person shall on conviction be punishable with imprisonment for a term that may extend for two years. Anyone with full knowledge makes a claim which s/he knows to be false for obtaining any relief material, assistance, repair, reconstruction or other benefits consequent to a disaster from any officer of the national, state or district authority shall, on conviction, be punished with imprisonment extending to two years and with fine. Anyone entrusted with money, materials and both meant for providing relief after a disaster misappropriates these, shall on conviction, be punished with imprisonment for two years and with fine. Anyone making or circulating a false alarm or warning about an impending disaster or its severity or magnitude that leads to panic shall, on conviction, be punished with imprisonment that may extend to one year or with fine. If an offence under this Act has been committed by any

government department, the head of the department shall be deemed guilty of the offence and hence shall be liable to be proceeded against and punished accordingly. Under this Act, any officer assigned duty, refuses to perform or withdraws without the written permission from the superior to do so, is liable to be punished for one year. No prosecution for punishable offences shall be instituted except with the previous sanction of the central government or the state government, as the case may be, or of any officer authorized in this regard, by general or special order, by such government. No court shall take cognizance of an offence under this Act except on a complaint made by the national authority, the state authority, the central government, the state government, the district authority or any other authority or officer authorized in this regard by the respective authority or government, as the case may be.

CHAPTER XI

MISCELLANEOUS

This chapter deals with various bureaucratic measures that may have to be taken to speed up the appropriate disaster management by disaster authorities at all levels in case of any disaster. It pronounces at the beginning that people affected by a disaster have the right to receive support without any decimation based on their gender, caste, community, descent or religious identities.

Bill No. LV-F of 2005 THE DISASTER MANAGEMENT BILL, 2005 (AS PASSED BY THE HOUSES OF PARLIAMENT — RAJYA SABHA ON NOVEMBER 28 2005, LOK SABHA ON DECEMBER 12 2005) ASSENTED TO ON DECEMBER 23 2005 ACT NO. 53 OF 2005

The High Powered Committee (HPC) suggested that in the preparation of the state, district and lower levels, the focus should be towards facilitating the administrative units to prepare their own area specific plans incorporating local characteristics. The HPC also suggested that these units of planning should have a component of providing help to the corresponding neighboring units in case of a disaster.

The planning process should follow a decentralized bottom-up approach; in other words, the assimilation of the smallest unit plans should become the basis for the district plans and similarly the districts plans are the basis for the state plans. To have parity across the various state plans, all plans follow a set of guidelines provided by the National Disaster Management Authority and keeping the local characteristics in the perspective. However, all plans must be Specific, Measureable, Realistic, Achievable within a Time frame (SMART) and must have a budget. A plan without a budget is not complete.



Fig.10.1 Organogram of disaster management authorities from center to villages

10.3 TSUNAMI WARNING CENTER

Learning from the devastation caused by the December 26, 2004 *tsunami* in the Indian Ocean, India unveiled an early warning *tsunami* system, the first of its kind in the world, which will sound an alert 13 minutes after an undersea earthquake from two potential sources. Set up at the Indian National Center for Ocean Information Services (INCOSIS) at Jeedimalta on the outskirts of the city of Hyderabad, the center is equipped to provide tsunami warnings at the subduction zone in the Andaman – Nicobar – Sumatra Islands arc and the Makran subduction zone north of the Arabian Sea (A subduction is the geological process when a tectonic plate pushes another from below). On October 15,2007, Science and Technology and Earth Sciences minister Kapil Sibal inaugurated the center on the built indigenously in two years at a cost of INR1.25 billion with the involvement of 14 different organizations and 150 scientists. An early *tsunami* warning can help the 400 million people living in India's coastal areas to save themselves. The information can also be shared with the neighboring countries.

The center comprised of a real-time network of seismic stations, bottom pressure recorders and tide gauges to detect *tsunami*-genic earthquakes and to monitor tsunamis.

The center receives real-time seismic data from the national seismic network of the Indian Meteorological Department and international seismic networks. The system detects all earthquakes of a magnitude of more than six on the Richter Scale in the Indian Ocean after 13 minutes of their occurrence.

BPRs installed in the deep ocean are the key sensors to confirm the triggering of a tsunami. The National Institute of Ocean Technology (NIOT) installed four BPRs in the Bay of Bengal and two BPRs in the Arabian Sea. In addition, NIOT and the Survey of India have installed 30 tide gauges to monitor the progress of *tsunami* waves. Seismic and sea-level data are continuously monitored in the warning center using a

custom built software application.

10.4 NATIONAL CYCLONE RISK MITIGATION PROJECT

India has a huge coastline of about 7,500 km. Globally, the second highest number of people exposed to tropical cyclones are in India, highest being in China. Recognizing that short and long term mitigation measures can minimize the impact of cyclones on life, property and infrastructure, the Ministry of Home Affairs, Government of India conceptualized a comprehensive National Cyclone Risk Mitigation Strategy. The Administrative Training Institute, Kolkata hosted a National Workshop Developing Strategy for Cyclone Mitigation in the coastal and island regions of India on 4th and 5th

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February 2003. The author was a member of this consultation. Based on the outcome of this process of consultation, the Ministry of Home Affairs, Government of India put in place the National Cyclone Risk Mitigation Project (NCRMP). The NDMAI was handed over the responsibility of this in September 2006. The coastal states and the union territories have been categorized as given below:

Table 10.1	Categorization of Cyclone Proneness of Coastal States and Union Territories
	Source: National Cyclone Risk Mitigation Project

Category	States and union territories
I – High vulnerability	Andhra Pradesh, Gujarat, Orissa and West Bengal
II A- Low vulnerability	Maharashtra, Karnataka, Kerala and Tamil Nadu
II B – Low vulnerability	Goa, Daman & Diu, Pondicherry, Lakshadweep and Andaman & Nicobar Islands

The objective of NCRMP is to minimize the vulnerability to cyclones and make the people and the infrastructures in the cyclone prone areas more resilient. The program has four components:

- Component A: Upgradation of cyclone forecasting, tracking and warning system, the responsibility of Indian Meteorological Department.
- Component B: Cyclone risk mitigation investment by the respective State Disaster Management Authority or by the state training institutes as applicable.
- Component C: Technical assistance by the hazard risk mitigation capacity building, the responsibility of the National Institute of Disaster Management.
- Component D: Project management and monitoring, responsibility of the Ministry of Home Affairs, Government of India.

The World Bank had approved the funding of this project and Government of India included this project in the 11th Five Year Plan. Gujarat State Disaster Management Authority, the project management unit of Gujarat for this program, has received from the Government of India, INR175 crores, the state government contributed 25% of the central assistance for this project in the state. The other two states where this program has been taken up by the respective Disaster Management Authorities are Orissa and Andhra Pradesh.

10.5 THE NATIONAL BUILDING CODE (NBC) IN INDIA

The National Building Code of India was first published at the insistence of the Planning Commission in 1970. Subsequently, three major amendments were issued:

two in 1987 and the third in 1997. Taking into account the aftermaths of disasters like the Orissa Super Cyclone and the Bhuj Earthquake, the NBC has brought out the National Building Code in 2005. The salient features of the code are:

- 1. Inclusion of a complete philosophy and direction for successfully accomplishing the building projects through an integrated multidisciplinary approach, right through conceptual stage to planning, designing, construction, operation and maintenance stages.
- 2. A series of reforms in building permit process.
- 3. Provisions to ensure the certification of safety of buildings against natural disaster by an engineer and structural engineer.
- 4. Provision for two stage permit for high rise and special buildings.
- 5. Provision for periodic renewal certificate of occupied buildings from structural, fire and electrical safety point of view.
- 6. Provision for empowering engineers and architects for sanctioning plans of residential buildings up to 500 m^2 .
- 7. Inclusion of detailed town planning norms for various amenities, such as educational facilities, medical facilities, distribution services, police, civil defense and home guards and fire services.
- 8. Revision of parking requirements for metro and mega cities.
- 9. Modification of special requirements for low income housing for urban areas.
- 10. Inclusion of special requirements for low income housing in rural habitat planning.
- 11. Revision of the provisions for buildings and facilities for the physically challenged.
- 12. Fire safety norms completely revamped through detailed provisions on fire prevention, life safety and fire protection.
- 13. Inclusion of new categories of starred hotels, heritage structures and archaeological monuments for fire safety provisions.
- 14. Substitution of halon based fire extinguishers/fire fighting system.
- 15. Promotion to new/innovative building materials/technologies.
- 16. Inclusion of latest provisions for earthquake-resistant design and construction.
- 17. Inclusion of details on multi-disaster prone districts.
- 18. Inclusion of new chapter on design and construction using bamboo.
- 19. Chapter on prefabricated and composite construction for speedier construction.

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- 20. Modification of provision of safety in construction.
- 21. Complete revision of provision on building and plumbing services in line with applicable international practices.
- 22. Provisions on rain water harvesting.
- 23. Inclusion of new chapter to cover landscaping needs.

(Source: Salient Features of the National Building Code).

Chapter

Responding To Disasters

11.1 DISASTER MANAGEMENT

Disaster management is the continuum of disaster \rightarrow response \rightarrow rehabilitation \rightarrow reconstruction \rightarrow development \rightarrow prevention \rightarrow mitigation \rightarrow preparedness. The components of the disaster management cycle are explained in Figure 2.1 and are further explained in Figure 2.2. There is no dichotomy between development and disaster management because both aim at improving the coping mechanisms of people, particularly the poor, in coping with macro or micro shocks. It is strongly advised that agencies, both private and public, involved in disaster responses, go through the whole continuum with a long-term vision of reducing the impact of future exigencies on lives, property and livelihood of people. Execution in each phase must be carefully done in a planned manner because of the interconnectedness of the phases. Success of the subsequent phases will depend on the implementation strategy adopted in the previous phase.

Disaster Management, therefore, consists of the following principles:

- Comprehensive The management should take into account all phases of disaster management cycle, all stakeholders and all impacts relevant to a disaster.
- Progressive Integration of disaster risk reduction component building disaster resilient communities.
- Risk driven—Use of sound risk management in assigning priorities and resources.

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- Integrated—Ensuring unity of efforts among all the levels of government functionaries and all sections of disaster affected society.
- Collaborative—Consensus building decisions among the team on all aspects of management.
- Coordinated—Synchronization of activities with all relevant stakeholders to achieve a common purpose.
- Flexible—Use of creative and innovative approaches in responding to disaster challenges.
- Professional—Science and knowledge based approach encompassing ethical practices, public stewardship, and continuous assessment leading to improvement.

DISASTER PLANNING

Effective disaster planning is efficient when the disaster responders start the planning processes before any disaster. There are two types of disaster responses: proactive, meaning before the event, and reactive, meaning after the incident. With the help of technology, especially with satellite imageries, most natural disasters are predictable. Disaster planning requires a set of information for taking informed decisions by senior management on the response. This set of information includes: the geographic area and the population affected, the possible location of the primary command center where relief material can be stored, the mode of quickest (within 48 hrs) transportation of the relief material to the site of disaster, the distance and facilities available to the nearest health center, equipments and tools needed for evacuation of people from the risk zone, the possible places for temporary shelter etc. In order to assess the immediate needs of the disaster affected communities, it is necessary that such assessment is done by a gender balanced multidisciplinary team of experts. It has been observed from responses to large disasters in different parts of the world that unplanned immediate disaster responses, inability to take appropriate relief and emergency decisions and communicate these decisions with the disaster affected people in the beginning of the disaster management cycle make recovery and reconstruction, the next two phases of the disaster management cycle, extremely complicated.

EARLY WARNING SYSTEM

Early warning system is the most crucial component of disaster mitigation. There are two essential components of an early warning system. The first is a sound scientific basis for predicting potential catastrophic events. GIS technique is one of the most appropriate scientific tools to predict natural disasters like cyclone, flood, drought and landslides. Earthquakes are not predictable in spite of the advancement of technology. Immediately after an earthquake, however, scientists are able to know from the seismic data: the intensity of the quake in Richter Scale, the location of the epicenter and the depth to the earthquake, the three most important aspects of earthquake that cause destruction. When the epicenter of a high-intensity earthquake (higher than 6.8 in the Richter Scale) is near a sea or under a sea, there is possibility of a *tsunami*. India unveiled its own tsunami warning center near the city of Hyderabad which has the capacity of triggering *tsunami* warning within 12 minutes of the detection of *tsunami* waves. The next important phase is to disseminate the information to those people at risk. This message must be clear and people centric, enabling proper responses by the people in the potential risk zone and the local government functionaries. In case of floods due to water originating in another country, it is necessary to have proper information sharing between the countries up and down the river for the early warning of possible flood.

CRISIS INTERVENTION AND MANAGEMENT

In terms of medical health, a crisis is the reaction of an individual to an event. Crisis, therefore, does not necessarily refer to a traumatic situation. A crisis is a period of transition in the life of an individual or a community. Most people go through it in some period of their lives and most people come out of it without a professional help. However, there are situations resulting in crisis which are beyond the bounds of a person's everyday life or beyond the abilities to cope which may require professional assistance for recovery. High-impact disasters can cause such an impact.

Crisis management refers to the activities and methods to offer short-term immediate assistances to individuals, who have experienced an event that has produced mental, physical, emotional and behavioral distress. Though crisis management is a skilled job done by the professionals, the relief and development workers in the absence of such professionals or in a given situation, can provide supportive role in crisis management after a disaster. After few days of the Orissa super cyclone in 1999, the author saw a man on the highway near the Paradip Port who was behaving abnormal; as a consequence he could have been run over by the passing vehicles on the road. Sensing something unusual, the author got down from the vehicle, grabbed him and seeing his mental health decided to have a dialogue with him. After much effort, the man told that he was apparently the only surviving member of his family in the village that had been ravaged by the cyclone. He was alive because he worked as a wage earner in a factory in Paradip. The author spent almost an hour with him letting him express his grief, and in the process his behavior slowly returned to normalcy. He was then taken to a group

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of families living in a road side temporary shelter with a request to include him in the group. Through this effort, the life of a person was possibly saved by a person without any formal or informal training on stress management. It is not only the people affected by a disaster who need crisis intervention and management. The author was the team leader of CARE India's response to the earthquake in Kashmir in 2004. One of the team members was on the road in Srinagar when a human bomb exploded not far from his vehicle. The sight of the consequences of this shocked and traumatized him to the extent that he was barely able to speak. He came back to the base camp shocked and distressed. He wanted to go back home immediately. The author did not want him to take with him the trauma and pass this on to his family members. He was given a lot of space by the team leader to express his feelings. He was under the personal care of the team leader for all the time he was awake, not letting him alone. He was allowed to go home two days after intense care by all the team members. This helped him to get over the initial trauma.

COMMUNITY BASED DISASTER MANAGEMENT

In recent times, new lexicons are found in disaster management, like: Disaster Risk Reduction, Community Based Disaster Risk Reduction, Community Based Disaster Management, etc. All these refers to a set of policies, plans and practices either by a state, or civil society or the communities that reduces the impact on life, property, livelihood of people affected by a disaster, infrastructure, the environment in the disaster affected area. Tthe relationship between disaster, hazard, vulnerability and coping mechanism has been explained in Chapter 2 by the equation D = H X V / C, where D denotes Disaster, H denotes Hazard, V is Vulnerability and C is the Coping capacity. This equation means that a Hazard can turn into a Disaster if the people affected are Vulnerable with low Coping capacity. In this equation, two components that can be changed are vulnerability and coping capacity. Vulnerability of people is not only due to their poverty but also due to their geographic location and hence difficult to change in short term. Therefore, one factor of the equation that can be changed with relevant training is the coping capacities of the communities in disaster prone areas. This and the core belief that people can develop the capacity to cope with disasters are the essence of a Community Based Disaster Management. Developing the capacity of people to "live with disaster" is possible. Globally, there are many very good examples of this. One of the first such systematic community based disaster management program has been included in the text under the heading "Disaster Management Cycle". It goes without saying that disaster losses are minimized in a prepared community, however poor they may be.

DISASTER MANAGEMENT PROGRAM EVALUATION

Apart from the ongoing assessment leading to the improvement of a disaster management program, it is essential to have an evaluation at the end of it. Evaluations are not intended to find faults or to provide undue credit. They should be perceived as lessons learnt for improvement in future intervention. In case the review team report is critical, the report should not be pushed under the carpet as experienced by the author twice in his professional life. In one such case, the author was a member of an international review team and was also the team leader for more than three weeks during the transitional phase of relief to rehabilitation after the Gujarat earthquake. As the team leader at that critical moment, he had to take two decisions: 1) to request the headquarters not to send further relief material, 2) to distribute more than INR 2.5 million worth of medical appliances bought into Bhuj to a number of hospitals run in the area by various trusts, because the injured due to the earthquake received necessary treatment in hospitals of adjacent district and hence there were no takers for these expensive appliances. When this and many other shortcomings were mentioned in the review, there were immediate reactions from his own peers responsible for those shortcomings. The report after the briefing was not shared among the staff.

Disaster Management Program Evaluation should be made against the eight principles of any disaster management program: was the program comprehensive, progressive, risk driven, implemented through integrated, collaborative, coordinated, flexible and professional approaches? Apart from these principles, the adherence of the disaster management to the Red Cross International Code of Conduct mentioned in the book under the heading *Sphere* should also be evaluated.

Tony Vaux made "An Independent Evaluation of the DEC Gujarat Earthquake Appeal" in October 2001. The summary of the findings are:

- The earthquake affected people received substantial and timely assistance.
- After the initial deaths, there was no further casualty due to secondary reasons like hunger, cold or epidemic.
- Immediately after the quake, far more people were rescued from the collapsed houses by neighbors, government functionaries and Indian military personnel than by the skilled external search and rescue teams.
- More efforts should have been given to increase the capacities of the local stakeholders reducing future vulnerability, a key component of the Red Cross Code for Humanitarian Response.

11.2 RESPONSE AND REHABILITATION AFTER DISASTERS

PRINCIPLE

Response after disasters both by the public or the private sectors like the civil society organizations involved in disaster response, must follow the principle of "good governance". Though the term good governance has become a new lexicon in the development and humanitarian sectors, the concept is not new; it is as old as human civilization. The term governance essentially means the process by which decisions are made and the process by which these decisions are implemented. Good governance has the following characteristics:

- Participatory
- Accountable
- Transparent
- Responsive
- Effective and efficient
- Equitable and inclusive
- Follow the rule of the law

Following the above characteristics assures that corruption is minimized, if not totally avoided; it also assures that the views and voices of those who have so far remained "excluded" from decision making processes that impact their lives and livelihood, are heard. The International Code of Conduct for humanitarian response captures much of what good governance is. The core value is that disaster affected people should not be treated as passive recipients but should be treated with dignity and should be involved at all stages of planning and implementation of disaster responses.

Suggested operational guidelines (based on the author's empirical insight of three decades of involvement in development and humanitarian responses):

- Development and relief workers are advised to live with the affected people forgetting temporary basic amenities of life. This is bound to pay rich dividends in the future.
- Equal emphasis is given to initiate a process leading to achievement of the target instead of being completely target oriented.
- Efforts on the inception of any recovery program should aim at converting it to a developmental one.

- Disaster response should have a disaster risk reduction component integrated with it from the beginning, apart from meeting the needs of the people affected by it.
- Valuable information like minimum wage, equal wage for equal work irrespective of gender identity, children below 14 having a right to their childhood, etc., could be conveyed through program implementation.
- One should be flexible in approach and should also learn to keep pace with the communities, not expecting the communities to keep pace with them.
- Sustainability depends on the creation of 'social capital'.
- Organizations and individuals should be accountable to the communities.
- The program(s) should be owned by the people.

RESPONSE AFTER FLOOD

Emergency response must be based on the assessed needs of the disaster affected communities, and not on their perceived needs. It has been mentioned earlier that a disaster might affect everybody in a society, but it is the poor and vulnerable people who are most affected by it. The children, the women, the aged, the invalid people and the disabled are the most vulnerable among the vulnerables. The immediate phase after a large-scale high-impact disaster like flood could be extremely chaotic. Also, during this phase, the needs of the affected people change very fast: what seem to be the most pressing needs today may become secondary day after tomorrow. Hence, carefully thoughtout disaster management planning is imperative and what is more important is that this planning must be a forward looking one. Appropriate social targeting also becomes imperative and special emphasis should be given to the poor and the marginalized sections of the society affected by flood.

IMMEDIATE RESPONSE STAGE

What could be the possible immediate basic needs of communities affected by flood? These could be:

- Rescue and evacuation to safer places
- Temporary shelter
- Food and nutrition
- Safe drinking water
- Environmental sanitation including toilets

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- Non-food items
- Hygiene kits (soap, sanitary napkins, ORS packets etc.)

It is not surprising that curative health has not been listed above. It has been the experience of relief and development organizations that disasters, like flood, do not create additional health problems, apart from the psycho-social impact on health. It is the existing health problems of the communities that get multiplied during disasters like flood. However, if a curative health service is needed, only the World Health Organization (WHO) approved drugs must be administered and drugs should be dispensed by a registered medical practitioner.

1. Temporary Shelter

Generally, after floods, people affected by it return to their villages once the flood water recedes. However, in extreme circumstances like the Bihar flood of 2008, the affected population is forced to stay in temporary shelter over a protracted period. This is when extreme care has to be taken to safeguard the safety and security of women and girl children. Various published and unpublished reports suggest that the existing social norms tend to break down in such a situation making women and girls vulnerable to sexual abuse.

In Bangladesh, with public private partnership, flood shelters have been constructed, more so along the Yamuna river. These 'flood shelters' are elevated landmasses with tube wells and toilets. There is no other infrastructure. People living in the "chars" of Yamuna, primarily the fishing community, have been trained to dismantle their houses in case of flood and reach the flood shelter with their belongings, however meager that may be, and the tins they use for their roofs. On reaching the flood shelter, they use the same tins for construction of temporary shelters and once the flood water recedes, they go back to their villages. Similar 'flood shelters' could be constructed in the known flood prone river basins in India which would definitely reduce the sufferings of people affected by flood. Resources available under the Mahatma Gandhi National Rural Employment Guarantee Scheme could be utilized in such Disaster Risk Reduction activity.



Fig. 11.1 A newly constructed ICDS center by VHAI after the 2008 Bihar flood that could be used as a flood shelter

Source: Shishir Das, VHAI

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When the flood affected people are forced to live on river embankments or on high roads or in the open ground, it becomes essential to provide them temporary shelter to shield them from the sun and the rain. It is a normal practice among the government and the civil society institutions to provide tarpaulin sheets. According to the Sphere minimum standard, 3.5 sq. m of minimum sleeping space should be provided to each person. Therefore, a standard size tarpaulin sheet of 15 ft X 12 ft available in the market, meets 95% of the Sphere Standard for a family of five.

2. Food and Nutrition

Food commodity	Daily ration for two adults	Kcal provided per day per adult
Rice	725 gm	2365
Dal	35 gm	117
Total	760 gm	2482
Food commodity	Dely retion for three children	Kaal muuidad nan day nan ahild

Table 11.1 The Sphere Minimum Standard of food aid Source: Catholic Relief Service

Food commodity	Daly ration for three children	Kcal provided per day per child
Rice	580 gm	1885
Dal	35 gm	117
Total	615 gm	2002

Therefore, if an organization decided to provide food assistance to the disaster affected people, it must follow the Sphere standard and provide approximately the aforementioned food quantity for two adults and three children. Similar calculation would have to be made to quantify the minimum food to be provided in wheat eating areas.

At times, post disaster, the nutritional status of under 5 children and adolescents may dip to such an extent that provisions of supplementary food becomes necessary. It is advised in such situations not to provide baby milk, even if the demand comes from the state officials, politicians or the communities. The reason being, that in a disaster when people live in cramped conditions where sanitation is poor and safe drinking water is scarce, feeding baby milk (in such unhygienic conditions) may become counterproductive.

There is tested and WHO-approved low-cost supplementary food that could be prepared by those living in temporary shelters, with some training. The process is as follows: One kg of wheat is cleaned and washed. Thereafter, when it is dry, it is roasted. Similarly, 250 grams of '*chana dal*' is separately cleaned, washed and roasted. Both of these are mixed together and this mixture is then crushed. The crushed mixture is then fried in a pan with a little oil and when the mixture turns brownish, a little jaggery or sugar is added. This is now ready to eat. This ready to eat material is sufficient supplementary food for two children for two weeks. To store the mixture for two weeks, it is advised not to add sugar and jaggery. Children should be provided this twice a day, preferably three hours before the major meals. Approximately, the calorie intake from this mix is 750 kcal per day.

3. Safe Drinking Water

This is a major area of concern after a disaster, more so after the floods. The flood water could infect all the wells and other water bodies and even the tube wells could be completely submerged for days. It is a matter of great relief to the relief workers in India, that the mortality due to water borne diseases after major disasters in India like the Orissa Super Cyclone or the Bihar flood, has been negligible. However, a study done by the Oxfam Kolkata office, after the Bihar flood of 1998, revealed that the water of the tube wells that were not fully submerged, was bacteria free, but the same water used at home had 22 different types of bacteria because of unhygienic storage and usage of water. It is, therefore, of prime importance that the quality of water should be safe not only at the source but till the end user (Source: Author who was in charge of the flood response).

How to purify dirty water

The items required are:

- Two buckets of 15 and 10 liters.
- 25 gram alum crystal.
- 2 pieces of clean cloth.
- A long piece of stick.
- Halogen tablets 20 to 30 (4 mg each).

The Process:

- The 15 liter bucket is filled with dirty water.
- The alum crystal is wrapped in a clean cloth and tied firmly with the stick.
- The end of the stick with the alum is dipped into the bucket of dirty water and the water is stirred at least 15 times.
- The bucket is kept under cover for one hour.
- After an hour, the water from this bucket is transferred into the 10 liter bucket with a clean mug.

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- 20 halogen tablets of 4 mg each is put into 10 liters of water.
- After half an hour, the water is safe to drink.

How to disinfect a tube-well submerged in flood

The items required are:

- A standard matchbox full bleaching powder.
- A water container.
- One liter bottle.
- A piece of clean cloth for straining.
- A thin piece of stick.
- Slide range to open the tube well.
- Hacksaw.
- Screw driver.

Process:

- The matchbox full bleaching powder is completely dissolved in one liter of water.
- The body of the tube well is removed with a range and the check valve is removed from the joint of the pipe.
- The mixture of bleaching powder and water is poured into the tube-well.
- The tube-well is reinstalled.
- The tube-well is kept unused for three hours.
- After three hours, at least 30 to 40 buckets of water is pumped out.
- The tube well water is now safe for drinking.

4. Water, Sanitation and Hygiene (WASH)

WASH is a recent lexicon in the vocabulary of disaster management and is now widely used. Sanitation is an area of high concern, particularly when disaster affected people are forced to stay over a long period in relief camps or in the river embankment or on high roads or in the open. The problem is compounded when flood-affected people take shelter on river embankments, where digging the pit for construction of temporary latrines is against the rule of the law.

Management of human excreta after a major disaster is a difficult, but high-priority task for the relief workers. The problem worsens because of the traditional practice of people of using open space for defecation and inadequate habit of washing hands with soap making room for anus to mouth infections. Temporary latrines could be easily constructed with very little money. However, no latrine should be constructed within 20 feet of a water body, like well or tank. To construct a temporary latrine, earth needs to be dug upto 3-feet in depth and one and a half feet in width. Around this 3-feet pit, four poles 4-feet high from the ground are firmly planted in the ground. A 3-feet long tin sheet is kept in a way that half of it hangs in the pit and the other half is firmly grounded. Two bricks placed on either side of the tin plate complete the construction of a temporary latrine. Gunny bags, 20 feet in length and 4 feet in height is wrapped around the poles for privacy. It is needless to say that the latrines should be kept clean: no latrine is better than a dirty one from the perspective of public health.

Environmental sanitation poses greater threats when the flood water recedes. Also, the mud houses which may not have been fully damaged during the flood, could collapse during this phase. Public health specialists suggest the spreading around of a mixture of lime and bleaching powder in a ratio of 4:1 (meaning 4 parts of lime and 1 part of bleaching powder) to improve environmental sanitation.

5. Non-Food Items

In a post-disaster scenario, the most essential non-food item is clothes. However, experience shows that children's clothing needs are not prioritized. This may be because of the logistic problems of procurement of different sizes of garments for different age groups. It has been experienced that the distribution of clothes often does not respect the local culture and traditions. As an example, in a large part of the country, Hindu widows, under no circumstances, would wear colored saris. Therefore, without the knowledge of the aid providers, a large section of the women may be 'excluded' from the benefits: this could be as high as 10 to 12% and they are the more vulnerable ones. In the north eastern parts of the country, the women in particular, wear distinctively different dresses according to their ethnic identities; hence, aid workers have to be sensitive to this while planning an immediate disaster response.

Sleeping mats, utensils and hygiene kits are the next items that are the disaster affected peoples' requirements. Some international and national relief and development organizations have pre-positioning of non-food items. After the Orissa Super cyclone, people at some villages received around 10 to 14 good quality blankets which are not needed in coastal Orissa in the months of May and June. Such inflexible practices are a sheer waste of resources.

Here is a simple, inexpensive and innovative example of how the communities affected by a disaster helped in quick distribution of 'relief':

In the late 1990s, the undivided Ganjam district of Orissa experienced a severe flooding which was caused by heavy rains in the catchment areas of Rushukulia river compounded by unsystematic and uncoordinated release of water from medium size dams. A large number of affected people took shelter in public buildings like schools.

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The affected people with the support of a local civil society organization: United Artists Association, came up with an extremely innovative concept. They distributed three colored cards to each family: red to those who need the outside assistance most, followed by yellow and green. When relief materials from whichever source it came from reached the area, the distribution was very peaceful and was according to the needs of the people which was decided by the affected people themselves, who obviously know best who the most and least vulnerable families were. (Source. United Artist's Association, Ganjam, Orissa).

The present-day flooding is not only due to heavy precipitation within a short duration alone. The human interventions on the free flowing water for dams, for construction of embankments to control the flow of the river with the objective of flood proofing, for generation of hydro electricity, etc., are equally responsible for floods. As a result of this, floods which supported growth of ancient civilizations, have now become a high impact disaster causing loss of life, property, cattle and agricultural land by sand casting. Sand casting often is responsible for the permanent loss of agricultural land: physically removing the sand is not cost effective. Otherwise, supporting people to get back into agriculture would have been the best recovery option.

Rehabilitation is a medium-term activity aimed at putting the disaster-affected people back to productive activities that they were engaged in prior to the disaster. It is at this stage of disaster management that social targeting becomes imperative. Sincere efforts would have to be made to reach those, who are normally left out of developmental gains. Organizations involved in post disaster recovery must share the following core values:

- All major destructions have seeds of construction in them.
- People, however poor and vulnerable they may be, have the capacity to overcome the consequences of a disaster.
- Though people's vulnerability gets more pronounced after a disaster, this does not mean under any circumstance that they do not have the capacity to overcome it.
- People, however poor they may be, when they come together, it generates tremendous collective power and wisdom.
- The poor are bankable (the success of the micro finance sector in India and elsewhere has proved it); and hence input for productive activities should not necessarily be a dole.
- Believe in the dignity of people.

Rehabilitation after Cyclone

The destructive power of a high-impact disaster, like cyclone, depends on its intensity. India, with a coastline of more than 7,500 km with high density of population is, therefore, prone to cyclonic storms and water surges. The East coast is more prone to cyclones than the west coast. The Bay of Bengal is the most cyclone prone region in the world. The Orissa Super Cyclone, the worst in living memory, with wind speed of more than 220 km per hr, killed more than 10,000 people and as the international experience suggests, more than 10,000 X 3000 = 30,000,000 were severely affected by this (for every person killed, 3,000 people are severely affected). Of all the natural disasters, cyclones are most predictable. The Indian Meteorological Department (IMD) with the help of radars and satellites is responsible for monitoring the formation of depression over the sea till it reaches the inland.

In a cyclone, the people living closest to the sea are obviously the worst hit. Among them, the fisher folk are the worst affected. It has been an experience both in India and Bangladesh that people, who suffered the most, in spite of repeated warnings did not move to safer places. The reasons could be:

- Many of them might not have the legal entitlement of the land in their possession and hence were afraid of losing possession if the warning turned out to be false.
- They might not have the access to the information.
- They might have felt that they would be able to cope with the impending hazard as they have braved in the past.

Immediate response after strong cyclone becomes difficult because of uprooted trees and power lines on the road. Reaching the most affected, the ones who live closest to the sea is, therefore, a challenge. However difficult that may be, the first task after clearing the road should be to reach those who are worst affected. Immediately after the Orissa Super Cyclone, when aid workers could reach the worst affected areas, most of them felt the need of psycho-social counseling, particularly those who lost members of their families. Such specialized person power in adequate number is difficult to get. Hence aid workers should have some training on this so that they could, to a limited extent, play the role of a psychological counselor. It is recommended that people behaving abnormal should be given an opportunity of venting out their grief. This could save lives and hence a conducive environment will have to be created for letting out the grief, and the onus lies with aid workers to provide the space.

Heavy rains that follow or accompany a cyclone create additional problems to the cyclone affected people. It however, washes away the salinity of the agricultural land inundated by sea water. Because of this, the agricultural land becomes cultivable for the immediate next crop. It is possible that tube wells close to the shore line have been completely submerged creating acute water scarcity. In such a situation, provision

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of safe drinking water assumes top priority. The cyclone affected people may also immediately need health services to cater to the wounds caused due to house collapse, uprooting of trees, etc.

From the experience of Orissa Super Cyclone, it is recommended that 'normalcy' is restored as early as possible after a major disaster.

What is Normalcy

- The affected people go back to their villages, even if they need to stay in temporary shelters there.
- Electricity is restored an electric bulb apart from giving the much needed light also sends a message that life goes on.
- Schools reopen even if the books and the school buildings have been completely destroyed. Being with peers acts as a psycho–social support to the children, it also protects children from trafficking.
- Markets reopen.
- The affected people get back to the productive activities they were engaged in.

The other immediate needs after cyclone are same as that described for floods.

RESPONSE TO DROUGHT

Drought is a slow impact disaster. The international communities or civil societies respond to it when the worst symptoms of it: deaths due to hunger, surface. It is obvious that today, with the revolution in information collection and dissemination, such a situation should not be allowed to happen. In all, 68% of the country is prone to drought. In major parts of India, monsoon lasts for four months. Major crops are raised in this period and harvested after the monsoon and in parts of the country, where irrigation facility is not available, poor peoples' well being depends on rain-fed agriculture. An area as large as a state, district or as small as a block is considered drought affected if the rainfall during monsoon is less than 25% of the average annual rainfall. If it is less than 50%, the area is considered by the government as severely drought affected. This drought is called as *meteorological drought*.

The Government of India has been implementing Drought Prone Area Program (DPAP) in identified districts of the country. This is also true that 73% of the sugarcane produced in Maharashtra comes from drought prone areas¹². However, there could be more or less the same annual rainfall but with long absence of rain during the critical growth of the major crops. This is referred to as *agricultural drought*.

In India, both forms of drought exist. Droughts can have serious impact on the economy of India: agriculture's contribution to the GDP is second highest and maximum



Fig. 11.2 Markets reopened and women got back to the activities they were engaged in, prior to the tsunami in Andaman — normalcy being restored Source: Shishir Das, VHAI percentage of the people in India is engaged in this sector. Both forms of droughts have devastating impact on the lives and livelihoods of the people in the central India tribal belt. Certain parts of the country: Kalahandi, Bolangir and Koraput (KBK) districts are perpetually affected by drought and have become infamous for near starvation of people residing there.

The impact of drought is inextricably connected to the process of marginalization of certain communities. Kalahandi receives an annual precipitation of more than 1100 mm, three times the rainfall in California, a big producer of grapes. Kalahandi is also a rice surplus district, yet the name has become synonymous with 'starvation deaths'. "The people of West Orissa are not, in themselves, passive recipients of drought. But more than half a century of organized relief has created dependencies, which make them doubt their own ability to construct and reconstruct their lives and livelihood. Without giving credence to the traditional strength of people fighting such odds, the engines of development can do little but lay waste on what survives¹³". Jharkhand, a part of the central India tribal belt, is frequently affected by drought. However, in 1999, a study conducted by Oxfam Kolkata office revealed that out of 125 years of rainfall in the region, which became a state in 2000, only 5 years had rainfall deficiency of more than 25%: three of these were after 1965.

Civil society response to drought is generally after media reports of starving children. However, there are few international and national civil society organizations that have developed tools to monitor the situation in known drought prone areas. The tools used are: the rainfall, the growth of crops, out migration of able bodied men, the cost of essential food items in the local market in comparison to previous years, etc.

The typical civil society response to drought has been creating employment opportunities through cash, or food, or both — for work. Such programs are aimed at providing much needed cash, meeting the immediate needs of people affected by drought and to create community assets that could store rain water to cater to the agricultural needs in the subsequent years. There is an inherent dichotomy in this: one of the criteria for response after drought is out migration of 'able-bodied men', yet, the programs undertaken are meant to cater to them. What happens to the women who not only have to fend for themselves but also for the children, aged and the sick when their men migrate?

In 1988, with Oxfam's support, a systematic nutrition assessment was carried out by a Kolkata based institution with distinctive competence of similar work in response to three years of consecutive drought in undivided Ganjam District and in Gunupur subdivision of undivided Koraput District of Orissa. The study team measured the food intake by a family in a day and converted it to calorie intake per person per day. The under–five nutrition assessment was conducted by the measurement of the Mid Upper Arm Circumference (MUAC) and the Body Mass Index of women was calculated. The survey revealed: more than 55% of the under-five children were severely malnourished: the calorie intake per person per day was nearly half of the prescribed 2,400 kcal and 80% of the women were at risk during child delivery because of low weight and height. The nutritional status of children from the predominantly tribal communities of Ganjam and Gunupur, after three consecutive years of drought was then compared with the children of Kalahandi in a 'normal' year. The comparison yielded a revealing picture. The under-five children of Kalahandi were more malnourished in a normal year as compared to those of Gunupur and Ganjam after three years of consecutive drought. (Source: Author, commissioning the survey by CINI).

Today, when the Government of India has the flagship program: Mahatma Gandhi Rural Employment Generation Programe, the civil society organizations technically do not need to mobilize external resources to respond to drought. This is more so, when the Ministry of Rural Development, Government of India, in association with UNDP has decided to converge all development activities with NREGA in 150 poor districts of India (the list is available on the internet). Drought proofing through the NREGA resources in the central tribal belt of India could benefit a huge section of the poor and vulnerable population in providing the much needed cash in the short term and helping them to cope with agricultural droughts in the future. What it needs is the political will of the governments and the local self governance institutions at all three tiers.

In 1989, Bolangir district of West Orissa was severely affected by drought. The Oxfam Bhubaneswar office decided to intervene. Before finalizing an intervention plan, the Oxfam team decided to look at the impact of the interventions of the past in similar situations. It was revealed from this, that large tanks built under cash or food for work were full with water but people having land close to the tanks migrated to the adjoining state instead of using the water to save the crop or cultivate new crops. The team, learning from the past, took a conscientious decision of not constructing new tanks under 'cash for work'. The team also decided to aim the drought response at the women. The initial response of the women was: "How would we do? We do not know how to read and write. Who would maintain the master rolls and make the measurement of the work done?" On probing further, it was learnt that there were one or two young women in each village who had been to schools and were able to read and write. They were trained to maintain master rolls and on the measurement of 100 cubic feet. It was they who prepared plans of excavating existing shallow water harvesting structures not far from their place of stay and the work began. The women came up with brilliant ideas: they engaged selected elderly women, who did not have the physical ability to participate in the 'cash for work' program, in their villages to take care of their children when they were working and similarly engaged elderly men to bring drinking water for them. The women paid the elderly people for their services from the wages they

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earned. The women, at one stage, felt the need of men working with them because the soil was too hard. While engaging one man for each group of five women, they set out a criterion: only those men who do not indulge in domestic violence would be accepted. The outcome of this program was monitored for two years. These women challenged the local power structure and got the rights of the water bodies in the area for raising fish after a good monsoon next year. (Source: Author, planning and implementing the program).

Kalahandi is known for its recurrent droughts and starvation. Even the low lying fields are used for rain fed single crop: paddy. The rest of the year this land is kept fallow. It could be safely concluded that under the surface of the low lying fields, enough water would be available within 30 to 40 feet for a second crop during winter. Accordingly, the Oxfam Bhubaneswar office took up a drought relief program with landless women, who took lease of the fallow low lying land for the winter crop: vegetables. The necessary water for the purpose was drawn by digging a small diameter well which was 30 to 35 feet in depth. The land owners were happy to lease the land out at no cost because after the crop is harvested, their land would have more moisture content and the remains of the vegetable plants would act as biofertilizers. For two consecutive years, women grew many varieties of vegetables: the product that grew best in the region, which also fetched good value was tomatoes. After the first or second rainfall, the shallow and small diameter wells dug would collapse for the owners to grow the traditional rain fed paddy (Author: in the capacity of Oxfam GB's regional representative in Orissa).

RESPONSE AFTER RIVER EROSION

All people affected by river erosion may not be economically poor prior to erosion. But they were certainly vulnerable to hazards because of the geographic location of their habitation and agricultural fields. It is also necessary to bear in mind that the people affected by erosion, when their houses and lands are eaten away by the river, may not have an alternative place to restart their lives unless safer homestead land is allotted to them with its legal rights. This aspect and the fact that they need to stay in temporary arrangements till alternatives are provided by the state, make them more vulnerable compared to other natural disasters. The social impacts of this disaster can be enormous; the children are invariably dropped out of schools, the young men migrate to far off places or are lured in to anti social activities, land owning classes, within moments become landless and are forced to work as wage earners, the marriage age of girls are lowered because, as they say, "Who would take the responsibility to ensure their safety and security?", the women start working as domestic help, leaving their siblings and young girls and the aged and sick to fend for themselves or are engaged in unhealthy
and exploitative enterprises as rolling *bidis*, young girls are trafficked on the pretext of gainful employment or marriage, etc.

It is a natural phenomenon that a long river tends to oscillate in its tail. Due to this, one bank could be prone to erosion because the soil may be softer in this end in comparison with the other. The rate of erosion becomes more due to human intervention like construction of barrage or other structural measures to contain the river from flooding. Often, rivers are the boundaries between states. With the shifting of the river, does the boundary also shift? In Malda District of West Bengal, the Ganges has shifted eastward by 30 km in the last 50 years or so. Due to the Farakka barrage on the river, there has been heavy silting and as a result, an island measuring 190 km² has been formed. About 100,000 people living there are denied of basic human rights: they are stateless people. The survey of India considers this as a "disputed land". There had been many commissions set up in the past to resolve the issue without success. River erosion may take place in moments but the process leading to erosion takes a long time and gives opportunities for the state and the civil societies to take proactive actions. The most pressing immediate needs of the people affected by erosion are:

- Rescue and evacuation
- Shelter
- Food and water
- Clothes
- Sanitation
- Hygiene kits
- Protection of children and girls from trafficking

REHABILITATION AFTER RIVER EROSION

The obvious difficulty in post-erosion rehabilitation is the availability of appropriate land for resettlement of the people affected by it. This could be made available by the hovernment. However, National Disaster Management Authority of India (NDMA) recognizes river erosion as a disaster but the existing relief codes that guide the government's response after a disaster does not include it. Hence, even if people affected by it have lost land, houses, cattle, etc., they get no financial compensation for it from the government; at least, that has happened so far in Malda.

RESPONSE AFTER EARTHQUAKE

Earthquake above 5 on the Richter scale can damage poorly constructed houses. The destruction of houses is the main cause of mortality during earthquakes. The earthquake in Latur in Maharashtra in September 1993, measured 6.4 on the Richter scale, was

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not a high intensity one, but was a shallow earthquake at a depth of 12 km below the surface. The death toll due to this earthquake touched more than 9,700. Half of the fatalities were children below 14 years and 55% of the dead were women. In Latur, the traditional housing stock consisted of walls made of large stones of various sizes and shapes with very little cementing material and the roof was made of concrete, hence heavy. When the earthquake struck, the houses collapsed because of caving in or out of the walls and the heavy roof fell on the people inside the house. The belief that Latur was situated on a seismic activity free zone was wrong. It is situated on a fault zone and hence prone to earthquakes. Had the houses been built with quake-resistant features, the mortality could have been much lower. An origin of a disaster could be natural but its consequences on life and property could be man-made. A 6.5 Richter Scale earthquake in Los Angeles in 1993 took only 2 lives. Changes in the existing practices of people in disaster prone areas coupled with appropriate policies of the government can reduce the impact of any disaster.

A comparison of destruction of lives between Latur and Kashmir earthquakes (Kashmir quake was 7.6 in the Richter Scale, therefore more than 10 times stronger) clearly shows the strength of the community wisdom. The total civilian death in the Indian side of Kashmir was 1,500 compared to Latur's 9,748 (the death on the other side of Kashmir across the border was reported to be high). The housing stock in these two places made the difference. Earthquake-proof houses are a misnomer; earthquake resistance housing is more practical. Kashmir has weathered many earthquakes of various intensities and hence the traditional housing practices take that into cognizance. Similarly, the century old houses in Uttarkashi were built with basic quake resistant features like:

- Tie-bonds: Wooden beams which literally bind together all the walls of a house.
- Tying inner and outer walls.
- Corner reinforcement.s
- Low roofs which drop the center of gravity.

• Small openings like doors and windows that enhance the rigidity of the house. (Adapted from the India Disasters Report 1999).

The Gujarat earthquake of 7.9 on the Richter scale took place on the morning of the Republic Day of 2001. The epicenter was located near Bhuj town, the district headquarters of Kutch district. The quake affected a large geographic area: Kutch district is geographically larger than two states of India, Kerala and Haryana. The number of dead was more than 10,000. The school going children and their fathers were celebrating the Republic Day in the open when the disaster struck. This fortunately caused lesser number of fatalities on that fateful morning. Most casualties were women, children below school going age and the aged.

One of the strongest earthquakes that ever hit India was the great Bihar-Nepal

earthquake of January 15 1934. The quake wrecked havoc in the northern part of Bihar bordering Nepal. The shock due to this was registered over 4,920,000 km² of undivided India and Tibet — from Lhasa to Peshawar and Vijayawada to Bombay. About 12.000 km² showed ground liquefaction, ground subsidence and ground water irruption. Just before the quake, several rivers of north Bihar went dry and several rivers changed t course. Such was the impact of the quake. The mortality due to this was estimated to be around 25,000.

Date	Magnitude	Place	Fatalities	Comments
October 08 2005	7.6	Kashmir	More than 80,000	Including the fatalities in Pakistan occupied Kashmir
January 26 2001	7.9	Kachh	More than 10,000	Epicenter in Kutch
September 29 1993	6.4	Latur	9,748	
October 20 1991	6.8	Uttar Kashi		
August 15 1950	8.5	Assam		Largest in mainland after independence
January 15 1934	8.7	Bihar	More than 25,000	Largest ever earthquake recorded in mainland India

Table 11.2	The History of Major Earthquakes in India (in the last 80 years)
	Source: Maps of India: Blog: History of Earthquakes in India

The immediate response after an earthquake is:

- To search for survivors;
- To attend to the emergency medical needs of the injured; and
- To meet other needs like food, shelter, clothes for all ages, sanitation, hygiene kits, etc.

Searching for the survivors from the debris is a highly specialized skill: often trained sniffer dogs are used for the purpose and hence this should be left to those with the skills. An earthquake does not affect the tube wells and therefore, safe drinking water is not an issue of concern. It is however obvious that people affected severely by a high intensity quake where the houses have fully collapsed would have to stay in the temporary shelter for a protracted period of time. The temporary shelters set up in response to an earthquake would have to bear this in mind.

It has been observed both in Uttarkashi and Kashmir, because of the tough terrain, the people living close to the roads received relief materials far more than they needed. In Uttarkashi, tin sheets supplied for temporary shelter were flattened keeping these on the road and letting vehicles go over these. Once flattened, these were used to make tin boxes. Therefore, some mechanism would need to be put in place for reaching those who live away from the road. It is a common practice of the people living in the upper reaches of Uttarkashi, that they construct a structure low in height and little away from their houses to store food; this is their coping mechanism developed through the wisdom of living in an earthquake prone area. In the Uttarkashi quake, these structures were not affected. Therefore, in majority of the houses, there was no food insecurity as a consequences of the quake.

Earthquakes do not cause adverse impact on the agricultural land. It is, therefore, recommended that the relief and development workers reaching the people should encourage the affected to get back into agriculture. Getting back into productive activities after a disaster, acts as a psycho-social counseling for affected people affected to come to terms with grief due to loss of close relatives and property. This also helps in restoring 'normalcy'. There has been overwhelming support, so far, from the international communities. This support should be used to assist people in restarting their lives and livelihood and definitely not make them dependent on it.

In a "Lessons Learnt" review of a large international civil society (name withheld on purpose) after the immediate response phase in Bhuj revealed that the agency supplied good quality of utensils like plates for eating food whereas, according to the women of a village, they needed instead, cooking sets. On further probing, the women told the review team that the agency decided based on the discussion with men only. The same agency mobilized doctors from among its staff based in different parts of the country and reached Bhuj with medical equipments and accessories to treat the injured. By the time the team of doctors reached, there were no takers for the services because most people, if not all, received the treatment or were under treatment in nearby hospitals that were not fully damaged (Author was a member of the review team). There is no better example than this to iterate the need for a proper assessment by a gender balanced team, based on which, decision makers could make informed choices.

After the Uttarkashi earthquake, a Delhi-based national organization, through its affiliate body in the state of Uttar Pradesh (again name withheld on purpose), decided to help the affected families for cultivating the winter crops: potatoes. The local agency supplied the same seeds to the farmers having farm land at altitudes of 4 to 12,000 ft. It is obvious that the seeds supplied would give good returns either at 4,000 ft or at 12,000 ft and definitely not at both the heights because of huge temperature difference in winter at these two levels. Even a well meaning recovery program may not yield required results because of lack of detailed planning.

In Latur, an agency known for its philanthropy in the country and also abroad (name withheld), was entrusted by the government to reconstruct one village. The new site was hardly 200 m away from the temporary shelter where people for whom houses were being built, stayed. The houses looked almost complete when the author

visited the site. When asked if people living so close knew which particular house was meant for them, the reply was in the negative. Not only that, the person in charge of the program said, "Have you gone mad? They in that case, would ask for this or that alteration and additions. There would be a lottery to decide who owns which house". The institution constructed a barrack but not houses. (Source: Author, unpublished report on "Comparison of Uttarkashi and Latur Earthquakes").

THE EXPERIENCE OF POST—EARTHQUAKE HOUSE RECONSTRUCTION IN LATUR AND BHUJ

In Latur, there was no attempt made by the government to have a uniform house reconstruction package. As a result of this, the cost of houses built by different agencies ranged from INR 12,000 to INR 40,000 per house. This was not fair. Why should one village or a set of few villages be deprived compared to others? Such different packages had put the implementing team in to great difficulties: people receiving a low cost budget house doubted the integrity of the staff in the field. There was a competition in Latur between agencies to build relatively expensive houses bringing machineries that are used for construction of high rise buildings.

In Bhuj, the Government of Gujarat laid down definite policies that should be adopted by any agency involved in the house reconstruction program. The Government of Gujarat proactively looked for public private partnership in the post–earthquake housing program. It laid down certain criteria for developing the private–public partnership and thereafter, for accessing public resources. The civil society organizations involved in the house reconstruction work in Bhuj experienced the greatest hurdle to meet the first condition of the government: to get a resolution signed by all in a village that they accepted the proposed model of the house.

The reasons for apparent problems in house reconstruction in Latur and Bhuj were:

- Agencies adopted a village based approach. Villages were not homogeneous units, they are as heterogeneous as India: there were some people who were more equal than others and therefore agreeing to a model catering to all posed the greatest obstacle
- Latur grapes were once considered the best grapes in the world. This would mean that there were few people in Latur who were rich and their expectations were very high. Similarly, Bhuj as a district, receives the maximum remittance from outside the district and there were many houses belonging to non resident Indians.
- The houses in both places were planned to be of made of bricks, cement and

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concrete. Trained workforces were brought in from the neighboring areas leaving no space for the local unskilled laborers. The affected people were treated as passive recipients.

- It was very difficult to satisfy both the poor and the rich.
- With many promises made, the earthquake affected peoples' expectations were raised (former US President Bill Clinton was brought in Gujarat by the Gujarati NRIs).

RESPONSE AFTER TSUNAMI

India in the past had not been classified as a *tsunami* prone country. Library research reveals that Andaman was last hit by a *tsunami* in the decade of 80s of the 19th century. Therefore, when the December 26,2004 tsunami was caused due to an earthquake under the sea of intensity 9 in the Richter Scale in the Sumatra-Andaman range, it took everyone in India by surprise. The tsunami waves move along the bed of the sea with tremendous velocity and unleash huge energy when they reach the shore. These waves along the seabed are not noticeable from the surface of the sea and hence cannot be detected unless sophisticated instruments are placed on the sea bed. The tsunami waves could reach up to 30 ft above the sea level while reaching the shore. This huge column of water with very high speed gathers tremendous amount of kinetic energy that is capable of destroying everything that comes in its way. As a result of this, the December 2004 tsunami killed more than 230,000 people in 11 countries of south east Asia, India is one of these. After the devastating *tsunami* of 2004, early warning systems have now been put in place. There was a *tsunami* warning issued by Indonesia in 2010 following a 7.8 Richter Scale quake in Sumatra; fortunately, there was no tsunami.

It goes without saying that people living close to the sea are the worst affected by a tsunami. They are the fisher folks, the people living in the resorts and hotels close to the sea beaches and others within the destructive zone of tsunamis. The immediate needs of the *tsunami* affected people would be similar to other high-impact disasters. These could be:

- Rescue of survivors.
- Care of the injured.
- Temporary shelter.
- Removal and disposal of dead humans and animals.
- Food and water.
- Clothes for all age groups.

- Sanitation including environmental sanitation.
- Hygiene kits.
- Psycho-social support.
- Care and protection of children who may have lost both parents.

Rehabilitation after tsunami becomes difficult for two reasons:

The government would have to allot alternative land to the fisher folk at a safe distance but not very distant from the sea because their source of livelihood is the sea and they study the sea very closely and intensely through the day and night.

Vast agricultural land may be inundated by the sea water making it difficult to grow crops immediately after a tsunami.

The international and the national communities overwhelmingly responded to such a high impact disaster like the *tsunami* of December 2004. Immediately after the *tsunami*, everyone seemed to converge on Nagapatanam in Tamil Nadu. This had happened to Jagatsingpur after the Orissa Super Cyclone. Very few, at least in the initial stage, went to the Andaman and Nicobar Islands. There would be a lot of lessons to learn for both the government and the civil society from this experience. The need of coordination both centrally (may be at Delhi) and at the grass root level are highly advised.



Fig. 11.3 A new school building in Andaman constructed by VHAI which could also act as a tsunami or cyclone shelter

Source: Shishir Das, VHAI

Chapter

12

HUNGER AND DISASTER

t has been described earlier, that there is an intrinsic relationship between hazards, poverty, vulnerability, disaster and the capacity to cope with disasters. Natural Lor man-caused hazards turn into disasters, if people exposed to it are poor and vulnerable. In spite of many achievements on the economic front, India is a home for a very large number, as large as 200 million, of hungry people. The under-five nutrition is a well-established indicator of poverty, vulnerability and household food security or insecurity. The international and national development and relief workers for a long time now have been raising the concern that the center of gravity of malnourishment is shifting from sub-Saharan Africa to India; "A report by International Food Policy and Research and another by Save the Children had pointed out that the country was home to a third of the world's malnourished children. The report added that 43% of Indian children were underweight, 7 million children were severely malnourished and 55% of women were anemic" (Source: Save the Children Fund India). According to one member of the National Advisory Council (NAC) headed by Mrs. Sonia Gandhi, the chairperson of UPA Government of India, as reported in the *Telegraph* of October 24, 2010, 36% of the total population of the country lives below the poverty line! This corroborates with what the development and humanitarian sector, both national and international, have been conveying. Newspapers of late, have been reporting that the total number of hungry people in India is more than that of 17 sub-Saharan countries of Africa put together. A study was conducted in 2008 by the International Food Policy Research Institute, Delhi, Welthhungerhilfe, Germany and University of California,

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Riverside, USA on Global Hunger Index (GHI). This study was conducted in "88 developing countries and countries in transition"¹⁴. According to the Global Hunger Index which denotes the proportion of people that do not consume adequate calories, India is slightly above Bangladesh, but below all other countries of South Asia. Based on the GHI, India ranks below Kenya, Nigeria, Cameroon and even Congo and Sudan, although the per capita income of these sub–Saharan countries ranks much lower than India. The table below shows the comparison of GHI between few countries of Africa and India:

Country	GHI 2008	GDP per capita*
Nigeria	18.4	1977
Cameroon	18.7	2124
Kenya	19.9	1535
Sudan	20.5	2088
India	23.7	2753

 Table 12.1
 Global Hunger Index in Selected Countries¹⁴

*Gross Domestic Product (GDP) dollar estimate at Purchasing Power Parity (PPP)

Source: World Development Indicators, 2007, World Bank

Within the country, there is a vast variation of the hunger index. Madhya Pradesh has the highest percentage of hungry people in the country: a situation considered as highly alarming with Hunger Index as high as 30.9. This is one and a half times higher than Nigeria. Madhya Pradesh is closely followed by Jharkhand (28.67) and Bihar (27.30). "The India Hunger Index represents the index calculated using a calorie undernourishment cutoff of 1632 kcal per person per day to enable compatibility of the India State Hunger Index with the Global Hunger Index 2008"¹⁵. In such a situation where more than 200 million people in the country are hungry, the consequences of even a moderate shock, be it natural or man–caused, could have a devastating impact on the life and livelihood of such a large section of the Indian society. The consequence of exposure of this population to a high intensity, 'high impact' disaster, is not difficult to apprehend.

Madhya Pradesh and Jharkhand are known for recurring drought and Bihar for recurring floods. In 2008, a civil society organization based at Jharkhand had monitored the nutrition of 1200 under–5 children in 20 villages of Madhupur block. It was evident from the analysis of nutrition levels in the children that there was food security in these villages as reflected by the nutrition of children, for only four months of the year: November to February (Source: Author, who interpreted the data).

After every bad flood in Bihar, a state with a large Dalit and Muslim population, a huge amount of resources are spent in plugging the breaches that are responsible for the flood, without any guarantee when this would be breached again causing yet another flood. This cycle of flood and flood protection has been brewing discontent among the people living in the areas bordering Nepal. Who benefits from such structural measures to contain floods, is an open secret.

Chapter **13**

GENERAL OBSERVATIONS

The following are the general observations based on the author's empirical insight gathered while responding to various disasters:

- 1. Large-scale destruction has seeds of construction embedded in it.
- 2. Organizations involved in humanitarian response are advised to work through the full cycle of disaster management.
- 3. International organizations supporting civil society organizations to respond to a disaster, therefore, should support the full cycle of disaster management.
- 4. Both the public and private Institutions should follow the *Sphere* standard in principle (the code of conduct) and in practice.
- 5. A well-coordinated needs assessment helps in making informed choices, thereby meeting the actual needs of the disaster affected communities rather than their perceived needs.
- 6. Technologies, like GPS and GIS, should be used to assess the population affected by disasters.
- 7. The impact of a disaster should not be assessed only by the mortality alone.
- 8. In case of large disasters, multi sector teams comprising of experts, with proper gender balance, should be involved in needs assessment.
- 9. Unnecessary, inappropriate and more than necessary relief provision is a sheer waste of resources.

- 10. In the initial phase after a disaster, the needs of the people affected by it evolve and change quickly. A good communication between the people in the field and in the headquarters where decisions are made, is extremely critical.
- 11. Performance in one phase of the disaster management cycle affects the outcome in subsequent phases.
- 12. Integration of Disaster Risk Reduction with development programs is imperative. The government and civil society organizations involved in development should integrate DRR in all development initiatives.
- 13. Public buildings like Anganwadi centers, schools, etc., in known flood, cyclone and *tsunami* prone areas could be built as temporary shelters instead of building standalone cyclone or flood or tsunami shelters which are not generally maintained.
- 14. There is no dichotomy between development and disaster management both increase poor peoples' capacity to cope with macro or/and micro shocks.
- 15. Children and women's needs after a disaster must be adequately addressed.
- 16. People affected by disasters should be treated with dignity must not be treated as passive recipients of doles.
- 17. There is a tremendous collective power and wisdom when people come together, even if they are poor and vulnerable. This collective power and wisdom should be put to use in disaster management.
- 18. Experience has shown that the poor are able to cope with disasters provided they are prepared.
- 19. The immediate 'relief phase' should be restricted to a limited period.
- 20. Normalcy should be restored as early as possible after a disaster.
- 21. People affected by a disaster should be encouraged to get back as quickly as possible to the productive activities they were engaged in, prior to the disaster this is possibly the best rehabilitation strategy.
- 22. A senior bureaucrat, mandated by the government, should be entrusted the responsibility to coordinate after a disaster, thereby reducing duplication, overconcentration in a pocket and ensuring more or less similar relief and rehabilitation packages.
- 23. Post-disaster housing program is not a priority for the poor unless used as a long term income generation among the poor, use of the salvaged material could bring down the cost of new houses by at least 20%.
- 24. A village-based approach in the reconstruction phase is bound to cause problems because a village in not a homogeneous unit. The socially and politically

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powerful will have high aspirations from the government or civil society which may not be met.

- 25. CSOs involved in the 'cash for work' after a disaster must not pay more or less than the minimum wage. Paying more than the minimum wage could adversely impact the next cropping cycle. Through the 'cash for work' program, very useful social messages could be passed on to people like minimum wage, equal wage for women and men and no one below 14 years should work as a wage earner, etc.
- 26. The poor are bankable and hence livelihood support in disaster rehabilitation programs should not necessarily be a dole: through such programs, people could create their own capital by paying back the cost of input after production, to meet future exigencies.
- 27. In the entire central India, where the land is undulating, where only rain fed agriculture is practiced, where population is predominantly tribal, appropriate land and water management could reduce the impact of agricultural drought. The NREGA resources could be used for drought proofing.
- 28. Disaster responses should be converted into long-term development programs.
- 29. For ensuring effective early warning systems in international rivers, there is a great need for coordination among civil society actors and organizations between upstream and downstream, apart from the already existing government systems.
- 30. The impact of global warming is already being felt by the poor and hence it is time to accept it as a given, and take appropriate Climate Change Adaptation Practices.
- 31. Action research on alternative livelihood resilient to climate change has become imperative.
- 32. India has a huge pool of competent human power to respond to disasters, hence only in exceptional situations, skilled people should be brought in.
- 33. There is a need for more intensive training of the Indian Administrative Services staff on disasters at the IAS Academy.
- 34. Disaster management should become a main subject in the curriculum in the middle and upper classes of all schools in the country.
- 35. This should also be in the curriculum of all the technical and professional courses at graduate and post graduate levels.
- 36. Students from upper classes of schools, college going youths and their teachers should be given basic training of disaster management.

- 37. All efforts have to be made using the most appropriate medium of communication to educate people of the country about the Disaster Management Act, 2005.
- 38. The PRIs at all levels should also be provided with basic knowledge on disaster management and on the Disaster Management Act, 2005.
- 39. Institutes teaching rural development and social work must provide due attention to disaster management and climate change adaptation.
- 40. There is an immediate need for the government and urban local bodies to impose building codes for earthquake resistant houses in Zone V of the seismic zoning map of the country.
- 41. Loss due to river erosion should be included in the Relief Code.
- 42. Disaster and Disaster Risk Reduction should be taught in all schools; both private and public, throughout the country.
- 43. Students should be fully aware of all the aspects of the Disaster Management Act of the Government of India.
- 44. Public private partnership, in the true sense of the term, is the key to disaster management: the hardware could come from the public institutions; the software could be provided by the private organizations and hence GO NGO coordination committees on disaster management need strengthening at all levels.
- 45. New industries should not be started in low lying areas close to the sea in view of sea water rise due to climate change.
- 46. Nuclear reactors must not be in Zone V of the seismic zoning map of India.

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Ushar Bhattacharya is a Geophysicist from IIT Kharagpur. He has been involved in social development and humanitarian responses in India for over three decades while working with the organizations like Oxfam GB, Action Aid UK and CARE India. During all these years he had responded well in managing various types of disasters in diverse social and cultural contexts across India. He was a member of the Editorial Team of the India Disaster Report published by Oxford University Press in 1999.

After Orisa Super Cyclone in 1999, he initiated a recovery program for the most vulnerable people affected by the super



cyclone. During this recovery program poor and vulnerable people affected by the cyclone created an asset of INR 10 million out of the productive activities supported during the program. He initiated a across border flood preparedness program involving key civil society actros and organizations of Nepal, India and Bangladesh. He was very closely associated with the making of a video film: "Between Devil and Deep Water" about the failure of Kose embankment in containing flood. This film was awarded as the best video film by the President of India in 1999.

After the September 2000 flood in West Bengal, in collaboration with UNICEF Kolkata office, he was involved in a pilot program "Community Based Disaster Preparedness" in the worst flood affected areas. This program is now being replicated throughout Asia.

He was the member of the "National Cyclone Risk Management Project" governed by Government of India.