Application of Management Information System

in

Natural Disaster Management

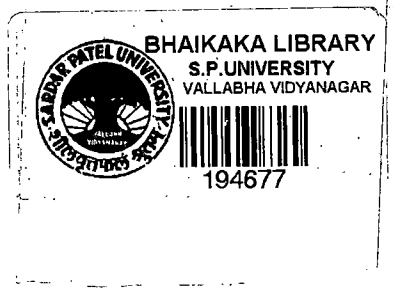
THESIS
SUBMITTED TO THE SARDAR PATEL UNIVERSITY
FOR THE AWARD OF THE DEGREE OF
DOCTOR OF PHILOSOPHY
IN MANAGEMENT

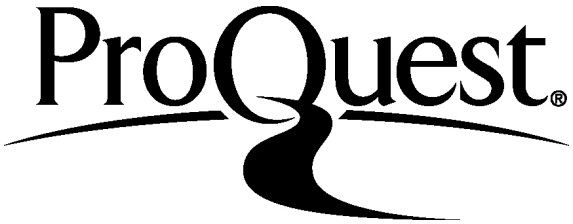
BY
BHARAT PATEL

SUPERVISOR
PROF. H.J. JANI

G.H. PATEL POSTGRADUATE INSTITUTE OF BUSINESS MANAGEMENT
SARDAR PATEL UNIVERSITY
VALLABH VIDYA NAGAR–388 120
GUJARAT, INDIA

February – 2003





Acknowledgement

I am immensely grateful to the professional advice, constant support and guidance given by my guide Shri H.J. Jani, Professor, G.H. Patel Post Graduate Institute of Business Management, Sardar Patel University, Vallabh Vidyanagar. The thesis would not have been completed, but for his cheerful support and direction, that too despite his official commitments.

I acknowledge the encouragement given by Kr. Fateh Singh Jasol, IAS, the than Director, SPIPA,; Shri A.K. Sinha, IAS, Director, SPIPA, Dr. Pramod Kumar Mishra, IAS, Chief Executive Officer, GSDMA.

I am grateful to my parent department Gujarat State Land Development Corporation for granting permission to register for Ph.D. and encourage me to undertake further studies.

I am highly thankful to Shri V.S.Gadhvi, IAS, Director Information, GOG; Shri T.P. Singh, Director, RESECO; Shri J.G. Pandya, Director (EC), GSDMA; Professor Vasudev Raval, B.J. Medical College, Ahmedabad; Dr. Bhalchndra Thakar, Director (Retd.), ISM. Thanks are due to Shri P.S. Sheshadri of Indian Institute of Management, Ahmedabad for editing the thesis.

I acknowledge the support provided by Shri Naimesh Dave, Deputy Collector; Shri Bharat Parmar, Mamlatdar; and Shri Pargi, Mamlatdar. I would like to thanks to my colleagues Shri Jagat Patel, Shri D.K. Sarvaiya, Shri N.H. Nai, Shri Ashok Trivedi, Shri Sunil Prajapati, Smt. Sushma Jecob, of SPIPA for their assistance and guidance.

I will remember with gratitude, the services of Shri Chirag Mehta and Smt. Neha Mehta who cheerfully worked on numerous drafts of the thesis. Thanks to my friend Shri Kapil Shah excellent and valuable programming work without which this study would have been incomplete.

On a more personal note, this thesis would not have been completed without the constant support, encouragement and understandings of my wife Mrs. Devyani and other family members (Kedar, Badri, Bablu, Guru), well wishers and friends.

Ahmedabad
February 27, 2003

Bharat Patel

List of Abbreviations

ACS	Additional Chief Secretary
BMTPC	Building Materials and Technology Promotion Council
CBO	Community Based Organisation
CEO	Chief Executive Officer
CR	Control Room
CWC	Central Water Commission
DDO	District Development Officer
DHA	Department of Humanitarian Affairs
DM	Disaster Management
DMIS	Disaster Management Information System
DSS	Decision Support System
ERC	Emergency Response Centre
GIS	Geographical Information System
GOG	Government of Gujarat
GOI	Government of India
GSDMA	Gujarat State Disaster Management Authority
GSLDC	Gujarat State Land Development Corporation
HF	High Frequency
HSC	Higher Secondary Certificate
IAF	Indian Air Force
IC	Information Centre
IDNDR	International Decade for Natural Disaster Reduction
IEC	Information, Education, Communication
IIPA	Indian Institute of Public Administration
IMD	Indian Meteorological Department
IS	Indian Standards
IST	Indian Standard Time
IT	Information Technology
MIS	Management Information System
NCC	National Cadet Corps.
NCDM	National Centre for Disaster Management
NDM	Natural Disaster Management
NGDP	National Gross Domestic Product
NGO	Non Government Organisation
PCCF	Principal Chief Conservator of Forest
PS	Principal Secretary
RESECO	Remote Sensing and Communication Centre
SF	Support Functions
SGDP	State Gross Domestic Product
SOP	Standard Operating Procedure
SPIPA	Sardar Patel Institute of Public Administration
SRP	State Reserve Police

SSC	Secondary School Certificate
TCM	Talati Cum Mantri
TDO	Taluka Development Officer
UHF	Ultra High Frequency
UN	United Nations
US	United States
UT	Union Territory
VHF	Very High Frequency
VIP	Very Important Person
VO	Voluntary Organisation
VSAT	Very Small Aperture Terminals
WAN	Wide Area Network
WSS	Water Supply Source

Shri H.J. Jani
Professor

G.H. Patel Post Graduate
Institute of Business Management
Sardar Patel University
Vallabh Vidyanagar -388 120

27-02-2003

CERTIFICATE OF BONAFIDE

Certified Bonafide that the thesis entitled **"Application of Management Information System in Natural Disaster Management"** submitted by Sri Bharat Patel for the award of the Ph.D degree of the Management Faculty of the Sardar Patel University, Vallabh Vidyanagar, under my guidance is the outcome of his original work and that the same has not been submitted for the award of any degree or diploma.

H. J. Jani

Bharat Patel

A/63, Avani Complex
Naranpura Bus Stop
Naranpura
Ahmedabad.

February 27, 2003

CERTIFICATE

I, Bharat Patel hereby certify that the thesis submitted by me entitled **"Application of Management Information System in Natural Disaster Management"** in fulfillment of the requirements for the award of the Ph.D Programme, is the outcome of the original study under taken by me and that it has not been submitted earlier for the award of any degree or diploma.

Bharat Patel

Research Summary

Gujarat is, natural as well as man-made disaster prone state. So it is, one of the unique states having various kinds of disasters like Cyclone, Flood, Drought, Earthquake, Fire, Industrial Accidents and Riots. Moreover due to wide range of coastal areas ranging about 1600 kms., the sea storms are the permanent problems, effecting directly to the fishermen and the lives of the people of coastal area.

The state government has taken up various kinds of measures including forecasting well in advance to control such kinds of disasters as well as to prevent and control the pre and post disasters situations. However, due to insufficient infrastructure facilities and non-availability of proper Management Information Systems and poor co-ordination, the total control of the situation is very difficult.

In the world, generally it is found that disaster can occur any time, anywhere, in any situation and it can damage very heavy. However, these damages can be minimized to the great extent, without loss of lives and property, by having better and efficient Management Information system. In short at the time of disaster, better and efficient MIS is of immense value and help whether the country is poor or rich. Considering the facts that any country facing disaster situation has to suffer heavily due to such occurrences, it is necessary to have pre and post disaster control measures through proper MIS, which can minimize the damages to the property, agriculture, industrial sectors and loss of lives. In the information system, any situation can be handled if the better and efficient MIS can be implemented. In this context, it was thought to focus on development of better MIS, which is very important for state Government in disaster management.

The Gujarat State has constituted various committees either of high level or district levels to prevent disasters and provide relief works to fight against the situation. The concern departments like Health, Revenue, Home, Agriculture, Irrigation, and Energy along with voluntary organizations are members of such committees. They are always very active in relief works. However, availability of past data, technology,

experience of government marchinary, help of computers, and latest information technology can result in preventing and controlling of disastrous situations. All the data, information technology, computers and communication technology viz: Mobile, satellite phone, remote sensing and communication through satellite, e-mail, internet, multimedia awareness, website can be put under one roof and a full proof Management Information System can be evolved.

The details regarding present system of Disaster Management in the state for major Natural Disaster like Flood, Earthquake, Cyclone and Drought etc., experiences of difficulties faced during management of various disasters because of present system and views or suggestions for batter management, suggestions for best Disaster Management Information System on the basis of their experiences and knowledge were asked in the open ended structured questionnaire and partial interviews was also taken in detail for state level senior policy makers and experts from various sectors like administration, health, industries, information, rural, technology, metrology etc. to determine the gap between existing system of Disaster Management and proposed Disaster Management Information System.

The study captured the assessment of present system of Disaster Management's capability to handle the situation at various stages of Disaster Management cycle. It has been found that an effective flexible, useful and full proof Disaster Management system itself and disaster Management Information System model is essential.

It was found that in present system network of Government is there up to local level starting from National / state level with infrastructure facilities and other supports by various government schemes. At the same time it was observed that planning at local level was diffused in the disaster situation, because it was not community based and participatory from the very beginning and it was also not in the context of local agro climatic situation and livelihood patterns in different parts of the state. Technology and communication facilities are present there but government marchinary is not known to if and community is unaware with number of things. So training of Government Machinery

and awareness campaigns for community people are required. Existence of NOGs and media can be used in complementary manner with synergic effects in the proposed Disaster Management Information System.

The study suggests new role in all the segments like Government, NGO and community for management of Disaster with proposed Disaster Management Information System model. The study also suggests the strategy for forecasting, warning, collection and dissemination of information, information channels, damage assessment, public awareness system, information networking system, software's like GIS, GPS etc's. Its connectivity and integration of all the systems in long-term perspective.

Disaster Management is a multi disciplinary subject having various aspects and different kind of classifications. It also covers various kinds of stages in Disaster Management cycle. So it is beyond reach for any body to cover all the things for all calamities that is why the study limited up to four main natural calamities (Flood, Earthquake, Cyclone and Drought) still there are number of things to do in this field. The study gives directions for such kind of further research also.

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Chapter I

Introduction

1.1 Nature and Size of the Problem

Natural disasters are estimated to have claimed about 3 million lives around the world since 1960, as well as severely affecting the livelihood of about 1 billion people. The damage caused to property is assessed at well over US $ 400 billion. The Asia Pacific region has been one of the worst hit regions of the world. It is estimated that nearly 50 per cent of the world's major disasters occur in Asia and the Pacific. Since the international Decade for Natural Disaster Reduction began in 1990, number of deaths from natural disasters in Asia and the Pacific has exceeded 2,00,000. The estimated damage to property was about US $ 50 billion until the Kobe earthquake and very heavy flooding in China took place in 1995. Damage now is estimated at US $ 120 billion. The national economies of developing countries in Asia and the Pacific are significantly affected by the loss of scarce resources that could otherwise have been used for social and economic development. In many cases the development process has been set back by years or decades. The frequency and intensity of adverse natural phenomena and the extensiveness and severity of the damage they cause seem to be increasing over time.

Floods, droughts, cyclones, storm surges, earthquakes, landslides and volcanic eruptions periodically affect a large number of countries in the region, causing great loss of life and extensive damage to property and infrastructure. In many coastal areas of Asia prone to damage by tropical cyclones and storm surge, the population is growing rapidly, together with the pace of economic development.

The most common of the water-related natural disasters in Asia are floods. Almost all of the countries in Asia frequently experience severe flooding. Although floods today do not claim as many lives as the storm surges, they affect

both urban and rural residential areas, as well as agricultural areas and cause the greatest damage to property. In some areas floods trigger landslides and mudflows claim a significant number of lives. Floods are the most frequent and thus the most destructive natural hazard affecting the region.

Most of the great disasters associated with tropical cyclones have been caused by storm surges in Asia. Storm surges occurring several hours in advance of the landfall of a tropical cyclone can hit a coastal area while people are still being evacuated and can therefore cause extremely high loss of life and material damage.

Droughts may affect large parts of the population, causing human misery in the region, particularly if remedial measures are not taken in advance. Although droughts generally occur in semi-arid or desert climates in Asia, they may also seasonally severely affect areas where the average rainfall levels are reasonable.

The main geological hazards that affect Asia are the earthquakes, tsunamis, volcanic eruptions and landslides. The region covers many areas of high seismic activity and volcanism. It has been estimated that during the last 300 years, over 2.5 million have died around the world as a result of earthquakes and that nearly 75 per cent of these fatalities occurred in Asia and the western Pacific. Volcanic eruptions in large island countries of Asia located at the western Pacific Rim have also claimed a considerable number of lives. Tsunamis are among other hazards that affect these countries.

Earthquakes are rather difficult to predict and when such prediction can be made, there is usually little time to issue adequate warnings to the people. However, timely predictions of volcanic eruptions in the countries of the region have enabled the concerned authorities to evacuate the people from danger zones before any harm was sustained.

In many countries of the region, it is gradually being recognized that the initial and most vital response to disaster must be at the local level and that the community must be well informed about disaster preparedness measures and be made alert at the time of disaster.

In Asia and the Pacific, natural hazards cause a high number of lives to be lost, and relatively small property losses in least developed and developing countries. In contrast, in the relatively developed countries where disaster prevention and mitigation measures are adequately established, the loss of lives is relatively small, but the damage to property is high. Losses may vary within a country itself. This is mainly due to the fact that the countries of region are at different stages of institutional development with regard to natural disaster reduction activities. Some countries have long established frameworks for responding to the requirement of the country. Others, particularly with the advent of the International Decade for Natural Disaster Reduction, have either strengthened their existing institutional mechanisms or are in the process of forming a framework.

In order to develop the appropriate systems and measures to mitigate the effects of natural hazards, it must first be studied how such hazards become disasters. Vulnerability of an area to a natural hazard or the probability of its occurrence defines the possible risk of exposure to a natural hazard at that place. A natural phenomenon is considered to be a natural disaster only when it causes both loss of life and considerable damage to property.

Natural hazards produced by the forces of the nature, upon which human society can have very limited control, are the main causes in the creation of natural disaster. Besides the usual natural forces, there is the extremely important human factor which amplifies the level of destruction and thereby transforms events of natural hazards into disasters.

Rapid population growth in the region is one of the main elements in increasing of vulnerability to natural hazards causing natural disasters. In the first place, the higher rate of population growth directly results in high population density and higher level of physical infrastructures. High population densities almost inevitably result in high death tolls, and high property values unavoidably result in high losses if appropriate preventive measures are not undertaken beforehand. Increasing population pressure in the countries of the region causes habitation of hazard-prone lands. The ever declining land-people ratio eventually forces people to inhabit hazard prone marginal lands in increasing numbers. The other effect of rapid population growth; which has a direct bearing on natural disasters, is the haphazard development and enlargement of urban areas. The main feature of urban growth driven by these factors in the region is the increasing emergence of slums and squatter areas at the outlying areas. These are the most vulnerable areas with high disaster risks where natural hazards often reach disaster proportions. The flood plains of South Asia support some of the highest densities of population in the world and the heavy density of population in the coastal environment is exposed to risks of flood disaster through cyclones, typhoons and tsunamis.

Poverty is also one of the major underlying causes for the inappropriate types and poor quality of building materials, substandard planning and building code regulations and, most importantly, weak enforcement of safety codes and provisions.

Another factor that exacerbates the effects of natural hazards is environmental degradation. The damage from natural hazards is higher in countries where environmental degradation is rampant. Deforestation, erosion, overgrazing / over cultivation and incorrect agricultural practices and degradation of natural buffers amplify the effects of natural hazards. Environmental degradation may eventually contribute to climate change, exposing areas to droughts and possibly triggering famines.

The impact of natural disasters is much higher in the developing countries than in the developed countries, and it is usually the poor who are most affected. In the catastrophic cyclone of 1991 in Bangladesh, for instance, most of the casualties were persons striving to eke out a living along the coastal flatlands. Natural disasters, particularly those repeatedly affecting certain areas, have an adverse impact on investment in those places, as well as on the non-formal economic sector.

The level of disaster preparedness is a major factor in the mitigation of natural disasters, with the available technology. Most natural disasters, particularly cyclones, floods, and droughts, can be forecast in advance. However, in most of the developing countries, disaster preparedness measures, especially the early warning systems, are inadequate. Not all of the people can be warned in time, and in many places there are not enough disaster preparedness measures such as adequate number of easily accessible cyclone shelters and evacuation equipment[1].

1.2 Global Overview

Disasters have been mankind's constant though inconvenient companion since time immemorial. The fury of nature can be as disastrously beautiful as the gifts of nature received gratis. Natural disasters continue to strike unabated and without notice and are perceived to be on the increase in their magnitude, complexity, frequency and economic impact. These hazards pose a threat to people, structures or economic assets, and assume disastrous proportions when they occur in areas of dense human habitations. Increasing population and various other socio-politico-economic considerations have forced people to live in areas that are considered uninhabitable like flood-prone areas of major river systems and the low lying areas along the sea and islands, which are often inundated.

Since 1960, natural disasters have resulted in the loss of three million lives and affected many more at global level. Their economic costs are on the rise in

alarming proportions: compared to the 1960s, the economic loss due to disasters has increased by a factor of 8, discounting inflation.

Ninety per cent of natural disasters and 95 per cent of disaster related deaths worldwide occur in developing countries.

The problems of disaster management in developing countries are unique due to the seemingly competing needs between basic necessities for people and economic progress. The environment has borne the brunt of this competition for resources with rapid increases in population due to the development process itself. The constant use of the environment and its resources has inevitably resulted in changes in the ecology and with changing environmental conditions, the nature and intensity of natural disasters has assumed newer dimensions.

It has often been pointed out that most of the world's worst disasters tend to occur between the Tropic of Cancer and the Tropic of Capricorn. Coincidentally, this is the area that is inhabited by the poorer countries of the world. A major significance of this is that such countries find themselves facing repeated setbacks to progress in addition to mounting pressure on ecology and environmental conditions due to rising population. Indeed, some countries seem destined to remain in the category of developing nations primarily on account of the severity and magnitude of such disasters. Seen in this backdrop, therefore, disasters can be a strong aggravating factor widening the differential between the wealthy nations and poor nations.

The fact that the more the nations develop aggravates the complexity of the problem; and the more assets they build up, the more vulnerable they become to disasters. This applies to all countries, rich and poor alike, and it underlines the need for all countries to try to develop and maintain an effective disaster management capability appropriate to their needs. It also underlines the necessity for coordinated international action in order to strengthen all aspects of disaster management to the extent possible.

Unless disasters can be mitigated and managed to the optimal extent possible, they will continue to have a dominating effect on the future. Since, the political, economic and social stability of the world depends significantly on bridging the gap between developing and developed nations, the mitigation and containment of disasters in the developing nations has to be taken up as an issue of prime importance.

It is strange but true that along with global socio-economic advancement, there has been a rapid rise in the toll of human lives and economic losses due to natural calamities all over the world. In India, the frequency of natural disaster has increased considerably in the last few decades, which has necessitated the strengthening of response mechanism of the existing civil administration system[2].

1.3 National Scenario

India is one of the world's oldest civilizations with a rich cultural heritage. It covers an area of 32,87,590 square kilometers, extending from the snow-covered Himalayan heights to the tropical rain forests of the south. Planning considerations begin with a review of the geography.

The seventh largest country of the world, India is well marked off from the rest of Asia by mountains and seas, which give the country a distinct geographical entity. Bounded by the Great Himalayas in the north, it stretches southwards and, at the Tropic of Cancer, tapers off into the Indian Ocean between the Bay of Bengal on the east and the Arabian Sea on the west.

It has a land frontier of about 15,200 kms and a coastline, including the Andaman and Nicobar Island and the Lakshadweep, of 7,516.6 km.

The rivers of India could be classified as (i) himalayan rivers, (ii) peninsular rivers, (iii) coastal rivers, and (iv) rivers of the inland drainage basin. The Himalayan rivers are perennial as they are generally snow-fed and have reasonable flow throughout the year.

The climate of India may be broadly described as tropical monsoon type. There are four seasons: (I) winter (January-February), (ii) hot weather summer (March-May), (iii) rainy southwestern monsoon (June-September), and (iv) post-monsoon, also known as the northeast monsoon in the southern Peninsula (October-December). The climate is affected by two seasonal winds – the northeast monsoon and the southwest monsoon. The north-east monsoon, commonly known as winter monsoon, blows from land to sea whereas the south-west, monsoon known as summer monsoon blows, from sea to land after crossing the Indian Ocean, the Arabian Sea and the Bay of Bengal. The south-west monsoon brings much of the rainfall in the country. With improvements in meteorology, it is now possible to make forecasts about the monsoon rains.

Geologically, the Indian subcontinent is divided into three principal segments. These are the:

- Himalayas and their extension to the east and the west;
- Indo-Gangetic plains to the south
- Peninsular India

India's population, according to the 2001 census, stood at 1027 million. The second most populous country of the world, India is home to 16 per cent of world's population even though the country has only 2.42 per cent of the world area. The United Nations Population Fund in its *The State of World Population*, 1998 has stated that India is rapidly climbing the population ladder and, with a higher birth rate, it would overtake the most populous country China by 2050 AD. The world population, according to the Report, is growing by over 80 million a year with India contributing about one-fifth to that growth[3].

1.3.1. Vulnerability

The unique geo-climatic conditions of India make this region particularly vulnerable to natural disasters. Disasters occur with unfailing regularity and despite better preparedness to meet all such contingencies; the economic and social costs on accounts of losses caused by natural disasters continue to mount year after year.

Among all the disasters afflicting the country, river floods are the most frequent and often the most devastating. Floods are most frequent in the Ganga – Brahmaputra - Meghna basin, which carry 60 % of the nation's total river flow.

Earthquakes are considered to be amongst the most dangerous and hazardous, their impact being sudden with little or no warning, making it almost impossible to predict or make preparations against its onslaught. Though about 50-60 per cent of total area of the country is vulnerable to seismic activity of varying intensities, most of the fault lines and resultant vulnerable areas are located in the Himalayan and sub-Himalayan regions, and in the Andaman and Nicobar Islands.

Drought is a perennial feature in some states of India. Sixteen per cent of the country's total area is drought prone and approximately 50 million people are annually affected by droughts. The drought of 1987-88 was one of the worst of the century.

India has a long coastline of 7516.6 km, which is exposed to tropical cyclones arising in the Bay of Bengal and the Arabian Sea. Latest episodes of cyclones in Andhra Pradesh (1996), Gujarat (1998) and the Orissa super cyclone (1999) are examples of the worst cyclones in recent memory bringing colossal damages to life and property.

In India, out of 32 states and union territories, 23 states are vulnerable to natural disasters like floods, droughts, cyclones and earthquakes. Only one state (West Bengal) faces all four types of disasters, six states face three types of disasters, nine face two types of disasters and six face one type of disaster. It is not uncommon to experience more than one or two types of disasters affecting the country at the same time in different geographical regions[4].

Of India's 25 States and 7 Union Territories, the following 23 states (plus one Territory) are particularly vulnerable to the types of disasters indicated here.[5]

Table : 1.1 India's Vulnerability.

State / Union Territory (UT)	Drought	Flood	Cyclone	Earthquake	Total
Andhra Pradesh	Yes	Yes	No	No	3
Arunachal Pradesh	No	Yes	No	Yes	2
Assam	No	Yes	No	Yes	2
Bihar	Yes	Yes	No	Yes	3
Gujarat	Yes	No	No	No	1
Haryana	Yes	No	No	No	1
Himachal Pradesh	No	Yes	No	Yes	2
Jammu & Kashmir	Yes	Yes	No	No	2
Kamataka	Yes	No	No	No	1
Madhya Ptradesh	Yes	No	No	No	1
Maharastra	Yes	Yes	No	Yes	3
Manipur	No	Yes	No	Yes	2
Meghalaya	No	Yes	No	Yes	2
Mizoram	No	Yes	No	Yes	2
Nagaland	No	Yes	No	Yes	2
Orissa	Yes	Yes	Yes	No	3
Punjab	Yes	Yes	No	Yes	3
Rajasthan	Yes	No	No	No	1
Sikkim	No	Yes	No	Yes	2
Tamilnadu	Yes	No	Yes	No	2
Tripura	Bi	Yes	No	Yes	2
Uttar Pradesh	Yes	Yes	No	Yes	3
West Bengal	Yes	Yes	Yes	Yes	4
Andaman & Nicobar (UT)	No	Yes	Yes	No	2
Totals :	14	18	5	14	

Source: Prakash, Indu, *Disaster Management,* Rashtra Prahari Prakashn, Ghaziabad, 1995,p-36.

It is observed that since last couple of years the vulnerability status of some of the states for certain disasters has changed. Now Gujarat and Andhra Pradesh are become more vulnerable to cyclones. Same way Gujarat, Maharashtra and Madhya Pradesh are more prone to earthquakes. So India's vulnerability is something beyond shown in the table.

1.4 Disaster Management

Disasters pose serious threat to normal life as well as to the process of development. These strike with sudden violence, tearing bodies, destroying lives, families and structures apart. Natural disasters are both sudden and powerful. Human vulnerability to them is an age-old phenomenon.

A disaster is the result of an immediate situation or the result of a long set process, which disrupts normal human life in its established social, traditional and economic system. This is due to destruction of the environment, which is caused by extra ordinary natural destructive phenomena or human induced hazards resulting in human hardship and suffering beyond recovery unless external aid is brought in.

The term 'disaster' owes its origin to the French word 'Disaster' which is the combination of two terms, 'des' meaning 'bad' or evil and 'astre' meaning 'star'. In earlier days a disaster was considered to be loss due to some unfavorable star. Nowadays, the concept has changed and the term 'disaster' is commonly used to denote any odd event, be natural or manmade, which brings about sudden and immense miseries to humanity[6].

A disaster has always been defined in terms of loss whether it is life or property or both.

These are different definitions of disasters :

1) Disaster is a sudden or great misfortune, calamity. (Concise oxford dictionary)

2) Disaster is a sudden calamitous event producing great material damage, loss and distress. (Webster's dictionary)

3) Disaster is a natural or human caused event which causes intense negative impacts on people, goods, services and / or the environment, exceeding the effected community's capability to respond (International Glossary to Disaster Management, DHA- Geneva, December.92)

1.4.1 Concept

Disasters are conditions, which disrupt normal functioning of the community, and cause widespread human material and economic losses that cannot be controlled and prevented by locally available resources.

Disasters bring misery to people and seriously affect the development process of the community. However, they always stimulate changes, which invariably help the process of human adjustment, and development and that are why we shall accept them as a challenge to transforming threats into opportunity. If a pre-warning system is evolved and if we properly prepare action plan by learning from experience from disasters in the past, we can overcome these threats by reducing mortality, morbidity and financial losses by providing immediate rescue, relief, rehabilitation and reconstructive services.

This means that at every level all disasters and relief services need to be documented in terms of time, duration, affected areas, population, type of effects, magnitude of effects, community and Government responses and outcome, and the disaster preparedness plans and relief services need to be evaluated to understand the shortcomings and for updating and preparing more effective and realistic preparedness plan.

Disaster management means planned and systematic approach towards understanding and solving problems in the wake of disasters. Practical experience has proved beyond doubt that commitment of resources to disaster preparedness

in the community yields better results both in terms of economy and effectiveness compared to sinking resources in an ad hoc manner in rescue and rehabilitation. It is unfortunate that when a disaster strikes people, organizations / administration are not prepared for disaster relief plans. They do not prepare action plans or do not carry on drills and be in readiness to meet the disaster situation to mitigate the resultant damage. Only after a disaster strikes to particular area, the community and the administration in that area become sensitive and start planning. Till that they believe that worst will not come to them, and when the worst comes, they feel helpless and face losses in terms of human lives and physical destruction of properties, crops and entire developmental process.

1.4.2 History

Disaster management is an old age phenomenon that we could see from our scriptures. Our Hindu scriptures like Vedas are thousands of years old. Out of these four Vedas Samved, Atharvaved, Yajurvaved and Rigveda, the atharvaved gave us Ayurveda Science. Charaksanhita is the book of Ayurveda science, which is derived from Atharvaveda. Some shlokas of Charksanhita are regarding disaster management. Those are in the Vimansthanam (Chapter III) of Charaksanmhita as shlokas 4(1), 4(2), 4, 6, 7(1), 7(3), and 10 as under:

4-(1) दृश्यन्ते हि खलु सौम्य ! नक्षत्रग्रहगणचन्द्रसूर्यानिलानलानां दिशां चाप्रकृतिभूतानामृतुवैकारिका भावाः, अचिरादितो भूरपि च न यथावद्रसवीर्यविपाकप्रभावमोषधीनां प्रतिविधास्यति, तद्वियोगाच्चातडक्प्रायता नियता । 4(1)॥

O, gentle one! Behold the stars; the planets, the moon, the sun, the wind, the temperature and the quarters are presenting their abnormal aspect, thus portending abnormal seasonal fluctuations. As the result of this abnormality the earth will fail to produce the herbs having the right qualities of taste, potency, post-digestive effects and specific action. In consequence of this failure there will ensue of necessity a marked prevalence of diseases.

4-(2) तस्मात् प्रागुद्भवसात् प्राक् च भूमेर्विरसीभावादुद्भग्च्छं सौम्य !
भैषज्यानि यावन्नोपहतरसवीर्यविपाकप्रभावाणि भवन्ति ।4(2)।

Therefore, well before such calamities occur and well before the earth has lost her savour. O, gentle one ! Collect the medicinal herbs while yet their taste, potency, post-digestive effects and specific actions remain unvitiated.

4. न हि सम्यगुद्भतेषु सौम्य ! भैषज्येयु सम्यग्विहितेषु सम्यक् चावचरितेषु
जनपदोद्धंसकराणांविकाराणांकिंचित् प्रतिकारगौरवं भवति ।4।

Nor indeed, O, gentle one! Are counter-measures to epidemics that destroy populations a difficult matter, provided the medicinal herbs are properly culled, properly prepared and properly administered?

6. ते तु खल्विमे भावाः सामान्या जनपदेषु
भवन्तिः तद्यथा-वायुः,दकं,देशं, काल इति ।6।

The factors that affect a people in common are – the winds, the waters, the country and the seasons.

7-(1) तत्र वातमेवंविधमनारोग्यकरं विधात् , तद्यथा
यथर्तुविषममतिस्तिमितमतिचलमतिपरूषमतिशीतमत्युषणमतिरूक्षामत्यभिष्यन्दिनमतिभैरवार
ावमतिप्रतिहतपरस्परगतिमतिकुण्डलिनमसात्म्यगन्धबाष्पसिकतापांशुधूमोपहतमिति ।7(1)।

Of these, the wind, if of the following description, is to be known as disease-inducing; viz., unseasonable, totally becalmed, violently blowing, exceedingly rough, intensely cold, intensely hot, excessively dry, excessively humid, fearfully clamorous, blowing from contrary directions and clashing with itself, extremely rotatory (whirlwind), and charged with unwholesome odours, moisture, sand dust and smoke.

7-(3). देशं पुनः प्रकृतिविकृतवर्णगन्धरसस्पर्शं केल्दवहुलमुपसष्टं सरीसृपव्यालमशकशलभमक्षिकामूषकोलूकश्माशानिकशकुनिजम्बूकादिभिस्तृणोलूपोपवनवन्तं प्रतानादिबहुलमपूर्ववदवपतितशुष्क नष्टशस्यं धूम्रपवनं प्रध्मातपतत्रिगणमुत्कुष्टश्वगणमुद्भ्रान्तव्यथितविविधमृगपक्षिसङमुत्सृष्टनष्टधर्मसत्यलज्जाचा रशीलगुणजनपदं शश्वत्क्षुभितोदीर्णसलिलाशयं प्रततोल्कापातनिर्घातभूमिकम्पमति भयारावरूपं रूक्षताम्रारूणसिताभ्रजालसंवृतार्कचन्द्रतार कममीक्ष्णं ससंभ्रमोद्वेगमिव सत्रासरु दितमिव सतमस्कमिव गुह्यकाचरितमिवाक्रन्दितशब्दबहुलं चाहितं विद्यात् ॥7(3)॥

The country of the following description is to be known as unwholesome; having colour, odour, taste and touch that are unnatural; excessively damp; abounding in serpents, beasts of prey, mosquitoes, locusts, flies, mice, owls, birds and animals such as the jackal and abounding in woods of weeds and Ulupa grass; abounding in creepers where crops

Have either fallen, withered or been destroyed in an unprecedented manner; where the winds are smoky; where the sound of birds is unceasing; where the baying of dogs always assails the ears; where herds of animals and flocks of birds of various kinds are always in a state of alarm and pain; where amidst the people, morality, truth, modesty, custom, character and virtue have either declined or been given up; where the waters are always agitated and up heaving; which is frequently subjected to the incidence of meteorites, thunderbolts and earthquakes; where nature is full of menacing sounds and sights; where the sun, the moon and the stars are frequently covered by dry, coppery, ruddy and gray clouds and which lastly is as if full of constant alarm and lamentation, crying, fright, and darkness as if visited by gnomes, and as if abounding in sounds of lamentation.

10. वाताज्जलं जलाद्देशं देशात् कालं स्वभावतः।
विद्याद्दुष्परिहार्यत्वाद्गरीयस्तरमर्थवित ॥10॥

The man of understanding will know that the water is more important than wind, and country more important than the water, and season yet more important than country by virtue of their degree of indispensability[7].

1.4.3 "Crunch Diagram"

The extent of damage from a disaster depends on:

1. The impact, intensity and characteristics of the phenomenon
2. How people, environment and infrastructure are affected by that phenomenon

The relationship between hazard and vulnerability is best represented in the pressure and release, or "Crunch Diagram".

		D		
		I		
		S		
Hazard	>	A	<	Vulnerability
		S		
		T		
		E		
		R		

This relationship can be written as an equation:

Disaster Risk=Hazard + Vulnerability

The complex nature of many disasters can also go beyond secondary effects. In some cases the interaction of differing hazards and processes of change may set in a chain reaction culminating in disastrous political and economic consequences. An example of this can be seen in many African famines; lack of rain and subsequent drought does not always turn into a famine. However, when combined with failed market systems, political discord and internal conflict, drought can easily become a famine, which in turn compounds the negative effects of these other factors[8].

Reference:

1 Reading Material Natural Disaster Management Cell, Sardar Patel Institute of Public Administration, Ahmedabad. *Imperatives in Natural Disaster Reduction,* 18-21

2 Gupta M.C., Vinod K. Sharma, L.C.Gupta, B.K. Tamini (ed), *Manual on Natural Disaster Management in India,* (National Centre for Disaster Management, IIPA, New Delhi, 2001) 1-2

3 Singh Prakash, William W. Mendel, Graham H. Turbiville, JR, *Disaster Response in INDIA*, (The Center of Excellence in Disaster Management and Humanitarian Assistance & The Foreign Military Studies Office, 2000) page 43-47

4 Gupta M.C., Vinod K. Sharma, L.C.Gupta, B.K. Tamini (ed), *Manual on Natural Disaster Management in India,* (National Centre for Disaster Management, IIPA, New Delhi, 2001) 5

5 Prakash, Indu, *Disaster Management,* Rashtra Prahari Prakashn, Ghaziabad, 1995,p-36.

6 Study Material of *Certificate in Disaster Management* by Indira Gandhi National Open University, New Delhi, CDM – 01, Block-1, Unit – 1. Page

7 Charaksanhita, *(Vimansthanam - Chapter III)* which is derived from Atharvaveda.

8 Gupta M.C., Vinod K. Sharma, L.C.Gupta, B.K. Tamini (ed), *Manual on Natural Disaster Management in India,* (National Centre for Disaster Management, IIPA, New Delhi, 2001) 12

Chapter II

Literature Review

2.1 Typology of Disaster

The Indian *Encyclopedia of Disaster Management*, edited by P.C. Sinha, describes disasters using the typology of natural, man-made, or a hybrid of the two[1].

- *Natural Disasters* include floods, earthquake, volcanic eruption, hurricane, tornado, and avalanche;
- *Man-made* disasters (or those with anthropogenic origin) are exemplified by some of the terrible accidents that have resulted from man's interaction with the artificial environment he has created, such as the nuclear accident at Chernobyl and the methyl isocyanate (MIC) gas tragedy at Bhopal;
- *Hybrid Disasters* can arise from a combination of anthropogenic and natural events like the destruction of rain forests (and resulting increased severity of flooding or mudslides) or deaths due to heat waves and pollution in the major conurbations around the world[2].

Sinha makes the point that although it is difficult to identify a clear pattern of disaster events, we should be able to discern general patterns of man-made development and settlement that are attendant to severe disasters. For some 17 categories of disasters, he suggests a high degree of human involvement as illustrated below:[3]

Disaster Type	Natural	Man-made	Hybrid
Avalanche/Rockfall	Yes	No	Yes
Air Transport	No	Yes	Yes
Road Transport	No	Yes	Yes
Marine Transport	No	Yes	Yes

Disaster Type	Natural	Man-made	Hybrid
Climatic	Yes	No	Yes
Drought	Yes	Yes	Yes
Famine	Yes	Yes	Yes
Epidemic	Yes	No	Yes
Plague	Yes	Yes	Yes
Earthquake	Yes	No	No
Fire	Yes	Yes	Yes
Explosion	No	Yes	Yes
Flooding	Yes	No	Yes
Mining	No	Yes	Yes
Volcanic Activity	Yes	No	Yes

In addition, we can be faced with C*ompound Disasters* when one type of hazard triggers a disaster, which, in turn, triggers another hazard, and subsequent disaster. A drought may lead to a famine, which may result in a civil conflict leading to mass displacement of people. Complex disasters are emergencies in which the contributory causes and the assistance to the affected people are circumscribed by political considerations. The disaster becomes complex because the collapse or breakdown of political authority makes assistance highly problematic. A way out of the impasse is found through an agreement between the parties involved in the conflict with humanitarian considerations prevailing over all the other considerations. The situation in Sarajevo, where conflicts among Bosnian Muslims and Serbs enjoined U.N. participation, falls into this category.

Disaster causes and factors have been categorized in other ways too. The nature of *Sudden Onset Hazards* can be geological (earthquake, tsunami, volcanic eruption, landslide) and climatic (tropical cyclone, flood). *Slow Onset Hazards* are typically environmental in nature (pollution, deforestation, desertification, and pest infestation). *Industrial and Technological hazards (*systems failure and accidents, explosions and fires, nuclear mishap) and *War and Civil Strife* (armed aggression, terrorism, and insurgency) are also prominent factors.

2.2 Causes and Characteristics of Disasters

2.2.1 Earthquake

A. Causes

The earth's crust is not one piece but consists of portions called plates, of varying sizes. These plates are not stable but move with three distinctive types of movements along the boundaries of the plates.

- **Convergent Boundaries** : Where plates push each other and one plate slides down the other one.
- **Divergent Boundaries** : Where plates pull away from each other.
- **Transformed Boundaries:** Where plates slide past each other.

Due to continuous movement of the plates, stress accumulation takes place at the boundaries of these plates. When the stress accumulation reaches a point of maximum supportive strain, a rupture takes place generating an earthquake. The earthquakes generated this way are most damaging. Approximately 95% of the earthquake activities occur at the plate boundaries. Some earthquakes, however, do occur in the middle of the plates, possibly indicating where earlier plate boundaries might have been. The point of rupture is called the focus.

The intensity of shaking at any place is related to the amount of energy released, the focal depth, distance of the place from the focus and the structural properties of the rock or soil on the surface. Some earthquakes are associated with volcanic activities as well[4].

B. Characteristics :

The impact of an earthquake is sudden with little or no warning. However, following a major earthquake, the after-shocks may give warning of a further earthquake. On some occasions, an earthquake may be preceded by less intense tremors or foreshocks.

- It is not yet possible to predict magnitude, time and place of occurrence of an earthquake.
- The onset is usually sudden.
- Earthquake prone areas are generally well identified and well known on the basis of geological features and past occurrences of earthquakes.
- Major effects arise mainly from ground movement and fracture or slippage of rocks underground. The obvious effects include damage (usually very severe) to buildings and infrastructures along with considerable casualties.
- On the average about 18000 people die each year due to this disaster throughout the world.
- About 200 large magnitude earthquakes (M>6.0) occur in a decade.
- The world's earthquake problem seems to be increasing with the increased population, high rise buildings and crowded cities.

The exact spot underneath the surface of the earth at which an earthquake originates is known as "focus" while the point lying vertically above the focus is defined as the "epicenter" of the earthquake. Earthquake focus depth is an important factor in shaping the characteristics of the waves and associated damage. The focal depth can be deep (300-700 km) intermediate (60-300 km) or shallow (< 60 km). The shallow focus earthquakes are more damaging due to the close proximity to the ground.

The energy released from the focus, due to elastic rebound of rocks is transmitted in all directions in the form of Earth's crust leading to earthquakes.

The power (energy) of an earthquake is reckoned in terms of its "magnitude" which is measured on an open-ended Richter scale from 1 to 9. But it is not a linear scale and not even a logarithmic scale.

The primary waves (or P-waves) are transmitted due to longitudinal vibrations set up within the earth. These waves have the velocity of the order of several kilometers per second and cause the preliminary tremors on the surface of the earth. These waves create an effect of horizontal pull and push and are also called pull and push waves. P waves travel at a faster rate and provide the initial jolt causing buildings to vibrate in up and down motions.

The secondary (or S-Waves) on the other hand are transmitted due to transverse vibrations. These are known as surface or slow waves. Even though the amplitude and size are small compared to other waves, these are the most destructive since they create vertical up and down movements in the ground surface as against horizontal oscillation due to longitudinal waves. These are long period waves and cause swaying of tall buildings. S waves travel at lesser speed than P waves and causes a movement similar to a rope being snapped like a whip. These waves cause a sharper jolt that vibrates the structure side to side and cause more damages.

While the "magnitude" of an earthquake defines the energy released by the event the "intensity" of the earthquake will depend on the particular place where it is measured. Obviously the intensity will decrease as the distance from the epicenter increases[5].

2.2.2 Floods

A. Causes

Flooding conditions may occur due to :

- Rivers in spate
- Snowmelt
- Storm surges
- Short intense storms causing flash floods

Flooding in rivers is mainly caused by:

- Inadequate capacity within the banks of the river to contain high flows.
- River bank erosion and silting of riverbeds.
- Landslides leading to obstruction of flow and change in the river course.
- Synchronization of flood in the main and tributary rivers.
- Flow retardation due to tidal and backwater effects.
- Poor natural drainage.
- Cyclone and heavy rainfall[6].

B. Characteristics :

The general characteristics of floods are generally the complex results of interaction of a number of connected phenomena and that the flooding characteristic of each river is different from another. They cannot be easily classified even in types or groups.

If there would have been no occupation of the riverfront or economic activities nearby, high floods might come as also subside without mankind being affected or bothered much.

Types of Floods

1. *Snow Melt Floods*

Precipitation in the form of snow does not produce runoff or infiltrate into the soil, but waits until the snow melts, which means that several months of precipitation can accumulate above the soil surface. Rain on the snow pack or water from the melting snow can be held within the pack until the high liquid water content finally causes the pack to collapse, releasing water catastrophically and causing a very large runoff very rapidly. Warm rain after a large cold spell may cause the snow pack to melt while the underlying ground is still frozen, which prevents any infiltration. Because of these reasons, snow melt floods can be very large.

2. Storm Surge

Floods in coastal areas and in river estuaries are usually due to storm surges, which result from the sea being driven on to the land by meteorological forces. Here two physical forces act together. A storm with intense low pressure causes the level of sea to rise because of barometric effects and strong winds associated with this storm, if directed on shore, drive the sea on the land. Storm surges are, thus, commonly associated with tropical cyclones. The east coast of India is particularly prone to storm surges. The storm that produces the surge can also give rise to heavy rainfall inland so that the estuary region can be subject simultaneously to river flooding and storm surge.

3. *Flash Floods*

Flash floods are defined as floods of short duration with a relatively high peak discharge. They arise from local precipitation of extremely high intensity, typical of thunderstorms. The high concentration of rainfall on a small area can have devastating effects as the river flow can rise to several hundred times the normal flow in the space of a few hours. Flash floods are common in arid and semi-arid areas. In these areas, what little rainfall there is usually occurs in short, intense storms. The intensity of the storms and the poor absorptive capacity of arid zone soils lead to much of the annual runoff occurring as flash floods, which can also occur following thunderstorms in more humid regions. Mountainous areas are prone to thunderstorms and the steep terrain and thin soils in the mountains assure high runoff with a short delay time[7].

2.2.3 Cyclone

A. Causes

The development of cycle of tropical cyclones may be divided into three stages

i. Formation and initial development
ii. Full maturity and
iii. Modification or decay

Formation and initial development stage: Four atmospheric and oceanic conditions are necessary for development of a cyclonic storm:

i. *A warm sea temperature* in excess of 26 degrees centigrade to a depth of 60 m, which provides abundant water vapour in the air by evaporation.
ii. *High relative humidity* of the atmosphere to a height of above 7000 m facilitates condensation of water vapour into water droplets and clouds, releases heat energy thereby inducing a drop in pressure.
iii. *Atmospheric instability* encourages formation of massive vertical cumulus cloud convection with condensation of rising air over ocean.
iv. *A location of at least 4-5 latitude degree from the equator allows* the influence of the forces due to the earth's rotation to take effect in reducing cyclonic wind circulation around low-pressure centers.

Mature Tropical Cyclones: As viewed by weather satellites and radar imagery, the main physical feature of a mature tropical cyclone is a spiral pattern of highly turbulent giant cumulus thundercloud bands. These bands spiral inwards and form a dense highly active central could core which wraps around a relatively calm and cloud free 'eye'. The eye has a diameter of from 20-60 km of light winds and looks like a black hole or dot surrounded by white clouds. In contrast to the light wind conditions in the eye, the turbulent cloud formation extending outwards from the eye accompany winds of up to 250 kph, sufficient to destroy or severely damage most non-engineered structures in the affected communities.

Modification or Decay: a tropical cyclone begins to weaken in terms of its central low pressure, internal warm core and extremely high winds as soon as its source of warm most air begins to ebb or are abruptly cut off. The weakening of a cyclone does not mean the danger to life and property is over. When the cyclone hits land, especially over mountainous or hilly terrain, riverine and flash flooding may last for weeks.

B. Characteristics

Tropical cyclones are characterized by destructive winds, storm surges and exceptional levels of rainfall, which may causes flooding.

a. Destructive winds: The strong winds that blow counter-clockwise in the Northern Hemisphere, while spiraling inwards and increasing toward the cyclone centre are highly destructive. Wind speeds progressively increase towards the core. As the eye arrives, winds decrease to become almost calm but rise again just as quickly as the eye passes and are replaced by hurricane force winds from a direction nearly the reverse of those previously blowing.

b. Storm surges: The storm surge defined as the rise in sea level above the normally predicted astronomical tide, is frequently a key or overriding factor in a tropical disaster. The major factors include.

- A fall in the atmospheric pressure over the sea surface
- The effect of the wind
- The influence of the sea bed
- A funneling effect
- The angle and speed at which the storm approaches the cost
- The tides

c. *Exceptional rainfall occurrences*: The world's highest rainfall spread over one or two days has occurred during tropical cyclones. The very high specific humidity condenses into exceptionally large raindrops and giant cumulus clouds, resulting in high precipitation rates. When a cyclone makes landfall, the rain rapidly saturates the catchments areas and the rapid runoff may extensively flood the usual water sources or create new ones.

Classification of Cyclone Disturbances

The classifications of cyclonic disturbances (low pressure areas) are made by the strength of the associated winds. The classification used in India is given in the following table[8].

Disturbance	Wind Speed (Knots)
1) Low Pressure Area	Less than 17.
2) Depression	17-27 (32-50 km/h)
3) Deep depression	28-33 (51-62 km/h)
4) Cyclonic storm	34-47 (63-88 km/h)
5) Severe cyclonic storm with a core of hurricane winds	48-63 (89-118 km/h)
6) Very severe cyclonic storm	64-119(119-221 km/h)
7) Super cyclonic storm	> 120 (223 km/h)

2.2.4 Drought

A. Causes

Drought is a temporary reduction in water or moisture availability significantly below the normal or expected amount for a specific period. This condition occurs either due to inadequacy of rainfall, or lack of irrigation facilities, under exploitation or deficient availability for meeting the normal crop requirements in the context of the agro-climatic conditions prevailing in any particular area. This has been scientifically computed as Moisture Index (MI). Drought, in this context, can be defined as adverse MI or adverse water balance which may be attributable not only to a prolonged dry spell due to lack or sufficient rainfall but also due to such other factors as excessive evapo-transpiration losses, high temperature, low soil holding capacity etc. the inadequacy is with reference to the prevailing agro-climatic conditions in any particular area. Therefore there is a drought in Jaisalmer (average rainfall 200 mm) if rainfall is not sufficient to grow grass and paltry coarse-grains, whereas in Bolangir or Koraput (Orissa- rainfall above 1000mm) there is a drought if there is not enough rainfall for bringing the paddy crop to maturity[9].

There are three types of drought:

- *Meteorological Drought* describes a situation where there is a reduction in rainfall for a specific period (days, months, season or year) below a specific amount (long term average for a specific time).
- *Hydrological Drought* involves a reduction in water resources (stream flow, lake level, ground water, underground aquifers) below a specified level for a given period of time.
- *Agricultural Drought* is the impact of meteorological/ hydrological drought on crop yield.

The three drought types are completely different and not synonymous.

B. Characteristics

A drought is characterized by scarcity of water. As an agricultural drought affects most (as compared to a meteorological or hydrological drought) and manifests itself before the situation can lead to a hydrological drought, it is the agricultural drought, which is a common concern. In fact when the word drought is used, it commonly connotes agricultural drought.

Main characteristics of drought (agricultural drought) are:

- It builds over a period of time (may be even a year or two) with increased scarcity of water-generally due to insufficient or erratic monsoon runs.
- It does not have a well-defined start. It is a creeping phenomenon.
- Generally it does not have a sharp ending although sometimes a prolonged spell of drought can come to a sudden end through a fairly long spell of especially heavy rainfall as in the case of depression or cyclone.
- Drought can be localized covering a district or a group of districts. On the other hand, it can be widespread covering a few states.
- An area affected by a drought usually takes an elliptic shape instead of a circular coverage.
- The region most prone to droughts in India are: Gujarat,Bihar,West Rajasthan, Marathwada, Telangana, Rayalseema, some parts of Orissa (Kalahandi and adjoining districts).
- Drought is more troublesome when it occurs over the rainfed areas of the country[10].

Review of Disasters

This set of information comprehensively deals with all major disasters; chronology of disasters and brief history and damage caused by major disasters and at many places government and civil society response[11].

2.3 Earthquake

Table : 2.1 List of Earthquakes in and around Gujarat by Date of Occurrence[11]

No.	Date	Time(GMT)	Latitude	Longitude	Depth	Magnitude on Richter Scale
1.	16June, 1819	-	24.00	70.00	-	8.0
2.	13Aug,1821	-	23.00	70.00	-	5.0
3.	19Apr,1845	-	24.00	69.00	-	6.0
4.	25Apr.1845	-	24.00	69.00	-	5.5
5.	27may,1847	-	21.40	75.00	-	6.5
6.	26Apr,1848	-	24.40	72.70	-	6.0
7.	25Dec,1856	-	20.00	733.00	-	5.0
8.	18Nov,1863	-	22.00	75.00	-	5.0
9.	29Apr,1864	-	24.00	70.00	-	6.0
10.	14Jan,1903	-	24.00	70.00	-	6.0
11.	15Aug,1906	-	25.00	70.00	-	5.0
12.	18Nov,1927	11:01:36.0	21.50	68.00	-	5.5
13.	14Mar,1938	00:48:24.0	21.60	75.00	-	6.3
14.	31Oct,1940	10:43:50.0	23.70	69.90	-	5.8
15.	14Jun,1950	04:24:16.0	24.50	69.00	-	5.5
16.	21Jul,1956	15:32:26.0	23.30	70.20	-	7.0
17.	1Sept,1962	22:31:30.0	24.20	73.00	-	5.0
18.	26Mar,1965	10:04:07.0	24.20	69.60	33	5.0
19.	27May,1966	22:14:14.4	24.50	69.70	5	5.0
20.	23Mar,1970	01:53:01.0	21.60	73.00	8	5.2
21.	26Mar,1975	16:19:17.9	19.70	68.70	-	5.1
22.	4Jun,1976	00:43:41.4	24.50	68.50	-	5.1
23.	24Aug,1993	17:47:30.4	20.60	71.30	25	5.0

Earthquakes are considered to be one of the most dangerous and destructive natural hazards. The impact this phenomenon is sudden with little or no warning, making it just impossible to predict it or make preparations against damages and collapse of buildings and other manmade structures. About 56 per cent of total area of the country is vulnerable to seismic activity of varying intensities, while the whole of Gujarat state falls under seismic zone of varying intensity[12].

From the earthquake hazard map of Gujarat, it is seen that almost whole of the state lies in seismic zones of probable Intensity IX (the severest) to VII (moderate) on M.S.K. Intensity Scale. The Kutch district, which has 80.3% of its area in intensity IX zone, has been subjected to one of the giant earthquakes in India in 1819 with a magnitude of 8.0 on Richter scale. A chronological list of earthquakes in Gujarat has been put in a tabular form. The location of the earthquake (probable epicenter) has been marked on the Earthquake Hazard Map of Gujarat. A more comprehensive list (Table: 2.2) has been prepared to cover the entire history of major and minor earthquakes with data from relief manual, IMD Catalogue and other sources. Four major earthquakes of the state are discussed at length with relevant information.

Generally speaking the Gujarat region and the Saurashtra peninsula are not as vulnerable as the Kutch region. However, there have been incidences of minor earthquakes in Saurashtra, Khambhat basin and South Gujarat and Arravali range in North Gujarat. Broadly Gujarat can be divided into four regions:

- Kutch
- North and Central Gujarat
- South Gujarat
- Saurashtra

Table : 2.2 Chronology of Earthquake in Gujarat.

Chronology of Earthquakes in Gujarat					
Source: Relief Manual, Revenue Dept.GoG[a]			*Source: Vulnerability Atlas of India : Gujarat*[b]		
Year	Date	Location	Year	Date	Location[c]
Kutch Region					
1819	16-Jun	Bhuj	1819♣	16-Jun	Rann of Kutch
1820	27-Jan	Bhuj	1821	13-Aug	South Kutch
1820	13-Nov	Bhuj	1845♦	19-Apr	Rann of Kutch
1828	20-Jul	Bhuj	1845♦	25-Apr	Rann of Kutch
1844		Rann of Kutch	1864♣	29-Apr	Rann of Kutch
1845	19-Jun	Lacpat	1903♣	14-Jan	Rann of Kutch
1884		Vagad area	1940	31-Oct	Rann of Kutch
1898	15-Oct	Kutch	1950	14-Jun	Around Gujarat
1903		Kutch	1956	21-Jul	Anjar
1950	14-Jun	Rann of Kutch	1965	26-Mar	Rann of Kutch
1956	21-Jul	Anjar	1966	27-May	Around Gujarat
			1976	4-Jun	Around Gujarat
North and Central Gujarat Region					
1684		Khambhat	1848	26-Apr	Banaskantha
1821	13-Aug	Kheda	1906	15-Aug	Around Gujarat
1842	9-Oct	Vadodara	1962	1-Sep	Arravali Range
1843	8-Feb	Ahmedabad			
1860		Kheda			
1864	29-Apr	Ahmedabad			
1935	20-Jul	Kapadvanj, Kheda			
1962	1-Sep	Arravali ranges			
South Gujarat Region					
1967	11-Dec	Valsad	1847	27-May	Around Gujarat
1970	23-Mar	Bharuch	1856	25-Dec	Around Gujarat
			1863	18-Nov	Around Gujarat
			1938	14-Mar	Around Gujarat
			1970	23-Mar	Bharuch
Saurashtra Region					
1919	21-Apr	Bhavnagar	1927	18-Nov	Arabian Sea
1922	21-Apr	Surendranagar, Patdi	1975	26-Mar	Arabian Sea
1938	June	Bhavnagar	1993	24-Aug	Arabian Sea (Near Diu)
1960	9-Aug	Amreli			
1940	31-Oct	Dwarka			
1962	14-Jan	Bhavnagar			

* Data gathered from two different sources to have a maximum possible chronology of earthquakes since they supplement each other

[a] 'Gujarat Rahat Niyam Sangrah' (Relief Manual), Revenue Dep., 1993 covers noticeable earthquakes from 1684 to 1970

[b] Vulnerability Atlas of India : Gujarat, 1997 covers earthquakes in and around Gujarat from 1819 to1993

[c] Not mentioned in the original source, arbitrarily put by author from geographical location. Refer to Gujarat Earthquake Hazard Map for exact geographical locations

♣ Same location of Earthquake

♦ Same locations of Earthquakes

9 7

From the earliest recorded earthquakes, the one in the Khambhat basin in 1684[13] was felt in whole of Central and South Gujarat up to Daman. The surrounding districts of Vadodara, Ahmedabad, Bhavnagar and districts of Surendranagar, Rajkot and Amreli felt earthquakes causing minor damages between 1842 and 1960.

The Kutch region has been a highly active tectonic region. The various facets of Kutch geomorphology such as its surface configuration, landforms and drainage characteristics reveal a complex interplay of tectonism, sea level changes, lithology and Cenozoic process of erosion and deposition[14]. Although, many studies about this region have been carried out so far, there is no study systematically dealing with developments so far. Table 2.2 indicates major recorded earthquakes of the Kutch region starting from 1819. A strong event took place in the Indus Delta in 1668 but virtually no data is available.

Minor earthquakes are recorded in the Arravali range in North Gujarat also, however, they have not caused major damages.

2.3.1 Bhuj Earthquake: 1819[15]

The earthquake that rocked the whole state and devastated a major part of Kutch district, especially the city of Bhuj on 16th June 1819 was one of the major earthquakes and with highest intensity also (M 8 on Richter Scale). The aftershocks lasted for next four months.

- Magnitude : 8 (Richter Scale)
- Time : 18:45 (IST)
- Duration:2.3 minutes
- Loss of Human lives:2000
- Houses Destroyed: 7000

The losses caused by quake were very huge and widespread. The death toll was too high as population of Kutch was not so dense in those times. Including Rao's palace, thousands of houses in Bhuj, Anjar, Mandvi and Lakhpat collapsed and 1150 people got buried under debris. Ahmedabad city also felt these tremors and the Jama Masjid with its elegant minarets collapsed in this quake. After this devastating earthquake, many others with severe tremors were felt in 1820, 1828, 1844 and 1845. The quake in 1845 was again devastating but sufficient data on these events are not available.

Important scientific changes after Bhuj Earthquake 1819: This quake is of foremost scientific importance with the changes that happened as consequences:

- One of the prime permanent changes that took place was lowering of the west Sindhri region and appearance of a new island near Pachchham. Due to lowering of the west part of the Rann, the ancient Castle of Sindhri was submerged.

- The most notable change was the formation of 10-20ft. high embankments called "Allah Bandh" as a permanent feature.

- Many parts in the Rann were turned into salty water lakes and big hills stopped flow of the Indus River in Kutch.

2.3.2 Anjar Earthquake: 1956[16]

Another scientific event of M7.0 occurred in 1956 causing severe damage in Anjar town, which was earlier badly shaken in 1821. On 21st July 1956 since most of 20,000-odd residents were indoors and the impact of the quake was intensified.

- Magnitude: 7 (Richter Scale)
- Time: 15:32 (IST)
- Villages affected:25
- Loss of Human lives:115
- Houses Destroyed: more than 3000
- Economic losses: more than Rs.1 Crore

People living in the industrial township of Anjar and nearby areas of Ratnal, Gubdak, Sukhpar, Tapar, Juran etc. places approximately 34 miles from Bhuj were enjoying their dinner or were already asleep when an earthquake took place. As buildings collapsed 115 died, over half the population were rendered homeless, more than 3,000 houses in 25 villages developed huge cracks, losses ran up to Rs. 1 crore. Such devastation wreaked by the quake made it one of the worst calamities to hit Kutch in the past 100 years. The quake also resulted in a landslide, which dislocated railway services and snapped communication and telegraph lines. Anjar, which was known for manufacturing knives and nutcrackers and was considered the industrial centre of Kutch till the government decided to develop Kutch as a major port, suddenly witnessed mass migration. Over 8,000 affected people migrated from the district a few days after the quake. Rains added to the misery of thousands living in temporary camps.

2.3.3 Bharuch Earthquake: 1970[17]

An earthquake shook the town of Bharuch and nearby village at 7:25 a.m. on March 23, 1970. Tremors were felt soon after that for many days.

- Magnitude: 5.2 (Richter Scale)
- Time: 07:25 (IST)
- Area affected: Bharuch and nearby villages, Surat, Bhavnagar
- Loss of Human lives:26
- Population injured:115
- Houses Destroyed: 150-175
- Houses partially damaged:2000-5000

As a result of the quake, 150 to 175 houses were either razed to ground or got severely damaged; and another 2000 to 5000 houses were moderately damaged. Minor damage was registered to the Narmada bridges also, however traffic was not disrupted. Cracks had emerged on ground at many places liquefaction of soil was seen in the plains of the River Narmada and due to that water and sand gushed out on the southern basin of the Narmada. Again small tremors were registered on March 26, 1970 and on April 26, 1970. Tremors were felt in far away places like Ahmedabad and Mumbai. In Bharuch, Kanthariya, Karmad and other places people heard voices 'bullet shooting' or 'plane crash', while in Khambhat, Kalol and Surat people heard noise of shaking of ground. The epicenter of the earthquake was almost nearby Bharuch. Government immediately started the rescue and relief activities and rehabilitation of the affected population.

The earthquake was felt in Surat in South, Bhavnagar in West and Ukai-Rajpipla in East, covering an area of approximately 27,000-sqaure meters. According to the Indian Geological Survey (1970) this earthquake was not a result of any human activity like search and excavation for petroleum products, but is took place due to shell construction activities at fault zone areas of Narmada.

2.3.4 Gujarat Earthquake: 2001[18]

On the 26th January, 2001 at 8.46 a.m. (IST), a devastating earthquake measuring 6.9 on the Richter Scale, according to Indian Meteorological Department, (U.S. Geological Survey has put the magnitude at 7.7) shook the entire state of Gujarat and before one could come to grips with reality, there was death and destruction all around. Out of 25 districts of Gujarat, 21 of them having 7904 villages fell prey to this devastation. This earthquake has caused maximum damage to Bhuj, Rapar, Anjar, Bhachau and Gandhidham talukas of Kutch district; Ahmedabad city and Daskroi taluka of Ahmedabad district, Wankaner, Morvi and Maliya - Miyana talukas of Rajkot district and Jodiya taluka of Jamnagar district; Dhrangadhra and Halvad talukas of Surendranagar district and Santalpur and Sami talukas of Patan district. In addition, Banaskantha, Anand,

Bharuch, Bhavnagar, Gandhinagar, Junagadh, Navsari, Porbandar, Surat, Vadodara, Mehsana, Kheda, Sabarkantha and Amreli district also experienced the fury of the earthquake.

Infrastructure Damage and Losses:

The earthquake caused substantial damage to private property and infrastructure in Kutch district and other areas of the State. Residential houses, Government offices, Industrial Houses, Roads, Power Sub-Stations, Railway Tracks, Telephone Exchanges and Water Supply were heavily damaged. Over 1364 buildings in health sector destroyed and in education, 5830 primary schoolrooms were completely destroyed and 35088 schoolrooms were damaged. 2040 secondary schools and over 140 technical and higher education institutes also damaged. There was heavy destruction to both rural and urban water supply schemes. Over 245 earthen dams or small reservoirs providing water for irrigation, rural and urban domestic needs and industry were damaged over 20 of which need complete reconstruction.

Earthquake 2001 - figures at a glance[11]:

- No. of Deaths : 17122
- No. of Injured : 166836
- Seriously injured : 20717
- No. of houses damaged : 904011
- No. of houses collapsed : 200438
- 40918 primary classrooms affected,
- 2040 secondary schools affected,
- 311 collages affected.
- 200 Km. road and 57 major bridges damaged
- 301 minor bridges damaged

- 245 dams to be repaired
- 5 packages announced for private housing
- 5 major packages for rural & cottage industry
- Rehabilitation Packages for all industries
- More than 100 senior officers deployed for relief,
- Reconstruction & rehabilitation.
- 19 worst affected Talukas upgraded to District status.
- 5450 earth-moving equipments mobilized to affected areas
- 1834 medical officers, 763 specialists, 2500 paramedical staff, 1965 jeeps/ambulances sent to affected areas.
- Cash doles to 9.11 lacs families amounting to Rs.67 crores given

- Household kits to 3.64 lacs families amounting to Rs. 38.5 crores.
- More than 1800 public buildings to be reconstructed.
- More than Rs. 2500 crores loss to productive sector.
- Total direct damages as per preliminary estimated Rs.15308 crore.
- 1364 health institutes to be rebuilt including 5 fully collapsed General Hospitals

Table : 2.3 Preliminary estimates of damage and reconstruction cost Earthquake:2001.

Preliminary Estimate of Direct Damages and Reconstruction Costs				
Sector	Direct		Reconstruction	
	(US $ million)	(Rs. In Crore)	(US $ million)	(Rs. In Crore)
Social Sectors :				
Housing	2127	10000.0	1234	5800.0
Health	47	219.9	60	280.0
Education	144	669.6	180	837.0
Total : Social Sectors	2318	10889.5	1474	6917.0
Infrastructure:				
Irrigation	40	186.0	90	418.5
Rural Water Supply	50	233.9	97	450.6
Municipal Infrastructure	30	140.9	45	209.3
Public Buildings & Monuments	73	339.9	95	443.6
Power	40	183.7	98	454.3
Transport	69	320.9	77	358.1
Ports	21	97.7	26	120.9
Telecommunications	11	51.2	26	120.9
Total: Infrastructure	334	1554.2	554	2576.2
Productive Sectors:				
Agriculture & livestock	117	545.0	74	345.5
Industry	191	900.0	101	475.0
Services	250	1162.5	200	930.0
Total : Productive Sectors	558	2607.5	375	1750.5
Environment	55	255.8	55	255.8
Total	**3265**	**15308.3**	**2458**	**11499.5**

Source: Socio-economic Review, GoG

About 3000 small-scale industries and over 20 medium to large-scale enterprises and thousands of cottage industries such as handicrafts were affected. Roads sustained relatively less damage, but other infrastructure services like electricity and telecommunications were extensively damaged. Civil administration was greatly affected, with office buildings, residential buildings and records destroyed. There has been detailed study by joint mission of Government of Gujarat, World Bank and Asian Development Bank on sector wise losses and impact of the earthquake.

2.4 Cyclones

Gujarat is blessed with the longest (1600kms.) coastline among all Indian states; however, it also faces severe cyclones and cyclonic storms time to time. Gujarat falls in the region of tropical cyclone. Though, Saurashtra and Kutch have been previously affected by cyclones, only the recent cyclones of 1998 and 1999 diverted attention of national and international community to proneness of the State with regard to cyclones. Undoubtedly, the cyclones affecting or passing by Gujarat are less in numbers as well as in intensity compared to the one generated in the Bay of Bengal and affecting eastern Indian states and Bangladesh, but have affected the region considerably resulting heavy economic losses and loss of lives.

Table : 2.4 Typical Cyclones crossing Gujarat cost during 1877-1999*.

Month	Period	Landfall Point
April	13-18 April, 1947	East of Diu
May	16-18 May, 1933	Veraval
	15-18 May, 1999	Kutch, Near Nalia
June	6-12 June, 1920	Veraval
	11-13 June, 1964	Near Nalia
	23-25 June, 1961	Near Nalia
	1-5 June, 1976	Near Bhavnagar
	17-20 June, 1996	Diu
	9th June, 1998	Near Nalia
July	10-13 July, 1997	Veraval
	14-15 July, 1903	Veraval
September	23-28 Sept., 1948	Near Diu
October	24-26 Oct. 1917	Near Porbandar
	21-23 Oct. 1975	Near Porbandar
November	15-20, Nov. 1893	Veraval
	18-21, Nov. 1896	Near Diu
	5-13 Nov. 1978	Nalia
	4-9 Nov. 1982	Diu
	12-15 Nov. 1993	North of Nalia

Most of the cyclones, which have affected Gujarat, are generated in the Arabian Sea. They travel towards northeast and hit the Gujarat coast, particularly the southern region of Kutch, western and southern parts of Saurashtra and the western part of south Gujarat. The nine districts, which fall in this region, partly or fully, are Junagadh, Rajkot, Jamnagar, Amreli, Bhavnagar, Kheda, Surat, Bharuch and Kutch[19].

2.4.1 Cyclones in Gujarat[20]

The gazetteer of Kathiawar published in 1886 describes two cyclones- one of 1850, which was intense in Rajkot and Camp area (Wadhvan Camp). The other cyclone occurred on the 21st of July 1881. The areas affected were Porbandar, Khambhalia, Jodiya, Junagadh and Vavania (Maliya, Miyana taluka of Rajkot District). The cyclone also moved towards the Rann of Kutch and it was accompanied by very heavy rainfall of 62cm in 24 hours.

It is observed that May, June October and November are the months when cyclones form in the Arabian Sea. The formation sites of storms on the Arabian Sea in April-June and October – December are shown in the table. There are clear zones for formation of cyclone, viz Region 60-70 degree East and 15-25 degree north in the Arabian Sea. The state has suffered through many cyclones (the latest being in May 1999) in recent years, causing major losses to life and economy, briefly described below:

Table : 2.5 Frequencies of Cyclone crossing districts during 1891-2000.

District	No. of Cyclones
Surat	0
Bharuch	1
Kheda	0
Ahmedabad	0
Bhavnagar	2
Amreli	0
Junagadh	11
Jamnagar	4
Kutch	6

Source : Part of presentation made at SPIPA by Dr.P.K.Mishra,IAS Principal Secretary & CEO, GSDMA, Gandhinagar, 2001.

2.4.1.1 Cyclone of May 1999[21]

The cyclone took shape in the Arabian Sea with wind speeds of 160- 200 km per hour. It changed its course, narrowly missing Gujarat, and vent its fury on the Pakistani coastal towns of Keti Bandar and Shah Bandar. Though the cyclone spared Gujarat, and there was no human life loss on land, around 453 fishermen died who were at sea when the cyclone struck. They were in sea before release of

cyclone warning. The damage on land was comparatively less, due to timely warnings by the meteorological department. Still losses of cattle heads run in thousands: 50,448 and damage to houses/huts was enormous. A total of 601 villages were affected in the districts of Kutch and Jamnagar.

2.4.1.2 Cyclone of June 1998[22]:

The cyclone proceeded almost in a straight line bearing 40 N towards the Jamnagar port, on the northern coast of the Saurashtra peninsula. The exit of cyclone from Jamnagar to the Gulf of Kutch was roughly at less than 150 kmph wind speed. After crossing the Gulf of Kutch, the cyclone passed to the east of the major port of Kandla. The cyclone then proceeded through the Rapar region of Kutch onwards into Rajasthan at less than 110 kmph. This cyclone is estimated to have travelled over land for a total of 250 km in Saurashtra and Kutch. Torrential rainfall of varying intensity accompanied the cyclone. A storm surge accompanied the cyclone in many of the stretches along the coast. Communications in the entire region were badly disrupted and infrastructure was badly damaged. The damaged caused by surge was severe in the ports of Kandla and Navlakhi on the Gulf of Kutch. The shelving of the coastline and timing of the cyclone (about the high tide period) aggravated the impact of the surge at wind on both human life and buildings were much less in comparison with the damage caused by the surge.

The cyclone that hit the coast of Kutch and Jamnagar was unprecedented and caused huge devastation. The Kutch district appeared on the warning sent by fax, but the collector of Kutch did not receive any such message. What made this cyclone unprecedented is the fact that against the initial forecast in terms of direction and velocity, it appeared that it did change the path and thereafter acquired added velocity and moved to Kandla; the sudden change was much more significant than in 1982. The storm surge of water, which hit the Kandla port, was as high as 15-20 feet, which was much higher than the original forecast of 5-6 feet. These changes made this cyclone a grave disaster.

The cyclone also hit corporate Gujarat in a big way: Reliance's Jamnagar plant suffered losses amounting to Rs.100 crore, Gujarat State Fertilizer Corporation's output was affected by 2,000 tones daily. It severely damaged IAF installations and buildings in the Jamnagar air base, caused damages worth Rs.8 crore to the military and affected navy's operations, and led to losses of up to Rs.600 crore to operations at the Kandla port. Further losses and, possibly, an environmental disaster were prevented by the timely implementation of the contingency plan to divert incoming oil, fertilizer and chemicals to Mangalore in Karnataka.

2.4.2 Overview of cyclones in Gujarat[23]

Date	Landfall/Devastation
October 19-24, 1975	Crossed Saurashtra coast about 15 km to the northwest of Porbandar on October 22. The storm maintained its severe intensity inland up to Junagadh, Jamnagar and Rajkot area. Maximum wind speeds were 160-180 km/hr (86-97knots) 85 people and 7,852 cattle died. It affected 1,637 villages. The cyclone caused considerable damage to property estimated to be about Rs.75 Crores.
May 31-June 5,1976	The storm accompanied by heavy rains with high velocity winds crossed the Saurashtra coast on the morning of June 3. Maximum wind speed was 167kmph (90kt).
October 28, 1981	Crossed the Saurashtra coast close to and west of Mangrol shortly after mid-night of November 1 and moved closed to Porbandar in the early morning of November 2 then moving north-eastwards as a severe cyclone up to Jamnagar, it weakened into a depression and lay near Radhanpur. The cyclone swept over the districts of Junagadh, Jamnagar, Rajkot and Surendranagar before the advancing cyclone was felt at Kandla port.
November 4-9, 1982	This cyclone was much more devastating than any other cyclone prior to that. It crossed the south Gujarat coast 5km west of

Kodinar (Veraval-Diu range) and proceeded towards Amreli and Bhavnagar and further onwards to Vadodara/ Panchmahals and then weakened in Madhya Pradesh. At landfall, it had a velocity of 200km/hr and was accompanied by very heavy rains. 12624 pucca and 54549 Kutch houses were completely destroyed. Damage to crop was to the tune of Rs.127.23 crore.

June 19-23,1983 — Torrential rains of an unprecedented nature hit the Saurashtra region causing widespread death and destruction. This was consequent upon a depression in the Arabian Sea that moved in the northern direction causing heavy rains and wind with a velocity of 60 to 90 km/hr in Saurashtra, Kutch and North Gujarat regions. 2,607 villages in 46 talukas were badly affected. Junagadh, Amreli, Rajkot Jamnagar and Bhavnagar.

June 5-9 1998 — The cyclone crossed Gujarat coast north of Porbandar on June 9. This has been the most devastating cyclone to hit coastal Gujarat. Due to poor dissemination of cyclone warning, thousands of saltpan workers were reported missing. The losses were gigantic and more than half of the losses were at Kandla and Navlakhi ports. The losses of lives and cattle heads were in thousands.

May 16-22, 1999 — The cyclone crossed the Pakistan coast to the international border in the afternoon of May 20. The storm caused severe damage in Kutch and Jamnagar districts. Loss of life was 453 among fisherman who were already in the sea before cyclone warning.

Table : 2.6 Recent major cyclones hitting the Indian coast[24].

No	Event State	Characteristics			Damages (approximate Nos.)		
		Time	Wind Speed (km/h)	Sea Surge (Meter)	Human Lives Lost	Houses damaged (lakh)	People Affected (lakh)
1	Andhra Pradesh	May 1990	240-250	5-6	928	13.86	77
2	Andhra Pradesh	Nov.1996	140-150	2.2	1057	6.5	70
3	Gujarat	June 1998	22	2-3	1910	2.57	25
4	Orissa	Oct.1999	270-300	6-7	10086	21.6	375

Table : 2.7 Details of Cyclones Hitting Gujarat and their Impact.

Year	Area affected	Dates	Landfall point	Wind speed (Km/hr)*	Damage Estimates (Crore)*	No. of Villages Affected	Human Lives Lost	Cattle death	No.of Huts/houses collapsed	No. of huts/houses Partially damaged
1975 (cyclone)	Jamnagar, Junagadh, Rajkot	21-23 Oct	Nr. Porbandar	>150	75.00	1,637	83	7,852	7,508/5,059	9,993/70,707
1976 (Cyclone & heavy rains)	Junagadh,Amreli Bhavnagar,	1-5 June	Nr. Bhavnagar	160-180	3	6,468	186	31,243	28,950/13,276	1,7,592/51,101
1981 (cyclone & unseasoned rains)	Jamnagar, Junagadh,Rajkot, Surendranagar, Kandla port	1-2 Nov.	Nr. Junagadh	120-140	-	4,286	17	13,942	1,128/677	8,68/6,034
1982 (cyclone & unseasoned rains)	Veraval, Amreli, Bhavnagar, Diu, Vadodara, Panchmahals	4-9 Nov.	Diu	200	127.32	8,813	544	200,555	48,896/45,010	179,829/1,13,665
1983 (depression & heavy rains)	Junagadh, Amreli, Rajkot, Jamnagar,Kutch Bhavnagar,North Gujarat	19-23 June	Saurashtra	60-90	-	2,647	594	83,768	28,977/1,293	83,222/43,199
1996 (Cyclone & heavy rains	Bhavnagar, Diu, Junagadh,Amreli	17-20 June,	Diu	-	-	8,117	126	2,116	1,405/794	33,165/25,459
1998 (cyclone & Strom Surge)	Porbandar, Jamnagar, Kutch (Kandla region)	9th June	Near Nalia	200	1865	5,765	1,910	26,640	14,664/9,670	91,671/2,27,448
1999 (cyclone)	Jamnagar, Rajasthan, Kutch	15-18 May	Kutch Near Nalia	-	80	601	453	50,448	4,419	11,747

* *Incomplete data source Revenue Department, GoG, Indian Meteorological Department*

Cyclone 1998[25] : In reality human error might just have contributed to the above mentioned harsh statistics wreaked by nature's fury in Gujarat. Here, the role of early warning becomes crucial. In other words, these statistics were the result of the failure to detect a cyclone of such devastating proportions by any concerned agency. In fact, as Kandla port officials had no prior warning of the cyclone of such magnitude, five vessels were at berthing and moorings when the tragedy struck. Labourers dependent on the activities at the port, saltpan workers and fishermen suffered the most. Many of them were just swept away in their sleep by the gushing waters.

2.5 Floods

Among all the disasters that occur in the country, river floods are the most frequent and often the most devastating. The floods in Gujarat are of not of as great severity as of the Ganga-Brahmaputra- Meghna basin in the northeast, Uttar Pradesh, Bihar and West Bengal, but do cause considerable damage to the urban centers, villages and agricultural fields[26]. The cause for floods is chiefly due to the peculiarities of rainfall in the state and in the country where out of the total rainfall 75% is concentrated over a short monsoon season of three to four months.

From the point of flood problem, Gujarat is moderately prone to the hazard. The flood hazard Map shows that the flood prone areas are mainly along the principal rivers in the state. The problems associated with these rivers are mainly inundation of areas due to spilling of riverbanks and inadequate drainage at places and erosion of banks. Whereas the Narmada, Sabarmati and Mahi basins frequently experiences river flood, the Suarashtra region experiences floods due to excessive rainfall as in the years 1982 and 1983. Flood mitigation measures have to consider possibility releases from the major reservoirs.

Floods in Gujarat : Last century :

River	Year
Narmada	1930,1933,1939,1941,1942,1944,1945,1950,1953, 1954,1957,1961,1962,1968,1969,1970,1973
Tapi	1944,1945,1959,1961,1962,1968,1969,1970
Sabarmati	1941,1944,1950,1955,1959,1963,1968,1970,1973

Floods in the last quarter in Gujarat and Saurashtra:

1979,1980,1981,1982*,1983*,1988*,1990,
1991,1992,1993,1994,1996,1997,1998,2000.
*Floods in Saurashtra.

The master plan for flood management prepared by the state government in 1964 is under revision from time to time. The Central Water Commission (CWC) has set up and operates 10 flood-forecasting stations in the state on important rivers.

The annual rise in the river caused by release of water from some reservoirs upstream. Causes the river to flood its banks to a certain degree. Community living in the riverbed or low lying areas have to shift temporarily, bed and baggage, to another location and only hope and pray their home still stands when the water recedes. When they do return to their homes, they have to battle with water-borne diseases. Recovery from this annual ritual takes a long time in the absence of economic means, community support and structures and facilities that aid recovery. The population living in the "planned areas" of the city usually doesn't notices this change regularly, but in the last years big towns and cities have faced huge losses owing to floods/ water logging. Erratic rains (especially heavy rains in a short span), lack of proper reservoir management combined with the malpractices of town and urban planning and lack of proper storm water drainage has lead the urban community captivated in floods more habitually then ever before. Recent floods of North Gujarat (1997), Surat (1998) and Ahmedabad (2000) are classical examples of such a state of affairs.

2.5.1 Earlier Floods & Flood Damage[27]

The floods of 1944 and 1959 were severe in terms of economic and infrastructure loss. In the Narmada basin more than 100 houses were severely damaged, while in villages near Surat, 413 houses were damaged and another 212 houses and 125 huts were completely washed off.

Table : 2.8 Gist of Damages in Gujarat Showing Maximum Damages.

Damage	Maximum Damage	Year	Annual Avg. (Since 1953)
Area affected (Million Ha)	2.05	1988	0.306
Population Affected (Million)	16.48	1982	1.934
Damage to Houses (Nos.)	387400	1982	36962
Damage to House (Rs.Crores)	113.411	1982	-
Human Lives Lost (Nos.)	2005	1979	135
Cattle Lost	200555	1982	13802
Damage to Public Utility (Rs.Crores)	134.74	1988	-
Total Damage (Rs.Crores)	299.181	1982	-

Table : 2.9 Major Floods and Flood Damage in Gujarat.

Year	Flood level (in ft.)	Area affected	Affected Population	Total damage			Preventive measures taken against flood
				Lives lost	Cattle Head loss	Crop loss (in lacs)	
FLOODS IN RIVER NARMADA							
1961	34.25 Bharuch	201sq.mt	18,800	87	12	3.46	-
1962	32.90 Bharuch	110 sq.mt	-	-	-	9.5	-
1968	38.5	144 sq.mt	2,00,000	122	10391	55.44	-
1969	32.5	39.7 sq.mt	6,980	-	-	7.37	-
1970	41.5	190 sq.mt	2,65,000	349	4386	385	-
1973	36.5	150 sq.mt	2,82,000	5	512	622.43	1.Planned for shifting 77 affected villages. 2. Planned for Narmada and its sub-rivers' flood basins costing Rs.1555 lakh 3. Erosion control programs costing Rs.323 lakh 4. Planned for raising the land level of 13 villages 5. 8 flood control schemes implemented. 6. Flood protection to Bharuch city.
FLOODS IN RIVER SABARMATI							
1963	21at A'bad	-	30	-	-	44	
1968	16	-	15,142	7	282	30.58	
1970	-	-	1,17,308	-	232	31.79	
1973	25.5	-	1,39,000	14	1935	1254.33	1.Four flood control programs at local level implemented costing Rs.36 lakh 2. Planned for 15 new flood control plans costing Rs.250 lakh 3. Planned for a protection wall around A'bad costing Rs.600 lakh
FLOODS IN RIVER TAPI							
1961	92at Hop bridge	3.7 sq.mt.	409	-	-	5.5	
1962	93.75	915acre	-	-	-	0.38	
1968	102.5	451 sq.mt.	5,39,000	114	6773	1722	
1969	96	39.75 sq.mile	12,700	7	3358	1270.5	
1970	100.5	66.38 sq.mile	2,47,000	7	3358	1270.5	1.Planned for shifting 19 villages. 2. Land bunding at Tapi river basin costing Rs.582 3. Increasing height of Ukai lake to collect 8 lakh cusec water to minimize the impact of flood on the downstream areas
FLOODS IN RIVER MAHI							
1968	238.75 at Vanakbori river	17.13 sq.mt	-	20	3282	10.4	
1973	249	174 sq.mt	4,55,000	14	1291	1329	1. Planned for raising the land level of 10 villages 2. Land irosion programme in 6 villages costing Rs.136 lakh
FLOODS IN RIVER VISHWAMITRI & DHADHAR							
1961	-	25.59 sq.mt	67	-	-	1.43	-
FLOOD IN RIVER VISHWAMITRI							
1970	-	-	-	-	-	26.62	Preventive measures
FLOOD IN RIVER DHADHAR							
1970	-	7712 sq.mt	-	-	-	46.76	Planned for redivision of basins of rivers Vishwamitri and Dhadhar costing Rs.324 lakh

Source: Gujarat Rahat Niyam Sangrah 1993 (Relief Manual), Government of Gujarat.

In Ahmedabad and nearby villages total 2000 houses were severely affected. Crops of cotton and grains were completely destroyed. During the flood of 1959, 17 villages of the Narmada basin were affected.42 cattle heads were lost and 58,214 people were put in vulnerable condition. Crops loss was Rs.11.26 lakh. In Tapi river basin 79 people and 554 cattle lost lives. Total damage was Rs.4.52 crore.

2.5.2 Recent Floods in Gujarat[28]

The Narmada, Sabarmati, Tapi and Mahi basins frequently experience river flood. The problems associated with these rivers are mainly inundation of areas due to spilling of riverbanks and inadequate drainage at places and erosion of banks. The state faced floods during the years of 1979,1980,1981, 1990,1991,1992,1993, 1994,1996,1997,1998 and 2000. The Saurashtra and North Gujarat regions experienced floods due to excessive rainfall is in the years 1982, 1983 and 1988.

Table : 2.10 Recent Floods of Gujarat.

No.	Item	Floods in 1987	Floods in 1998
1	Affected Areas	12 district	Surat district
2	Loss of Human Lives	220	24
3	Loss of cattle head	8813	2900
4	Damage of houses/huts	102220	22294
5	Damage to agri. crops (in Crore)	83.50	58.59
6	Damage to agri. Land (in Hac)	455202	-
7	Damage to infrastructure (in Crore)	242.83	9.84
8	Damage to power Sector (in Crore)	49.88	3.50

2.5.2.1 Floods in 1997:

Floods in this year were one of the most severe when almost whole of the state was in water. It was due to cloudburst on 24th-28th June 1997. This created flooding in large tracks of low-lying areas of the state, especially North Gujrat, were all the major towns were submerged in water. This caused waterlogging and huge economic losses to people of Mehsana and towns of Visnagar, Keralu and Vadnagar and a few others. Losses to infrastructure were massive and the economy of North Gujarat was badly disrupted.

2.5.2.2 Flood in Surat in 1998[29]

On September 17 , two platoons of the Indian Air Force (IAF) were rushed here today as more than 80 per cent of the city was submerged under the impact of floods. Surat was RED ALERTED. All the 22 gates of the dam were unbolted. A meeting was held between the district collector and higher officials to discuss the abrupt situation.

Eight helicopters, 43 rescue boats, more than 200 IAF personnel of the 107 Air Defence and Artillery (ADA) and over a thousand volunteers were pressed into relief and rescue work as over one lakh persons of the city have been marooned in the city alone. The army and rescue workers were divided into four teams and equipped with helicopters, rescue boats and food packets. As urgency, action plan was drawn to cope up with the flood.

The Surat flood was the result of immense low pressure established near Burhanpur district of Madhya Pradesh, which is 350 km. Away from Surat. Due to low pressure there was heavy rain at the origin of river Tapi. All the 152 villages in the way located nearby the banks of Tapi were cautioned and the people residing at lower areas were requested to shift to higher places. This disaster is also considered as a result of inefficient reservoir management. Certain facts have revealed that if all the gates of Ukai reservoir were not opened at that time whole of South Gujarat would have witnessed the worst disaster of the century. The dam authority was helpless to do so, therefore, this disaster can also be attributed to human error. Further damage was ruled out with water levels beginning to recede later.

The Municipal Commissioner Shri Jagdisan formed an action plan for removal of waste and dead animals. Many dead animals were set on fire by the cleaning staff. There was post-flood plague havoc. A special medical team from Hyderabad arrived in Surat for the investigation of the rats' corps, if there were any symptoms of plague but no symptoms were found.

2.6 Drought

Right from the inception of Gujarat as a state perception, 23 years have been drought years; Every third year is a moderate drought year and every seventh year is severe drought year in the state. Gujarat ranks second in India both in respect of arid as well as semi-arid regions in terms of area. Saurashtra region is mainly semi-arid area and Kutch and parts of Jamnagar, Surendranagar and Banaskantha fall in the arid region. Except for some parts in south Gujarat, the state is either arid or semi-arid. The state has humid, sub-humid climatic conditions in some parts in south with highest rainfall of about 2000mm, which gradually decreases to about 300mm in Kutch. The rainfall pattern has a conspicuous impact on its economy. Droughts are frequent in north Gujarat, Kutch and Saurashtra regions due to poor and erratic rainfall.

In the 1970s to 80s, droughts and famines were the biggest killers in India. Due to extensive irrigation development and Green Revolution the grain production scenario has changed. There are now no starvation deaths[30]. Efforts are underway to achieve food security through PDS; however, malnutrition is widespread, especially among women and children in Gujarat[31].

2.6.1 Drought in Historical Context[32]

From ancient time till today the state has faced many droughts, which not only created loss in terms of economy but also claimed deaths of thousands due to starvation and spread of epidemics. The horrifying details of the intensity of droughts are available in the descriptions of many foreign authors. Peter Mundey, a British East India Company's employee described the drought of 1633 of Gujarat thus, "the heaven (Gujarat) is turned into havoc. Dead bodies were lying unclaimed everywhere in the pious ground of the Rudramal of Sidhdhpur. Skulls of the dead ones were scattered on the roads in Mehsana and Ahmedabad lost all its prosperity and charm and a larger part of the population migrated from the city in search of food and water". However, the worst part of the famine situation of that time, was that people turned cannibals, which is shocking to believe, but the State in its history has witnessed the most horrifying face of drought.

A document written by Dutch vendor Wan Twist in 1638 also explains the same vulnerability. He mentioned that people were ready to accept slavery and to commit murder to feed them. Some of the states (princely) were taking measures likes distributing cooked food during the drought of 1747 and exempting revenue taxes in some districts during the drought of 1791-92 in the Maratha period; But resources were scarce compared to the needs and demand of the population. Moreover, most of such efforts were kept reserved for specific boundaries or for certain communities only. This also did not help much to eradicate the sufferings.

The year of 1812 can be noticed as a revolutionary phase in drought relief. In Kutch, Jamadar Fateh Mohammad employed many drought-affected people to dig out a pond in Deshalpar and the workers were paid in kind. This may be one of the pioneer works of relief.

In 1808 the East India Company took over all administrative charges and that is how they had to weigh the burden of provision of relief in disasters, where they did not take so much interest initially. During their period of rule, a devastating drought hit Gujarat, which is known as the 'Chappanio Kal' in the history of the state. In fact, this was the most severe drought during the nineteenth century spread on a larger part of the country. Despite of all the efforts made by the state, *Mahajans* and philanthropic organizations, the death toll was too high to imagine. Loss of animal heads was also high. The situation was really grave and people sold their adolescent daughters just for two rupees and women enslaved them to get some meals. There were incidences of family mass suicides. The devastation caused by the drought in 1900 was observed by Lord Curzon, who convinced the Secretary of the State to start construction of canals for the benefits of the drought-affected population. A separate relief fund was also established for this purpose. Gradually, more and more steps to fight out the disasters were taken. Besides the state, the civil society also accepted it as a moral responsibility to come forward in such as critical condition. This brought a noticeable change the results of reducing the impact of the disaster.

In the past 40 years, Gujarat has experienced 11 years of severe drought and very severe drought situations, in 1972-73,1985-87, 1992-93, 1995-96 and recent scarcities of 1998-99 and 2000-2001. Earlier, the limited geographical area used to experience droughts and food scarcity, while now more and more districts are trapped in drought situation[33].

2.6.2 Government Relief Measures and expenditure

Here, a case of the last scarcity of 1999-2000 is presented to illustrate that how the government responds to a scarcity situation.

2.6.2.1 Scarcity of 1999-2000 and actions initiated by the Government[34]

It became clear by about the end of August 1999 that the rainfall would be less than the normal and the state government took a number of steps to assess the situation and provide relief. The Chairman (Additional Chief Secretary, Agriculture) of the weather watch group with the help of data provided by the Indian Meteorology Department (IMD) regarding the progress and behaviour of the monsoon alerted the state government of the impending scarcity situation.

- At a cabinet meeting held on 23 August 1999, it was decided to supply fodder at Rs.1 per kg subject to a maximum of 3 kg per cattle (revised to 4 kg per cattle) to panjarapoles, cattle-camps and individuals in 71 talukas which recorded less than 125 mm of rainfall.
- A state level cabinet sub-committee was constituted to take policy decisions and to co-ordinate and oversee the scarcity relief measures.
- District level scarcity relief committees under the chairmanship of the district in-change, minister and the Chief Secretary to government as Vice Chairman and Collector as Executive Vice Chairman were constitution.
- Collectors of the eight non-scarcity district (mainly in South Gujarat) were directed to procure fodder.

- Inter-state movement of fodder was banned under the Essential Commodities Act in order to conserve the existing supply of fodder. All grass available with the forest was also reserved for scarcity use.

Pending final assessment, a preliminary report was submitted to the Government of India on October 15, 1999. In the Memorandum, assistance to the extent of Rs.528.86 crore was sought. After a detailed assessment of the extent and severity of scarcity, a revised memorandum involving an expenditure of Rs.922.49 crore was later submitted to the Government of India. The final break up of the amount asked for is shown here.

Table : 2.11 Central Assistance Sought.

Sr. No.	Sector	Central Assistance Sought (crore Rs)
1	Employment generation	375.75
2	Water supply	311.00
3	Agriculture	100.00
4	Animal husbandry	87.90
5	Cash Doles	20.00
6	Health & Nutrition	27.84
Total Requirement		922.49
Less Available in CRF		200.33
Net requirement of Central Assistance		722.16
Assistance sought from Central Govt. by GoG -Scarcity of 1999-00		

Scarcity was declared in 9449 villages of 17 districts on 22 December 1999. Subsequently the number went up to 19 districts. Half the state population (2.50 crore) was affected by drought.

2.6.2.2 The State Government relief measures[35]

- 7.93 crore man- days provided through relief works.
- 15.77 crore kg. grass was supplied through 455 grass depots.
- 31 lakh cattle heads maintained through 133 panjarapoles, 175 gaushalas and 556 cattle camps. 74882 old, 3262 children, and 6779 pregnant women provided with cash doles.
- Drinking water supplied by tankers to 2987 villages.

2.6.2.3 Scarcity of year 2000 and actions initiated by Government[36]

The rainfall during 2000 was erratic and inadequate. This resulted in a second consecutive year of scarcity. The scarcity extended to 23 districts out of 25 districts. In some districts shortage of fodder continued during the monsoon also. Out of 226 talukas, 80 talukas have received less than 50 per cent of normal rainfall, while 96 talukas have received 50 per cent to 75 per cent of normal rainfall.

- The State Government declared 13133 villages of 199 talukas as scarcity/semi-scarcity affected. There is an increase of 3684 villages from the last year.
- As on 1st May 2001, 9951 various scarcity work were completed and 7436 works were going on where 26.13 lakh labourers were working.
- Through these relief works 7.20 crore mandays of employment was generated, where Rs.136.44 crore was paid as wages. Adults are paid Rs.10 per day; children Rs.5 per day and pregnant women are paid Rs.20 per day as cash doles for those who are not able to go to relief works. As on 1st May 2001, 106253 adults, 8141 children and 9513 pregnant women were provided cahs-dole of Rs.7.40 crore.
- In the scarcity affected districts (as on 1-5-2001) about 2.16 lakh cattle were maintained in 377 panjrapoles and gaushalas.
- In addition to this 1.04 lakh cattle were maintained in 165 cattle camps. To maintain these cattle, the state government provides a subsidy of Rs. 10 per cattle per day. A total subsidy of Rs.13.67 crore was paid up to 1-5-2001.
- State government initiated steps for the water supply situation. In all, 6545 villages are experiencing shortage of drinking water supply and government took measures to provide drinking water to all needy villages.

2.6.2.4 Meeting the demands of Drinking Water Supply[37]

In January 1999, it was anticipated that water through hand pumps will be available at 60 meters depth, but at many places the depth went down to 90 meters. The rate of success of 100 mm bores which was 93 per cent in drought years of 1985-86, 1986-87 and 1987-88 went down to an alarming level of 65 per cent. Rate of success of 150mm bores was 58 per cent. This forced the government to explore deeper tube wells/bores to meet the water demands. There was also difficulty in getting water for tanker filling in near proximity to the villages and this significantly added to the tanker supply cost.. The position was worse in Saurashtra since the reservoirs were practically empty. The state government prepared a State Master Plan for 6312 villages and 72 worst affected urban centers as given in table 2.12:

Table: 2.12 Expenditure on Emergency Drinking Water Supply.

Sr. No.	Measures to mitigate Drinking water scarcity	Total villages planned to be covered	Estimated Cost (in Lakh)
1.	100mm dia. Bores	1679	997.45
2.	150mm dia. Bores	2136	5260.8
3.	Deep tube wells	327	1603
4.	Rejuvenation of individual WSS	1009	2305.35
5.	Rejuvenation of regional WSS	880	2464.13
6.	Construction of new wells	44	102.6
7.	Activities for urban areas	69	5026.75
8.	Activities for Municipal corp.	3	7241
9.	Deepening of existing wells	133	106.4
10	Supply with tankers	3100	5440.9
11	Water evaporation retardant		270
12	Purchase of 3000 hdpe tanks		270
	Grand Total		31088.38

Source: Drought in Gujarat: 1999-2000&2000-2001,NCDM,IIPA

This total expenditure of Rs.310.88 crore was based on districts wise requirements.

In June 2000, out of 72 such urban centers, 13 centers were getting drinking water once in 6 days, 9 were getting once in 3 days and 27 were getting once on alternate days. The total affected urban population was placed at approximate 84.00 lakhs. During March 2000 at many places the water supply level was as low as 20 to 40 litres per person per day as against the normal standard of 120 litres per person per day.

The government took the following emergency measures for the urban areas facing acute water shortages:

1. Emergency water supply scheme based on 120 tube wells for supplying water through a 90 km. pipeline to city of Rajkot form the nearby Wankaner region completed in 55 days at a cost of Rs.74 crore.

2. Emergency water supply scheme based on tubewells for the town of Surendranagar/Wadhwan completed at the cost of Rs.17 crore.

3. Emergency water supply scheme based on Mahi canal for the city of Ahmedabad completed at the cost of Rs.12 crore on a priority basis in six months.

Table : 2.13 Total Expenditure on Emergency Water Supply.

Place	Cost (in Crore)
Urban areas	035.57
Municipal Corporation	179.30
Rural areas	127.47
Total Expenditure	342.35

The state undertook a massive programme of drilling new sites for hand pumps and tube wells. 4204 new hand pumps 100mm bores were drilled in 2969 villages. 1041 bores of 150 mm diameter were drilled in 769 villages. 305 tube wells were drilled in 296 villages.

2.6.2.5 Regional water supply schemes and other measures taken to meet water supply demands[38]

- The main plank for ensuring drinking water supply as a long-term measure has been the on-going 165 regional water supply schemes costing Rs.1092 crore covering 5206 villages. Out of this, 53 regional water supply schemes covering 1081 villages costing Rs.100 crore were completed.
- Government also took initiatives of completing the Mahi canal pipeline project of Rs.1000 crore for supplying water to about 1600 villages and urban

centers of Bhavnagar and Amreli districts. Pipelines were laid from Pariej in Kheda district to all talukas in Bhavnagar and Amreli districts.

- The scarcity situation was also met by sending railway tankers to scarcity-affected areas of Jamnagar. 10 tube wells were drilled at Khodiyar railway station near Ahmedabad and a sump of 20 lakh litres capacity was constructed for filling the tankers. A same capacity sump was constructed at Jamnagar Hapa station also. From there water was distributed through Jamnagar city's existing water supply system and other places. A similar exercise was undertaken to supply water to 42 villages and 2 towns from water available in the Dhatarwadi dam in Amreli district.
- This massive programme of supplying water from the Narmada canal for finding permanent solution to the drinking water supply problem of chronically drought affected areas to cover 8215 villages and 135 urban centers.

2.6.3 Drought Relief and Need of shift in approach

The drought in Gujarat has mainly taken the shape of acute scarcity of drinking water and fodder together with other socio-economic consequences attendant on significant fall in agricultural production in the affected areas. But more than that it has become a creeping disaster, hampering development of affected region.

- It is revealed that the districts trapped in the recurrent drought in the state have low values of indicators of human development. Districts suffering from acute water scarcity viz. Kutch, Banaskantha, Mehsana, Sabarkantha, Surendranagar and Rajkot have low values of human development. (Census 1991). The drought and scarcity just not determine economic development but also human development.
- Recurrent drought in many parts of the state like in Rajkot city take away complete administrative energy and no resources are spared for development works.

- The preceding section, where government's relief measures for scarcity of two consecutive years is described, makes it pretty clear that relief measures have no vision and they are highly cost-intensive. They have become a regulated operation with no mechanism of delivery, there is no drought-proofing component integrated in providing relief. Earlier drought relief works had the vision that while providing labour to the affected population, community assets were also created, which worked towards achieving drought proofing. At this stage, a shift in approach is needed. Cost benefit analysis and evaluation of response are also needed to work out the economics of relief.
- Today, government put forwards its relief measures highlighting engineering measures like: drilling of bore wells, laying of pipe lines, canal work, tinkering operation and crore of rupees spent on carrying out such measures with little about work generated for some mandays, cash doles distribution to vulnerable groups. These measures are nowhere near achieving drought proofing. Rather, at end of the process, this ad hoc and visionless gigantic measures lead to severe hydrological drought with already dangerously depleted groundwater situation and short term fire-fighting measures to meet need of the hour without much attention to adverse future consequences.
- On one hand Government tends to go on implementing highly technical works to meet water supply demands, but no steps are taken to revise the age-old processes and systems of declaring scarcity, targeting beneficiaries and *anawari* system, which in itself is contradictory[39].
- Relief is not at all delivered to address vulnerabilities. Health and nutrition during drought are very much ignored. During the year 1996-97, Rs.60,00,000 were kept for health and nutrition, which was not utilized for this purpose at the end. The seven ways in which government offers relief: free assistance, special nutrition, water supply, public health, fodder supply, cattle care and other expenditure. Out of the total expenditure, during drought relief, the state spends more then half amount on water and fodder supply and hardly any steps are taken for special nutrition and public health[40].

- Traditionally drought has been associated with famine and non-availability of food in sufficient quantities. With overall satisfactory monsoon over the country as a whole during the past decade, the situation in this respect has dramatically changed and in spite of droughts in certain parts of the country and floods on others, foodgrain production in 1999-2000 touched a high of 205.9 million tones with a bufferstock of 28 million tones, bursting at seams[41]. With efforts to achieve food security with PDS, there are no or a few starvation deaths. Drought triggers widespread malnutrition. More than 50 per cent children of less than five years are malnourished. Among women and young girls also, this problem is very prevalent.
- With overemphasis on major schemes and huge technical interventions and completion of the Narmada dam is seen as solution to all the problems, may prove to be risky in future. Local solutions are not provided any momentum and steps taken for water harvesting, rejuvenating groundwater levels and optimizing between local solutions and large transfers of water are grossly inadequate. This also reflects government's priority and intentions.
- Droughts in remote, poor and desert communities have ruined the already poor existential base of thousands of people; with no other livelihoods left, relief remains the only option. It is difficult to believe that many communities derive higher income in drought years than in so-called normal years[42].
- No attention is paid to rehabilitation after consecutive years of drought. After continuous scarcity, resulting in reduction in purchasing powers, people are not in position to timely buying and sowing seeds in a good year. Measures in such areas are very much required[43].
- The recent declaration by the government of India on a new scheme of crop insurance is healthy step in this direction However, a great deal of effort is required in implementing such schemes effectively at the grassroots level.

Table : 2.14 Drought Relief Expenditures by the State Government In Recent Years.(in lacs)

Sr.No	Description	1993-94	1994-95	1995-96	1996-97	1997-98
1	Free Assistance	121.89	117.38	224.76	431.40	200.00
2	Special nutrition	0.00	0.00	0.00	10.00	5.00
3	Potable water	24402.36	2672.13	1050.85	6200.90	3130.00
4	Public Health	0.00	36.78	0.00	60.00	35.00
5	Fodder	211.76	1530.60	1874.67	2329.80	1610.00
6	Cattle Care	2.00	0.00	0.00	90.00	10.00
7	Other expenses	1069.65	3057.70	40.61	3027.90	3180.00
	Total	3807.66	7414.59	3190.89	12150.00	8170.00
Break up-Other expenses						
1	Other relief tasks	950.00	3050.00	0.00	2749.74	3000.00
2	Employment to women	0.00	7.50	0.00	10.00	5.00
3	Employment in forest	0.00	0.00	0.00	10.00	5.00
4	Employment in command areas	0.00	0.00	0.00	20.00	10.00
5	Employment in micro Irrigation. Scarcity work	0.00	0.00	0.00	20.00	10.00
6	Purchase of new Jeeps	0.00	0.00	6.47	63.16	50.00
7	Employments in road work	0.00	0.00	0.00	10.00	10.00
8	Employment in handicrafts	0.00	0.00	0.00	10.00	10.00
9	Employment in hand weaving	0.00	0.00	0.00	10.00	10.00
10	Buildings	0.00	0.00	0.00	10.00	10.00
11	Land conservation	118.81	0.00	34.14	10.00	10.00
12	Maintenance of instruments	0.84	0.00	0.00	50.00	50.00

Source: Hemantkuar Shah, Gujaratma Kudarati Aapatti Ane Sarkari Kharch, Disaster Mitigation Institute, Ahmedabad, 1998

2.7 Repercussions of Disasters

The social and economic progress achieved over decades by the people and advances in health and other social sector can be significantly ruined by disasters. The escalating frequency of disasters, resulting in appalling loss of life, massive economic losses, multifold growth of injuries, disabilities, disease, and deaths and disrupting life-supporting systems, and adding to health, social and economic burden to the people of Gujarat can not be easily represented in statistics since their impact revolves around and focuses on human beings and has much wider social and economic implications. The preceding pages dealt with the impact of natural catastrophes on the state of Gujarat, but it is not that easy to say, since these disasters also slow down the development of the state and particular regions which are already impoverished and have depleted natural resources. In a majority of cases, development programmes are adversely affected and resources embarked for development are consumed in repairing the damage caused to infrastructures and built environment. The losses incurred are such that they are beyond the capacity of the state forcing it to borrow money from international funding agencies for reconstruction and rehabilitation, which are adding to the fiscal deficit of the state. Repaying the loans will put additional stress on the state economy[44].

Although detailed statistical data on disaster damage are still not completely worked out in depth, it is known that damage caused by disasters greatly exceeds the total amount of assistance – both bilateral and multilateral- which disaster affected state/country receive from abroad. In terms of percentage of their SGDP/NGDP the losses caused by disasters in many of these states/countries may cancel out real economic growth[45]. Gujarat has been a prosperous in economic growth; however lagging behind in the human development[46].Therefore ramifications of disasters, if not controlled timely, may deal worst blow on the state economy and human development.

2.7.1 Economic Impact

Disasters cause loss of life and disrupt economic activities more than any other type in a short span. According to current estimates, the possible extent of damage caused by extreme natural catastrophes in one of the large metropolises and industrial centers of the world have already attained a level that can result in the collapse of the economic system and financial market of entire country. Gujarat, which contributes to almost 11% of GDP and 10% to net domestic consumption, influences the Indian economy to a large extent.

Chiefly the economic impact will be owing to[46]:

Asset losses: These are the direct damage as result of looses of value of the buildings, equipment, inventory and other losses to private and public property in following areas:

Output losses: These are value of the production of goods and services lost as a result of the asset losses and other disruption.

First Costs: This is addition to the fiscal deficit as a result of various revenue losses of State Tax Revenue, Non Tax Revenue, shared taxes, grants, Revenue Receipts, Revenue Expenditure of interest, Capital Expenditure, Loans and Advances, and additional expenditure of Relief and Rehabilitation. The recent disaster have made considerable additions to the fiscal scenario as result of relief and rehabilitation expenditure and huge borrowings from multi-lateral and bilateral funding agencies.

Worldwide, economic losses due to natural phenomenon are also multiplying rapidly and increasing at an alarming rate of 400% for each decade[47].

Economic losses will be in following areas

- Social Sectors:
  - Housing
  - Health
  - Education

- Infrastructure Sector:
  - Irrigation & Dam safety
  - Rural Water Supply
  - Municipal and Environmental Infrastructure
  - Public Buildings and Monuments
  - Power
  - Transport
  - Ports
  - Telecommunications
- Productive Sector:
  - Agriculture and livestock
  - Industry
  - Services

2.7.2 Psychosocial Impact[48]:

The psychosocial impact is difficult to quantify, but it is the most lasting effect of any disaster and it lasts with a human being throughout his/her life. Sudden changes owing to psychosocial consequences of disaster are shock felt on the occurrence of calamity (i.e. people scared by feeling of earthquake tremors) on death of kin, large-scale human deaths and injuries, collapse and devastation.

The social fabric of the disaster-hit areas is damaged to a great extent. In addition to the immediate sufferings, large numbers of families are torn by the death or serious disability of family members. This will have long-term consequences on the well being of other members, particularly widows (especially young women), single parent children, orphans, and the elderly.

Other social impacts include deep insecurity among those who have lost shelter and other assets, and increased risks among them to impoverishment. The livelihoods of many families have been disrupted, and those who do not posses other work skills or are not casual laborers, suffer the most. This category includes: artisans, handicraft workers, salt workers and fisherman. They particularly appear to be one of the most severely affected groups.

Economic recovery has been hampered by cattle head losses among the pastoral community. Insecurity also stems from repeated tremors in the region and continuing drought. Though the people of Kuchchh are known for their strong independence and resilience, among those who were poor prior to the disaster, there may be a sense of helplessness and dependency. Such situation does lead to stress migration and children of the migrant community are deprived of education and health facilities and they often are forced to work by circumstances.

Another serious consequence of the disaster is an almost complete lack of services in the worst-hit villages and urban areas, including education, health, water supply, electricity, solid waste disposal, and agricultural extension.

Above-mentioned consequences have lasting effect, often observed that disaster-affected community develops a different psyche and changes in basic nature. This symptom is well observed in refugees and displaced people. This area itself holds potential for important social research.

2.7.3 Environmental Impact[49]

In addition to damage to dwellings, infrastructure and facilities, disasters have resulted in a number of environmental impacts. Due to recent earthquake, previous cyclones, ongoing drought, and previous flooding in the major urban centers of Ahmedabad and Surat, North Gujarat and other disaster-hit region, the environmental vulnerability has changed .

The quantity of debris and debris disposal methods, temporary shelter set-up and the reconstruction effort impact on the environment and ecology. Moreover, there are areas where the environmental impact requires ongoing environmental monitoring. The major environmental impacts include:

(a) Industrial/chemical hazards as a consequence of catastrophes in industrial area, ports etc.
(b) Multiplier effect owing to industrial hazard
(c) Debris and rubble removal and disposal

(d) Impacts and residual risks from damage to industrial facilities
(e) Impact to water and water management resources, impact due to heavy drawing from bore wells to meet emergency supplies in water deficient areas
(f) Impact to municipal and industrial environmental infrastructures such as sewage and wastewater treatment
(g) Re-operating of industrial units where environmental measures are not met/compromised
(h) Productions to meet demands of rehabilitation
(i) Potential impact on aquifers due to flooding or earthquakes
(j) Potential impact on ecosystems

2.7.4 Cultural Impact

Disasters affect the culture of any community to a great extent. On occurrence of each disaster, some of the inherited cultural values are lost. Disasters affect:

(a) The traditional livelihood pattern (which may be part of specific community and inherited since many generations)
(b) Vernacular architecture and shelter of the community, often looked by outsiders with artistic view but for affected people woven in their day-to-day life.
(c) Damage to historical monuments, religious monuments and heritage structures
(d) Changes in celebration, social occasions and ethnicity

It will be very important to say that most of the time, the coping mechanism accepted by the community itself and introduced from outside, especially on habitation, do take away the cultural traditions. Rehabilitations are generally not culture-sensitive, leading communities to miss their cultural heritage on each disaster[50].

References

1 Singh Prakash, William W. Mendel, Graham H. Turbiville, JR, *Disaster Response in INDIA*, (The Center of Excellence in Disaster Management and Humanitarian Assistance & The Foreign Military Studies Office, 2000) page 14-15

2 Sinha P.C., ed., *Encyclopaedia of Diaster Management,* vol.1, Introduction to Disaster Management (New Delhi : Anmol Publications Pvt. Ltd. 1998), 1-3.

3 Based on figures by P. C. Sinha, 4

4 Gupta M.C., Vinod K. Sharma, L.C.Gupta, B.K. Tamini (ed), *Manual on Natural Disaster Management in India,* (National Centre for Disaster Management, IIPA, New Delhi, 2001) 21-22

5 Study Material of *Certificate in Disaster Management* by Indira Gandhi National Open University, New Delhi, CDM – 01, Block-2, Unit – 5. Page 5-6.

6 Gupta M.C., Vinod K. Sharma, L.C.Gupta, B.K. Tamini (ed), *Manual on Natural Disaster Management in India,* (National Centre for Disaster Management, IIPA, New Delhi, 2001) 29

7 Ibid.p.32

8 Ibid.p.46-47

9 Ibid.p.55

10 Study Material of *Certificate in Disaster Management* by Indira Gandhi National Open University, New Delhi, CDM – 01, Block-2, Unit – 8. Page 31-32.

11 Shah Jolly, State Environmental Action Programme(SEAP), (Report for GEC, Vadodara) Ahmedabad.

12 BMTPC, Gujarat: Vulnerability Atlas of India, Ministry of Urban Development, New Delhi, 1997

13 State Relief Manual

14 Merh S.S., *Role of Active Tectonism in Evolution of Kutch Landscape*

15 State Relief Manual

16 The Times of India Relief Fund and State Relief Manual

17 State Relief Manual

18 *Socio-Economic Review 2001*, Government of Gujarat

19 *State level consolidated Cyclone Action Plan*, State Revenue Department

20 *State level consolidated Cyclone Action Plan*, State Revenue Department

21 *Centre for Science and Environment & State Level Consolidated Cyclone Action Plan,* State Revenue Department.

22 Indian Meteorological Department, *State Level Consolidated Cyclone Action Plan*, State Revenue Department, The Times of India Relief Fund.

23 Indian Meteorological Department, *State Level Consolidated Cyclone Action Plan,* State Revenue Department, The Times of India Relief Fund.

24 Sinha Anil, Disaster Management: *Lessons Drawn & Strategies for Future*, NCDM, Indian Institute of Public Administration, New Delhi, 2001

25 Revenue department, Sachivalaya, Gandhinagar, *Memorandum to the Government of India on the Cyclone in Gujarat on the 9th June, 1998*,1998.

26 BMTPC, *Gujarat: Vulnerability Atlas of India*, Ministry of Urban Development, New Delhi, 1997

27 *State Relief Manual*

28 State Revenue Department

29 Surat Municipal Corporation

30 Department of Agriculture & co-operation, High Powered Committee on Disaster Management: Report, Ministry of Agriculture, Government of India, 2000

31 *White Paper on Water in Gujarat*, UNICEF, IRMA

32 State Relief Manual

33 *White Paper on Water in Gujarat,* UNICEF, IRMA

34 Gupta L.C. & Vinod K. Sharma, *Drought in Gujarat: 1999-2000 & 2000-2001,* National Centre for Disaster Management, Indian Institute of Public Administration, 2001.

35 *Socio-Economic Review 2001*, Government of Gujarat

36 Ibid.

[37] Gupta L.C.& Vinod K. Sharma, *Drought in Gujarat: 1999-2000 & 2000-2001*, National Centre for Disaster Management, Indian Institute of Public Administration, 2001.

[38] Ibid

[39] Mishra Usha, *Exploring Drought Relief Policy and Practice: A Consultation with Government and NGOS*, Oxfam (India) Trust

[40] Shah Hemantkumar, *Gujaratma Kudarati Aapatti Ane Sarkari Kharch,* Disaster Mitigation Institute, Ahmedabad, 1998

[41] Sharma V.K., National Centre for Disaster Management, Indian Institute of Public Administration, 2001,Personal Discussions with Author

[42] Vyas Shailesh, Presentation of Drought Proofing Programme in Kutch, Sahjeevan, 2002

[43] Mishra Usha, *Exploring Drought Relief Policy and Practice: A Consultation with Government and NGOS*, Oxfam (India) Trust

[44] Gujarat Earthquake Recovery programme, ADB and World Bank Joint *Assessment Report.*

[45] Office of United Nations Disaster Relief Coordinator, *Guidelines for Disaster Prevention: Volume : 3* ,Management of Settlements, United Nations, Geneva, 1976

[46] Hirway Indira, Mahadevia Darshini, *Gujarat Human Development Report 1999*, Mahatma Gandhi Labour Institute Ahmedabad 1999.

[46] Gujarat Earthquake Recovery Programme, ADB and World Bank Joint *Assessment Report*

[47] Office of United Nations Disaster Relief Coordinator, *Guidelines for Disaster Prevention: Volume : 3* , Management of Settlements, United Nations, Geneva, 1976

[48] Parsuram S. & Unnikrishnan P.V., *Indian Disaster Report: Towards A Policy Initiative,* Oxford University, 2000, Gujarat Earthquake Recovery Programme, ADB and World Bank Joint Assessment Report

[49] Gujarat Earthquake recovery Programme, ADB and World Bank Joint *Assessment Report*, Gujarat Earthquake-A Rapid Environmental Appraisal, Gujarat Institute of Desert Ecology.

[50] Shah Jolly, *State Environmental Action Programme*(SEAP), (Report for GEC, Vadodara) Ahmedabad.

Chapter III

Gujarat and Disaster Management

3.1 Gujarat: Multi-hazard Disaster History

The state of Gujarat has been facing the most overwhelming natural disasters in the last decade. These natural disasters have not just caused colossal destruction but have also paused a stop to various development programmes. The unique geo-physical setting of the state makes this region highly vulnerable to natural disasters like droughts, floods, cyclones, earthquakes, etc. In last decade either the whole state or a large part of it has witnessed extreme climatic conditions or drastic natural events[1].

The state has suffered from the severe droughts and acute scarcity situations, desertification of swathes of the state where economic ravages continuously the fragile ecologies and environmental degradation. Moreover, drought, epidemics, floods, cyclones, earthquakes and other human-made disasters dominated the last decade. In the year 1994 Surat suffered heavily due to pneumonic plague. Drought years followed by heavy rains caused floods in the state. In 1997, 12 districts of Gujarat were flooded, especially in North Gujarat, in 1998 South Gujarat and particularly Surat city was flooded and a cyclone struck Kandla port and other coastal areas causing colossal destruction. The next year was again a cyclone and scarcity year, and in year 2000 the economic capital Ahmedabad was flooded, causing economic losses in thousand crores[2]. The year 2001 witnessed the most devastating earthquake and the next year 2002 communal riots. These disasters have not just resulted temporary economic losses and casualities, but have put a brake on the development process in the state since resources earmarked for development are diverted to meet the needs of disaster and its aftermath.

During the last 40 years from Gujarat's inception, 23 years have been drought years.[3] Starting from 1850, 24 cyclones struck the state and 9 earthquakes out of which three has been highly devastating[4]. South Gujarat and the central part continue experiencing the demon of floods. Gujarat is having concentration of chemical industries, particularly, in a stretch of 400 kilometers from Ahmedabad to Vapi, known as the 'Golden Corridor'. Ankleswar in Bharuch district is Asia's largest chemical zone[5]. The State being highly industrialized and looking at its multi-hazard industries, it is quite evident that these have the potential of causing multiplier ruinous effects. The state has a large number of chemical and pharmaceutical industries, petroleum industry, and major ports, which have, added to the state's vulnerability to catastrophes. All through the recorded history, the state has endured natural disasters increasingly claiming more lives and causing disabling injuries and tremendous economic losses[6]. In spite of improvements in prediction techniques, advances in telecommunications and better efficiency in emergency relief and rehabilitation, natural disasters seem to be occurring frequently.

This study is an endeavour to address the plethora of natural disasters in Gujarat, their colossal devastating impact, and the kind of response they have received. The study encompasses issues of preparedness and the transformations needed to mitigate the disaster consequences and future possibilities with regard to government response mechanism, policy initiatives, and promoting a culture of strategic and preventive planning and of preparedness and mitigation to scale down the disaster consequences with the help of application of management information system in natural disaster management.

3.2 Geographical Situation of Gujarat State

With a population of 1027 million (5% of the country's population) in 2001 and an area of 1.96 lakh sq. km, Gujarat ranks tenth in respect of population and seventh in respect of area in India. With the proportion of urban population at 34.5 per cent compared to 25.7 per cent for the country, it is fourth amongst the

state in the country in respect of urbanization. It has the longest coastline of 1600 km along the western part of India extending from Lakhpat in the north to Valsad in the south. (Map A : Location)

While the Aravalli ranges run along the northern fringe, the Western Ghats cover a small portion of the south. Major rivers like Mahi, Sabarmati, Narmada, and Tapi coming from the neighbouring state enter through the eastern fringes.

Geologically the basic complexion of the state consists of volcanic rocks except the alluvial plains of North Gujarat and the western borders of the Saurashtra peninsula. Soils in the southern region are deep black; central and northern parts of the state have old alluvium, and the Saurashtra region has medium black soils. All along the coast saline alluvium is found[7].

3.2.1 Physiography

Gujarat can be divided into five major physiographical zones:

1) Alluvial plains extend form Banaskantha in North Gujarat to Bulsar in the south. The alluvial plain also extends westwards to the little Rann and Bunny area of Kutch.
2) The Eastern hilly tract lying between 300-1400 meters above mean sea level form a major divide. Most of the rivers in Gujarat originate from the hills in the east and flow towards south and south-westwards except Narmada and Tapi, which cut across the hilly tract along the faulted zones.
3) Uplands of Kutch-Saurashtra comprising sandstone, shale, basalt rocks with elevation of about 150-500 meters above mean sea level and slope radial towards the coastal tracts. Mount Girnar is an isolated mountain (117 meters above mean sea level) in the Saurashtra region.
4) The low-lying coastal tract ranging in elevation from 3-25 meters above mean sea level makes the coastal areas of Saurashtra and Kutch. These low lying areas extend from Rann of kutch through the Little Rann of kutch and the low lying delta region of Bhadar, Bhogavo, Sabarmati, Mahi, Dhadar, Narmada and Tapi rivers.

GUJARAT STATE : TALUKA MAP

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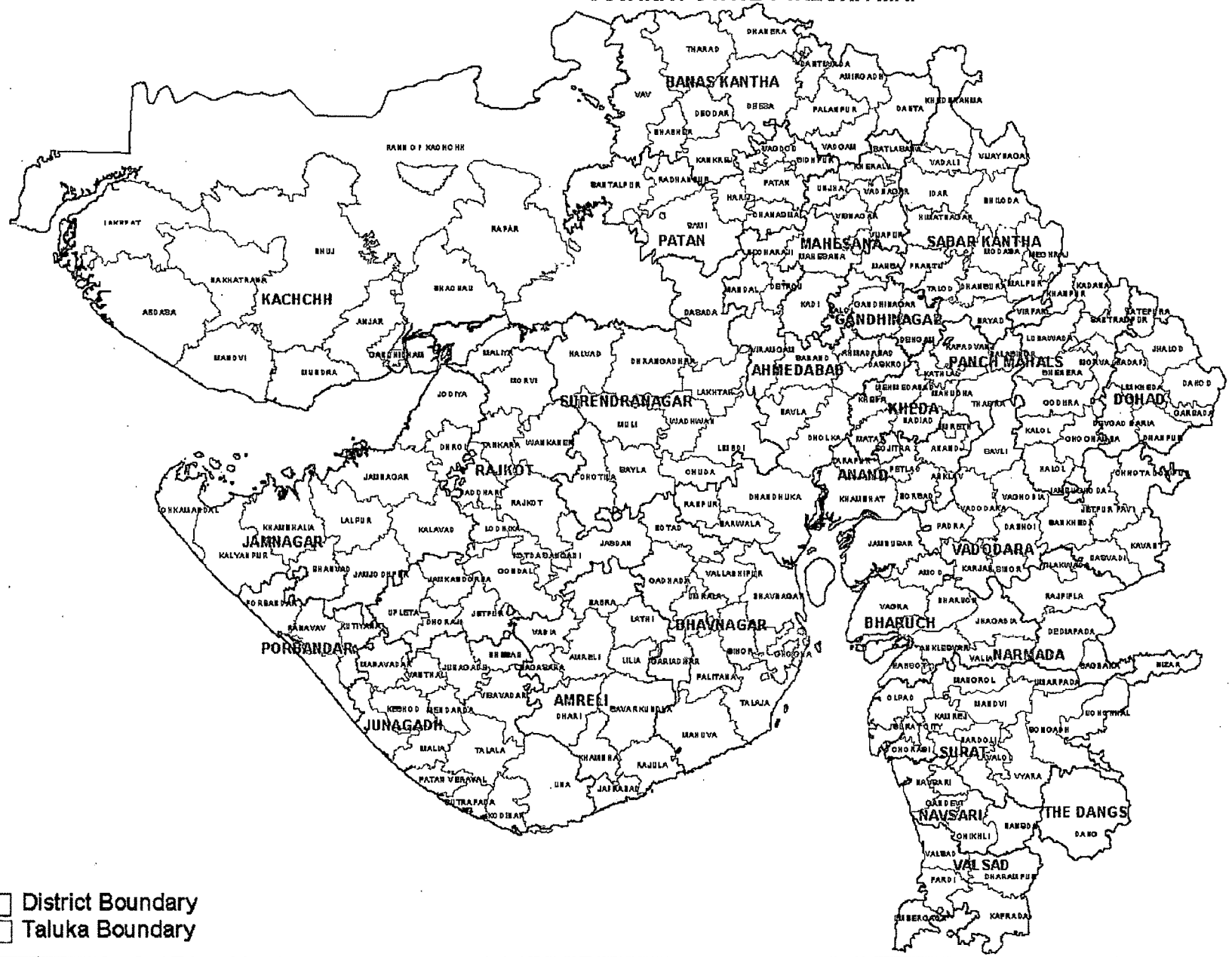
(For Official Use Only)



District Boundary
Taluka Boundary

Prepared by RESECO.

5) Marshy to saline desert of Rann of kutch and Little Rann of kutch extending to the saline tracts around the Gulf of Kutch. This vast expanse of salts mixed with clay is devoid of any vegetation or habitation. The general elevation of this tract varies between 1and 4 meters above mean sea level.

3.2.2 Drainage

Drainage of all five physiographical regions of Gujarat State is distinct with the prevailing topographical and physical characteristics of the rock formation. Except Tapi, Narmada and Mahi, all rivers of the state originate from the eastern part. The rivers flow with highly meandering courses in a westerly direction and cut across the alluvial plains. The rivers Narmada and Tapi flow along structural troughs in a western direction. The rivers in Saurashtra originate from the central uplands and represent a radial drainage pattern.

3.2.3 Climate

Gujarat has humid, sub-humid and semi-arid to arid type of climatic conditions with the highest rainfall of about 2000 mm in the south, which gradually decreases to about 300 mm in Kutch. The rainfall pattern of Gujarat State has conspicuous impact on its economy. Droughts are frequent in north Gujarat, Kutch and Saurashtra regions due to poor and erratic rainfall.

3.2.4 Agriculture

The net area sown in 1995-96 and 1996-97 was about 9.6 million hectares, forming 49% of the total area of 19.6 million hectares and the gross cropped area was 11 million hectares. On the basis of weighted average, 49.8% of the area is under foodgrains, out of which 15 per cent is under bajra, 9.7 per cent under wheat and 7.3 per cent under rice. The balance of 50.2 per cent is under non-food crops, of which 21.1 per cent is accounted for by groundnut and 23.7 per cent by cotton[8]. Gujarat is a major producer of groundnut and cotton, as in 1997-98, which was a good year, it accounted for 33.4 per cent of the country's production of groundnut and 28.5 per cent of the country's production of cotton[9].

Production of rice, wheat and bajra was 10.10 lakh tonnes, 17.03 lakh tones and 12.81 lakh tonnes respectively during the year 1998-99, as against 10.42 lakh tonnes, 16.47 lakh tones and 14.95 lakh tonnes during the year 1997-98. Production of groundnut in 1998-99 was 25.78 lakh tones as against 26.16 lakh tonnes for the year 1997-98.

During the preceding year (1999-2000) due to the deficient monsoon in Saurashtra, Kutch and northern districts of Gujarat, the estimated decline in the kharif foodgrain was to the extent of 29 to 31 per cent. The estimated figures of production showed a decline of 45 per cent in bajra, 83 per cent in jowar, 72 per cent in groundnut and 41 per cent in moong. It is estimated that Gujarat sustained a whopping loss of Rs.4500 crore because of failure of crops.

3.2.5 Water Resources

The availability of irrigation facilities is a key factor in increasing agriculture production. The ultimate irrigation potential through surface water as per the latest estimate is 39.40 lakh hectares, which includes 17.92 lakh hectares to be irrigated through the Sardar Sarovar (Narmada) Project. Groundwater resources are relatively limited and have been over-exploited in many parts of the state. There is an urgent need to curb the over-exploitation of groundwater and the only alternative left is augmentation of water resources through surface water. The overall position regarding water resources in the state can be seen from following table:

Table : 3.1 Position of Water Resources in the State.

Item	Ultimate Irrigation Potential	Irrigation Potential Created up to June 1999 (Likely)	Maximum Utilization up to June 1999 (Likely)
1	2	3	4
1. Surface Water			
1.1.Major & Medium Schemes	18.00	13.82	12.31
1.2 Sardar Sarovar Project (With conjunctive use)	17.92	--	--
1.3 Minor Irrigation	3.48	2.40	1.45
Total – (1)	39.40	16.22	13.76
2. Ground Water (With Private Resources)	25.48	20.21	17.19
Total – (1+2)	64.88	36.43	30.95

(In lakh hectares)

It indicates total irrigation potential created up to June, 1999 and maximum utilization at present comes to 47.70 per cent of the ultimate potential.

The latest available figures of actual irrigation are for the year 1994-95 and the net irrigated area is 30 lakh hectares, forming 30% of the net area sown[10].

As indicated in the table above, a major part of the groundwater resources already stands exploited. Out of the existing 183 talukas 31 fall in the over-exploited category, 8 in "dark" category and 42 taluka in "grey" category[11]. In north Gujarat, particularly in Mehsana and Banaskantha, water is being extracted from a depth of 1000 and 1500 feet, heavily depleting the entire underground water reservoir.

3.2.6 State and other States at a Glance

Gujarat is the only and leading state to have a set up like Director, Non Government organsiations co-ordination. It was set up with the objective of strengthening the network of NGOs in the state for supplementary activities in various government schemes and projects. The Director, NGO Co-ordination, has to create a database of NGOs in the state. The set-up can provide a supportive role in Disaster Management activities also.

Most of the states in the country have control rooms at state level. Some of states like Maharashtra and Andhra Pradesh have state of art level control rooms. Some of them are on developing stage. The control room of Gujarat state is state of art level in terms of hardware but still there is room for development in terms of software.

The existing administrative structure to deal with the ravages of the earthquake were not found satisfactory and hence the Gujarat Government constituted the Gujarat State Disaster Management Authority on 8 February, 2001 with the chief minister as chairperson and ten members. In a similar fashion, immediately after the Orissa cyclone the Orissa government constituted the Orissa state disaster management authority, on 29 October, 1999. In spite of being two years junior GSDMA is performing well by all means over and above the rehabilitation of the 2001 earthquake affected people.

3.3 Vulnerability Profile of Gujarat:

On account of its geographical position, climatic and geological setting, gujarat has had a fair share of disasters of varying magnitudes from times immemorial. Non-availability of moisture during the greater duration of the year and majority of the region being arid and semi-arid makes the state's landmass vulnerable to drought; on the other hand, heavy concentration of rainfall within a span of a few rainy days in large parts of the state causes heavy run-off, leading to high floods and water-logging problems. The tectonic movements of the plates of the Indian subcontinent make the state vulnerable to severe seismic disturbances and the cyclones rising from the Arabian Sea frequently attack the 1600 km coastline of the Saurashtra peninsula and Kutch. Refer Table 3.2, 3.3

Table : 3.2 Components of Vulnerability and their Determinants

Components of Vulnerability	Variables involved	Socio-economic and Technical Determinants
Initial Well-being	Nutrition; physical and mental helath; Morale/faith; Capacity for self-reliance	Class Position; Gender; Ethnicity; Age; State and Civil Society
Livelihood resilience	Income opportunities; Livelihood type; Qualifications; Assets and savings	The above plus shifts in power relations and effects on livelihood after hazard impact
Self Protection	Building quality; Hazard protection; Location of home and livelihood;	Socio-Economic: as above plus: Technical ability and knowledge of and availability of protective measures;
Societal Protection	Type of protection, its cost and feasibility; return period; Duration; Intensity; Magnitude	As above plus, Building, regulations Technical interventions by higher levels; Level of scientific knowledge Characteristics of technical practices (elitist?) Quality and robustness of insurance systems; Type of science and engineering used by state and dominant groups
Social Capital	Social cohesion; Rivalries; Number and strength of potentially conflicting groups;	As above, plus, type of state power; capacity for civil society to develop and enable positive networks and interactions.

Table : 3.3 Vulnerability Matrix- Components of Vulnerability and Variables affecting them

Variable Component	Income Group	Gender	Ethnicity	Type of State	Civil Society	Science & Technology distribution and type
Initial well-being						
Livelihood Resilience						
Self Protection						
Societal Protection						
Social capital						

3.3.1 Vulnerability Atlas and Hazard Mapping

This study has put maps and information and data regarding hazards and risk from the Vulnerability Atlas of India. In relation to the Yokohama Strategy for Safer World in 1994, the Ministry of Urban Development and Poverty Alleviation, Government of India (1994) had constituted an expert group to study the following issues related to impact of natural hazards particularly with respect to housing and infrastructure:

- Need to identify vulnerable areas with reference to natural hazards such as earthquakes, cyclones, floods, etc., having a potential of damaging housing stock and related infrastructure.
- Preparation of a vulnerability atlas showing areas vulnerable to natural disasters and determination of risk levels of houses.
- Formulation of a strategy for setting up techno-legal regimes for enforcing disaster resistant construction and planning practices in natural hazard prone human settlements.

The result of this was in three parts:

Part-I Techno Legal Measures

Part-II The Vulnerability Atlas of India

Part-III Technical Guidelines

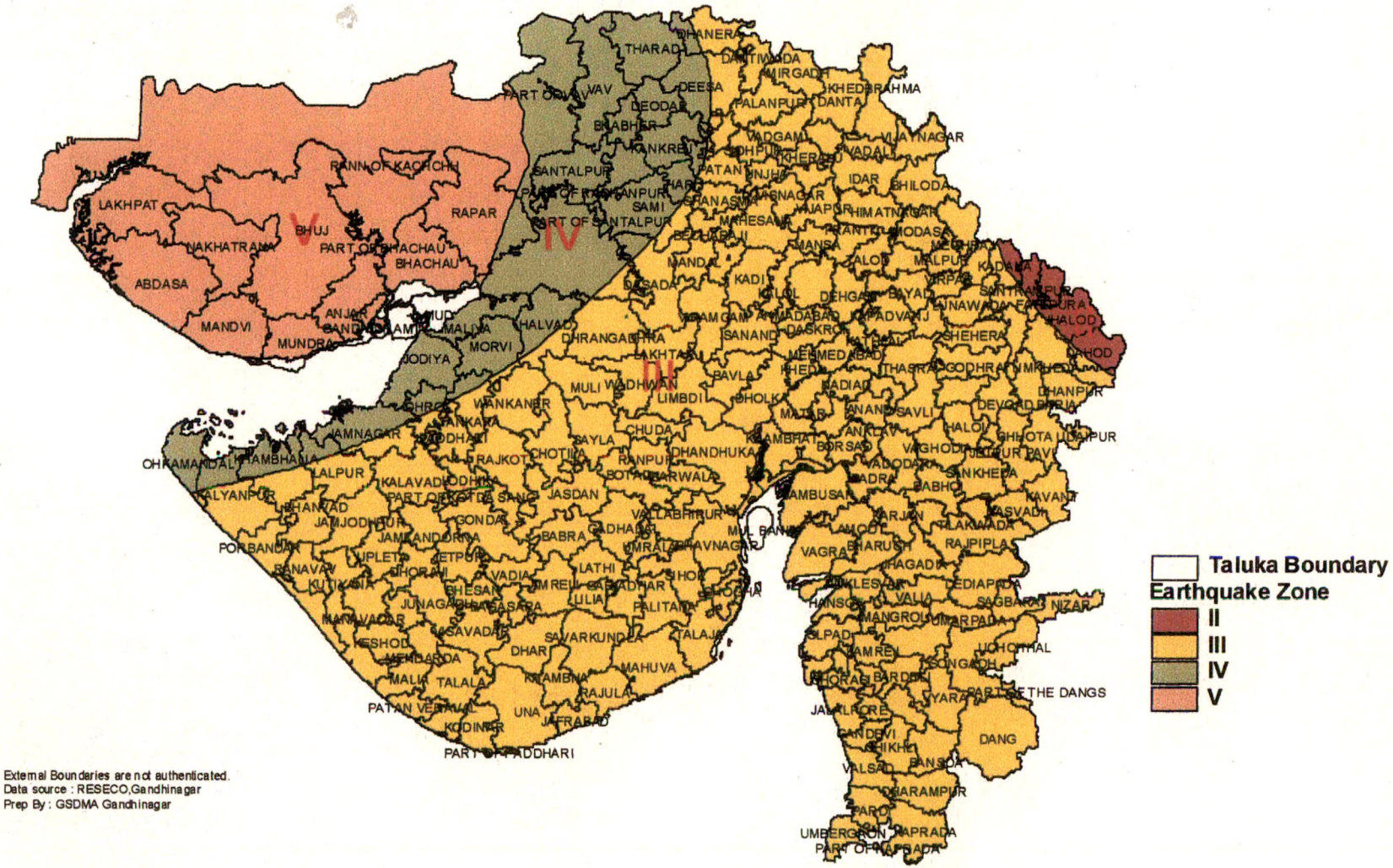
The Vulnerability Atlas of India is an appreciative initiative taken by the Government of India in the direction of long-term disaster mitigation; however, it certainly has limitations, which one can overcome by detailed hazard mapping studies at local levels with more accuracy. The Vulnerability Atlas has been prepared with following regulations and information, and that has imparted certain limitations to the Atlas:

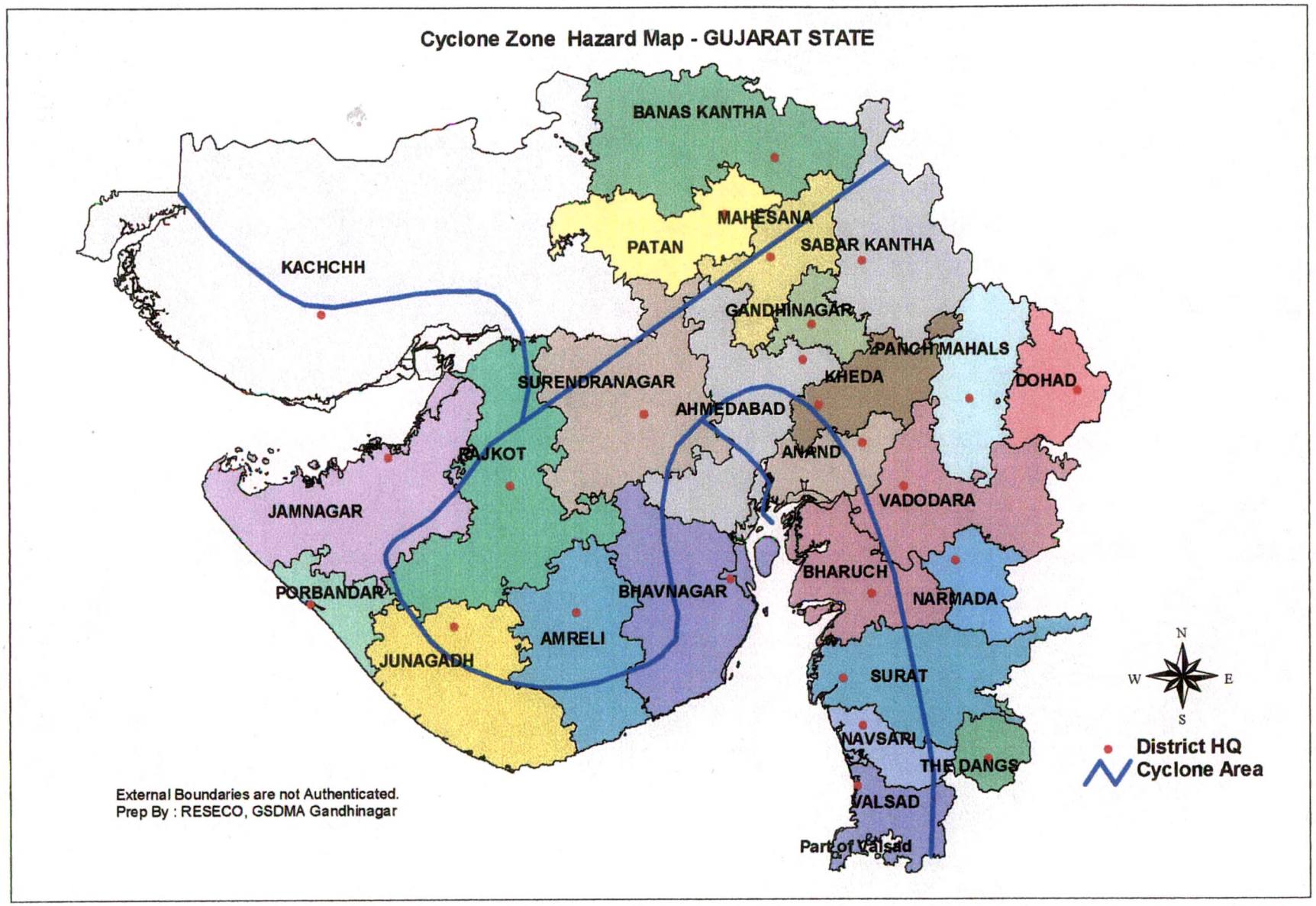
- Earthquake Hazard Maps are based on the Seismic Zoning Map of India given in IS;1893 1984. Seismo-tectonic features are marked as per ONGC maps. However, the seismic zoning map of India has not been upgraded since 1960. In these last four decades, ground movements capable of changing the existing fault lines and / or developing new faults must have taken place. There have been no recent attempts to produce new hazard maps using satellite imagery in lineament mapping, along with geo-dynamic measurements of strain accumulation.(Map : B Earthquake Prone Zone)

- The Cyclone and Wind Hazard maps are based on wind speed maps given in IS 875 1987 (part III). Along with design wind speed, the numbers of cyclones, which have crossed each latitude of the seacoast in the past, are also marked. The built structures' vulnerability is derived from the Census of India (1991). The supporting base information is not upgraded, which may to improper final results. (Map : C Cyclone Hazard Map)

- The Flood Hazard Maps based on the Flood Atlas of India prepared by the Central Water Commission. Maps show unprotected areas close to the rivers liable to flooding, as well as areas that have been protected using bunds, but other low lying areas outside river flood plains (which are also flooded during heavy rains due to choked drainage path) are not plotted because of lack of data, which has to be collected by each state/local administration (Map : D Flood Hazard Map)

EARTHQUAKE ZONE AREA - GUJARAT STATE




Cyclone Zone Hazard Map - GUJARAT STATE
BANAS KANTHA
MAHESANA
PATAN
SABAR KANTHA
KACHCHH
GANDHINAGAR
PANCH MAHALS
KHEDA
DOHAD
SURENDRANAGAR
AHMEDABAD
ANAND
RAJKOT
VADODARA
JAMNAGAR
BHARUCH
NARMADA
PORBANDAR
BHAVNAGAR
AMRELI
JUNAGADH
SURAT
NAVSARI
THE DANGS
VALSAD
Part of Valsad
N
W
E
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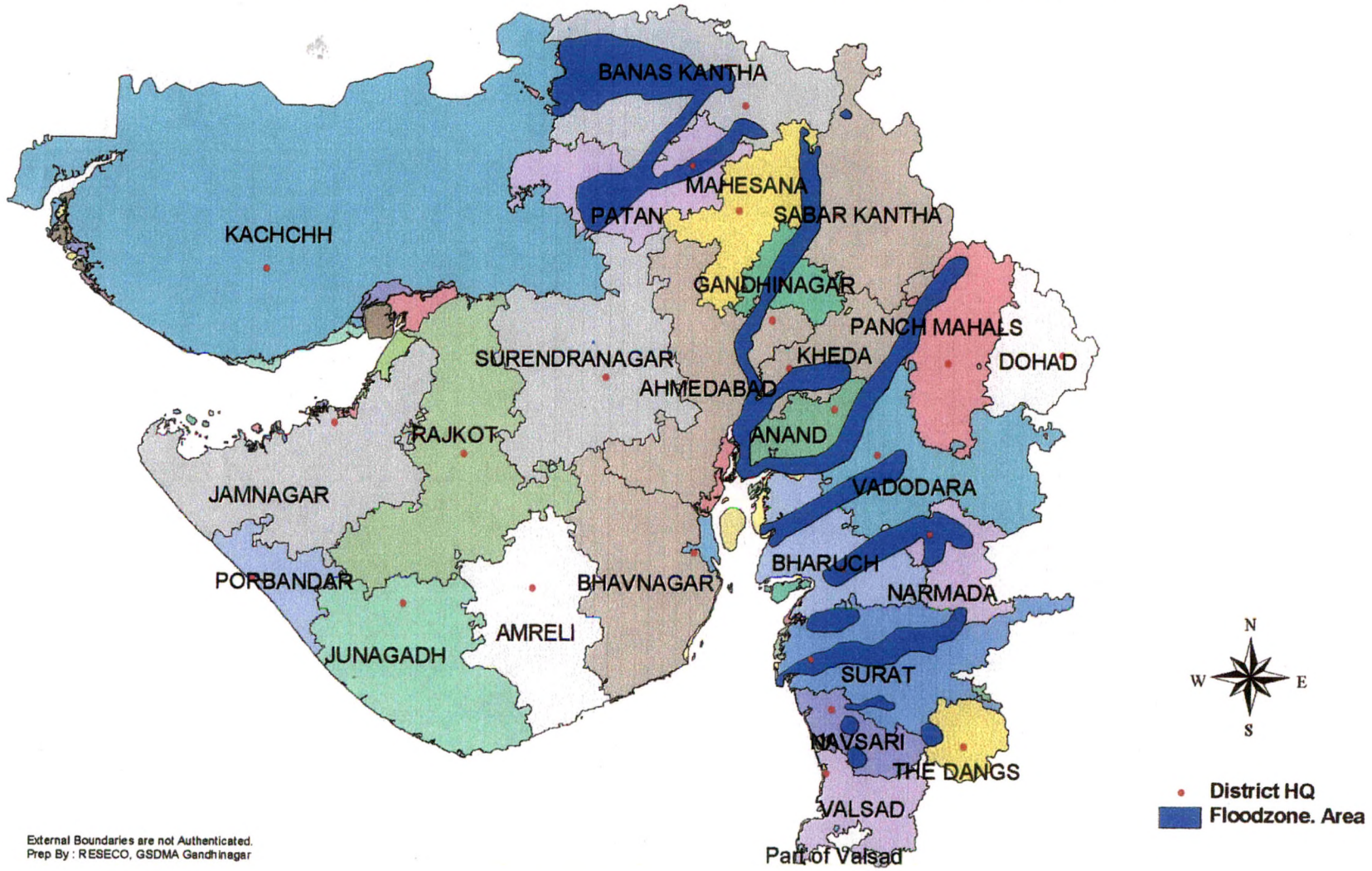
District HQ
Cyclone Area
External Boundaries are not Authenticated.
Prep By : RESECO, GSDMA Gandhinagar

FLOODZONE HAZARD MAP -GUJARAT STATE



External Boundaries are not Authenticated.
Prep By : RESECO, GSDMA Gandhinagar

3.3.2 Physical Vulnerability

Physical vulnerability relates to [14]:

- Physical location of people (flood plains, low-lying areas, cyclone paths, fault zones)
- Human settlement's proximity to the hazard zone (this can be proximity to hazardous industry also apart from the natural hazard zone)
- Resistance offered to hazards by the shelter (technical capacity of the building)
- Standards of safety maintained to counter the effects
- Dependency on natural resources and environmental degradation (especially in droughts)

For example people are only vulnerable to floods because they live in a flood prone area, physical vulnerability also relates to the technical capacity of buildings and structures to resist the forces acting upon them during a hazard event. It is apparent by now that the Gujarat is vulnerable to multiple hazards having multiplier effect. Out of the total 25 districts, the districts of Ahmedabad, Bharuch, Surat and Valsad are prone to all four hazards[15] indicated in the Table 2. Other districts except Rajkot are prone to three hazards. Thus, more or less the entire state is prone to various kinds of natural hazards and more people are now vulnerable than ever before. It has also become apparent that, on the one hand, particular communities are periodically exposed to the same hazards, on the other hand, hazards are striking areas where they are not expected and also in higher magnitude.

The industrialized part as well as the coastal area having major ports and gigantic industries hold enormous potential of devastation owing to the multiplier effect of natural phenomena that can strike on these units/areas. The Kandla port was affected very badly during the cyclone of 1998. The port handles chemicals that may prove to be extremely hazardous if any calamity strikes. While looking at the cyclone hazard map, it is apparent that starting with Ahmedabad district to Kutch, starting from the shore to some kilometers towards land, the whole of the coastline is in very high damage risk zone B (50m/sec wind speed)

Areas from Kheda district to Valsad, Silvassa and Dadra and Nagar Haveli, fall in the moderate risk zone (47m/sec wind speed). Thus, all the ports and industries falling in this belt are highly vulnerable to severe damages. The Earthquake Hazard Maps and the Flood Hazard Maps by BMTPC also indicate the state's physical vulnerability. The Earthquake Hazard map has indicated the underlying principle deep-seated faults, and major and minor faults. Though, the Flood Hazard Map has not indicated the low lying areas, it can be very useful with locally available data of low lying areas and other geographical characteristics are used for any further planning.

From the earthquake hazard map of Gujarat, it is seen that almost whole of the State lies in seismic zones of probable Intensity IX (severest) to VII (moderate) on M.S.K. Intensity Scale. The Kutch district, which has 80.3 per cent of its areas in intensity IX Zone, has been subjected to earthquakes in India. Kutch has a long-standing history of earthquakes. Gujarat is located in the Himalayan collision zone where the Indo Australian tectonic plate slides under the more northern Eurasian plate in a predominantly northern direction at a rate of 2 centimeters per year. This process compresses the region and the crust is being forced into folds of young deposits. This process causes active fault lines below the surface of the ground known as "blind thrust faults". These faults do not rupture the surface, but create rolling hills. There is evidence of at least four of these hill patterns in Gujarat.[16].

Most of the coastal areas of the state fall in the 50m/s (180km/h) wind velocity zone, other areas fall into 47m/s, 44m/s and 39m/s velocity zones. The state has experienced 24 cyclone crossings from 1850 to 2000 out of which 11 have been severe cyclonic storms. The probable maximum surge height that can be expected to strike the coast is as much as 5m above concurrent tide level. During the cyclone of 1998 there have been incidences of this height being 8 meters. A large proportion of the buildings in the state run the risk of moderate (M) to very high (VH) risk from high velocity winds. The nine districts that fall in the high-risk zone with cyclones partly or fully are Junagadh, Rajkot, Jamnagar, Amreli, Bhavnagar, Kheda, Surat, Bharuch and Kutch[17]

Table : 3.4 Multi-hazard Prone Districts in Gujarat.

District Name	Percent area under EQ intensity, M.S.K.			Percent area under wind zone		Max. Probable storm surge ht.	Percent area flood prone	
	IX or more	VIII	VII	Speed m/s	% of area	At coast line (m)	Unprotected	Protected
Ahmedabad*	0	0	100	50	25	4.8	5.9	11
Amreli	0	0	100	50	32.5	2.8	0	0
Banaskantha	0	61.1	38.9	47	100	0	8.8	0
Bharuch*	0	0	100	44	100	4.8	22.4	0
Bhavnagar*	0	0	100	50	62.6	4.7	0	0
Dang	0	0	100	44	100	0	2	0
Gandhinagar	0	0	100	44	100	0	47.1	0
Jamnagar*	0	0	58.4	50	91	2.5	0	0
Junagadh*	0	41.6	100	50	74.5	2.8	0	0
Kutch*	80.3	19	0.7	50	36.3	2.5	0	0
Kheda	0	0	100	44	100	0	17.7	0.2
Mehsana	0	17.1	82.9	47	59.7	0	28	0
Panchmahals	0	0	78.1	44	100	0	4	0
Rajkot*	0	15.9	84.1	50	21.3	0	0	0
Surat*	0	0	100	44	100	4.8	28.1	0
Vadodara	0	0	100	44	100	0	8.8	0
Valsad*	0	0	100	44	100	5	3.7	0

*Source: Vulnerability Atlas of India: Gujarat (*Districts prone to cyclone including storm surge)*

Gujarat is moderately prone to the floods hazard[17]. The Flood Hazard Map shows that the flood prone areas are mainly along the principal rivers in the state. The problems associated with these rivers are mainly inundation of areas due to spilling of riverbanks and inadequate drainage at places and erosion of banks. The Narmada, Sabarmati and Mahi basin frequently experiences river floods due to heavy rains in the upstream, and the Saurashtra region experiences floods due to excessive rainfall as in the years 1982, 1983 and 1988.

While referring to relative importance of different ecological disasters for Gujarat, Earthquake, though envisaged once in 50 years, can create the most ruinous effects. Cyclones and floods with comparatively less vulnerability of the State can be dealt effectively. Earthquake with no warning and with most of the State's area under Zone-V to Zone-III, the risk involved is much higher.

Moreover, the Golden Corridor of Gujarat, though lying In the Moderate Damage Risk Zone (MSK VII) has the potential of great economic losses even with lower intensity earthquakes.

Major Parts, the Golden Corridor and the Silver Corridor of Gujarat can prove to be ruinous if their potential of multiplier hazard is overlooked while planning out long-term mitigation and preparedness measures. The increase in damages due to disasters is being brought about by concentration of people in disaster – prone areas. Why this is occurring can be the topic of a volume all on its own. However, in terms of disasters, what it translates into is the understanding of increasing and changing vulnerability.

3.4 State Level Disaster Response

In the context of the federal structure of the country, the responsibility to cope with natural disasters is essentially that of the state government. The role of the Central Government is supportive in terms of supplementation of physical and financial resources. Only two entries in the State list that are remotely related to the subject of disaster management are entry 14, which deals with agriculture, including protection against pests and plant diseases, and entry 17, which deals with water, including water supply, drainage and embankments. This is grossly inadequate, and disaster management needs to be included in the Seventh Schedule of the Constitution[18].

3.4.1 Set up at State level

The nodal department for formulating, controlling, monitoring and directing measures for disaster preparedness and for organizing rescue and relief operations with necessary co-operation among all the departments of the state government. The chief secretary is in overall charge of the relief operations in the state and the Relief Commissioner and the Additional Relief Commissioner function under his direction and control. The State Relief Commissioner, is in charge of the relief and rehabilitation measures in the wake of natural disasters in

the State. In many states, the department of revenue is also in-charge of relief. The state government has framed the state contingency plan and relief manuals and the districts have their contingency plans that are updated from time to time.

In case of a disaster, the state government invites NGOs and other national and international relief organizations to join in the efforts to reach out to the victims. GSDMA is a nodal agency formulated after Earthquake 2001 under and the chief minister chairs this authority. There have been many changes after the recent earthquake. Particularly for earthquake rehabilitation, there have been many committees formed at various levels. It is still not clear whether the committees would be functional after the rehabilitation stage[19].

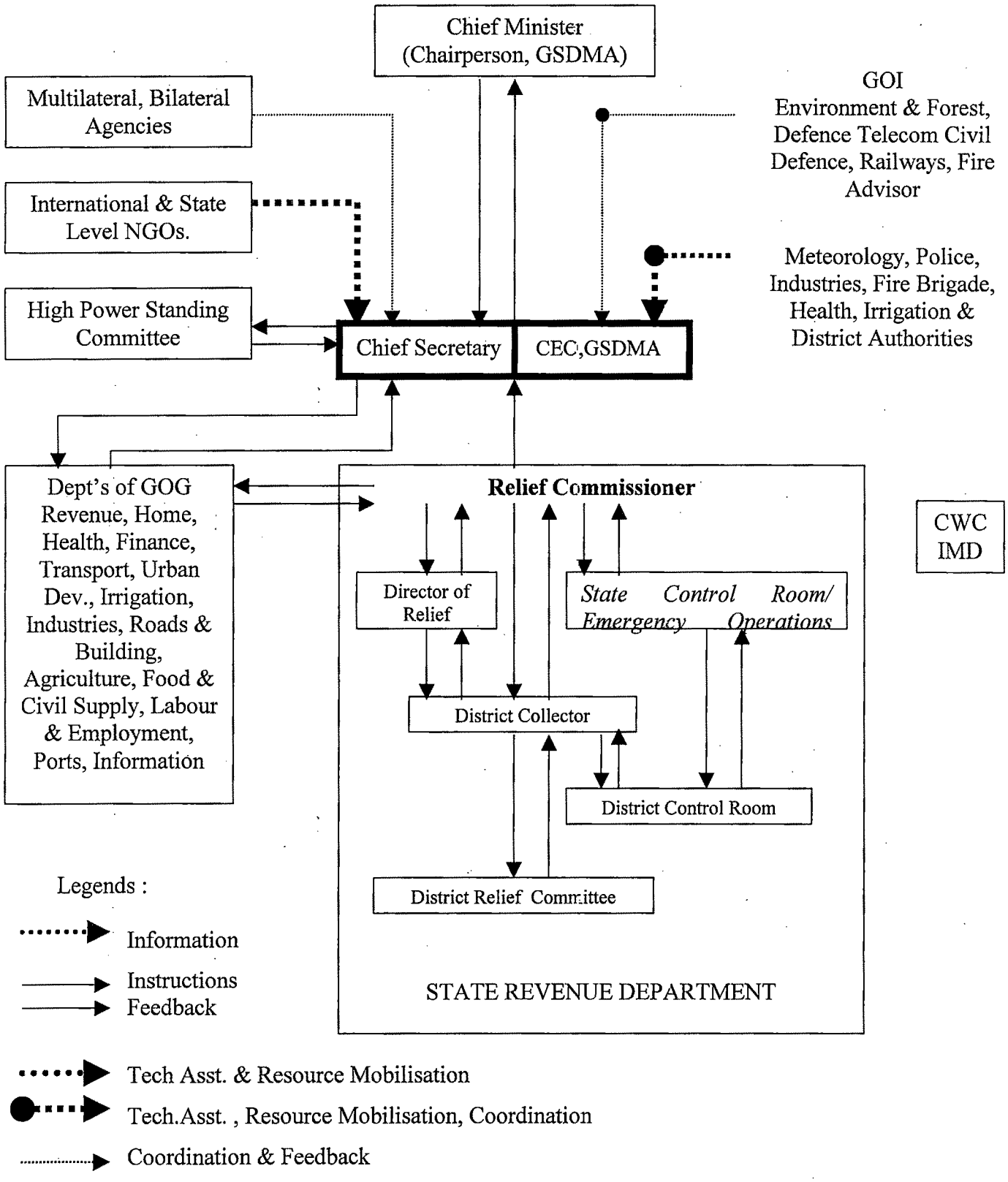
State High Power Standing Committee:

➢ Chief Secretary	Chairperson
➢ ACS, Finance	Member
➢ PS, Revenue	Member
➢ ACS, Agriculture	Member
➢ ACS, Home	Member
➢ Secretary, Civil Supplies	Member
➢ Secretary, Health	Member
➢ Secretary, Forest and Environment	Member
➢ PS, Roads and Buildings	Member
➢ Secretary, NWR and WR	Member
➢ Secretary, Ports and Fisheries	Member
➢ Director General of Police	Member
➢ PCC Forest	Member
➢ Relief Commissioner	Member Secretary

3.4.2 High Power Standing Committee

A State level High Power Standing Committee chaired by the Chief Secretary functions with members from various departments to deal with all matters and situations arising out of natural calamities including disaster preparedness.

Figure : 3.1 Response and Inter action In Gujarat State on Occurrence of Disaster



During the occurrence and continuance of a natural calamity, the above committee of secretaries headed by the chief secretary functions to monitors the day-to-day situation and issues necessary directions to deal with the situation.

3.4.3 Sub-Committee

Another sub-committee is chaired by Additional Chief Secretary/Principal Secretary Revenue and / or Commissioner of Relief which co-ordinates activities of all agencies, officials and non-officials engaged in relief operations. Liaison officers of all the departments are members of this sub-committee and the Director of Relief is member secretary of this committee and is responsible for coordinating with district authorities.

3.4.4 Commissioner of Relief

A full time officer designated as Commissioner of Relief is the overall in charge of preparedness exercise, rescue, relief and rehabilitation operation in the state.

3.4.5 Gujarat State Disaster Management Authority (GSDMA)

The existing administrative structure to deal with the ravages of the earthquake were not found satisfactorily and hence the Gujarat government constituted 'the Gujarat State Disaster Management Authority' on 8 February 2001 with the chief minister as chairperson and ten other members. The Resolution spoke of the need for a permanent arrangement to handle a calamity. It is therefore evident that the existing disaster management system at the state level was found inadequate.

The objectives of the Gujarat State Disaster Management Authority are the following:

- To undertake rehabilitation and reconstruction as also social and economic activities for restoration of the situation.
- To make efforts to minimize the impact of natural disasters.
- To make the best use of funds, grants, donations, assistance etc received from the government of India and other foreign countries or any other

institution/persons for prevention of such natural calamities or handling the aftereffects.

The jurisdiction of this authority will be the entire state and will work as an autonomous body. It has been registered as a society under the Societies Registration Act, 1860. The government of Gujarat has also created a separate Rehabilitation and Reconstruction Division under the General Administration Department of the State Government and the work of the Gujarat State Disaster Management Authority has been transferred to the General Administration Department. Further, the State Government constituted a taskforce to suggest effective measures for preparation of a long-term Disaster Management Plan, headed by the Chief Executive Officer of the Gujarat State Disaster Management Authority

The Gujarat State Disaster Management Authority constituted on the pattern of a similar authority formed in Orissa earlier has a CEO and two Additional CEOs. It has six Directors and a chief Engineer who look after different aspects of work relating to Disaster Management. The Chief Minister is the Chairperson of GSDMA and meets at least once a month. It has the powers of the state cabinet.

Besides this, two committees have been constituted for redressal of grievances- one at the district level, which is headed by the Minister in charge of the concerned district and the other at the village level headed by an officer not below the rank of the deputy collector or Mamlatdar.

GSDMA is also looking forward for long-term mitigation in the state. The path drawn abruptly today seems quite appropriate, although how much of it is put in practice, their approach and process will determine the future of the state with respect of disasters. GSDMA's plan ahead drawn in series of meetings by task force and in various workshops. It is yet to be given concrete shape; presently it is simply listing of all possible measures, suggested by various subject experts/representatives. While putting this points in a future strategy, what remains and what is left is not clear. (Refer Figure : 3.2)

Figure : 3.2

Gujarat State Disaster Management Authority
General Administration Department, Government of Gujarat

Chief Minister
Chairperson

Advisory
Committee

Chief Executive
Officer

Additional CEO

Additional CEO

Director Administrati

Director-Disaster Management

Director Housing & Emergency Communication

Director Finance

Chief Engineer (Procurement)

Controller of Accounts

3.4.6 State and District level Contingency Plans

The State level contingency plan is the consolidated plan (from district contingency plans) to be put in action on occurrence of a calamity. These contingency plans lay down specific action points, key personnel and contact points in relation to all aspects. However, these plans are not comprehensive in nature and are only response plans and do not take into account any mitigation or reduction measures. Action is initiated on the receipt of warning only. These plans require regular updating and further development into manuals and SOPs for guidance. Contingency plan at district level is prepared by the collector and approved by the state government. It is prepared in coordination with local defense personnel and other departments of Government.

3.4.7 State and District Control Rooms

There is also provision of a well-equipped state of art control room. Presently, the State Control Room has hotlines with the District Control Room and coordinates relief activity and receives information from various districts. District Control Rooms do not function annually; Collectors start operating it generally before onset of monsoon, i.e. from June and so and operates till September and November. Staff from control room are seconded from other departments.

The control room is responsible for:

- Transmitting to the Relief Commissioner information as to the development of crisis situation.
- Receiving information and communicating to appropriate agencies for immediate action
- Collection and submission of information relating to implementation of relief measures to the Relief Commissioner
- Keeping the state level authorities apprised of the developments on a continuing basis.

3.5 District level Disaster Response

The district collector is the focal point at the district level for directing, supervising and monitoring relief measures for disaster and for preparation of the district level plans. The collector jointly with the DDO exercises coordinating and supervisory powers over functionaries of all the departments at the district level. The actual day-to-day work of administering relief or implementing contingency plans and coordinating and supervisory powers over functionaries of all the departments at district level are the responsibility of the district collector. During actual operations for disaster mitigation or relief, the powers of the collector are considerably enhanced. In emergency, the state administration informally permits the collector to exercise higher powers and the competent authority later ratifies decisions. When a disaster is apprehended, the entire machinery of the district, including officers of technical and other departments, swings into action and maintains almost continuous contact with each village in the disaster threatened area. The role of sub-district administration is also crucial here[20].

3.6 Panchayati Raj Institutions and Local Self Governance

It is a surprising fact that though the panchayati raj institutions in Gujarat have very good hold at local level, they do not have any active role to play during emergencies. Each layer of the system has some specific functions to perform during an emergency, which is well defined in the Panchayati Raj Act of 1993. But there are not given any financial assistance to perform any of such duties. This keeps their role limited and most of the time passive, though their close attachment to the public and good knowledge of crisis and resources can prove them as very good managers at such critical periods of time.

Section 99 of the Gujarat Panchayat Act 1993 covers 106 different activities of the panchayats. The community development activities include the following two responsibilities during emergencies:

- Assistance to disabled, poor and sick people
- Assistance to all victims during occurrence of any natural calamity

Section 130 of the act mentions 86 responsibilities of the taluka panchayats. About emergency relief it says, "....shall provide assistance during flood, fire, epidemic and any other such natural calamities."

Districts panchayats are assigned a major role in emergencies. Section 154 mentions 73 tasks of the district panchayats and one of them is "Establishing and managing relief camps during natural calamities like drought and famine, fire and earthquake".

In a nutshell, emergency relief is part of the responsibilities of the panchayati raj institutions but they are not given any assistance to carry on such activities. They have no other role to play except providing all necessary data of damage and loss. Same is the case with municipalities and corporations[21].

References

1 Shah Jolly, *State Environmental Action Programme*(SEAP), (Report for GEC, Vadodara) Ahmedabad.1

2 State Revenue Department

3 Shri Jai Narain Vyas, Ex-Minister, Narmada and Water Resources, Gujarat State

4 State Revenue Department

5 State level *Response Plan for Chemical, Industrial and Nuclear Hazards*, Gujarat, GSDMA

6 State Relief Manual

7 Gupta L.C. & Vinod K. Sharma, *Drought in Gujarat: 1999-2000 and 2000-2001*, National Centre for Disaster Management, Indian Institute of Public Administration, 2001.1-5

8 *Socio-economic review* –Gujarat State- 1999-2002

9 *Agricultural Statistics at A Glance 1999*, Ministry of Agriculture, Government of India.

10 Statistical Abstract of Gujatrat State 1998.

11 Buch, V.B. Vice Chairman, Sardar Sarovar Narmada Nigam Ltd. (SSNNL),"*Meeting the Challenge of Development.*

12 Gujarat Earthquake Recovery Programme, ADB and World Bank Joint *Assessment Report.*

13 *Socio-economic review –2001*, Government of Gujarat.

14 Kumar Santosh, Disaster Management, Analysing Vulnerability, Disaster Mitigation: Experiences and Reflection.

15 BMTPC, Gujarat :*Vulnerability Atlas of India,* Ministry of Urban Development, New Delhi, 1997

16 Merh S.S., *Role of active tectonism in evolution of Kutch Landscape.*

17 BMTPC, Gujarat :*Vulnerability Atlas of India*, Ministry of Urban Development, New Delhi, 1997

18 Shah Jolly, *State Environmental Action Programme(*SEAP), (Report for GEC, Vadodara) Ahmedabad. 44-47

19 *State level consolidated Cyclone and Flood Action Plan*, State Revenue Department.

20 Gupta M.C., Vinod K. Sharma, L.C.Gupta, B.K. Tamini (ed), *Manual on Natural Disaster Management in India*, (National Centre for Disaster Management, IIPA, New Delhi, 2001)

21 Department of Acriculture and Co-operation, High Powered Committee on Disaster Management: Report, Ministry of Agriculture, Government of India, 2000 and Hemantkumar Shah, Gujaratma Kudarti Aapatti Ane Sarkari Kharch, Disaster Mitigation Institute, Ahmedanad, 1998

Chapter IV

Research Methodology

4.1 The Study

This study is an attempt to explore the possibilities of use of management information system (MIS) for natural disaster management (NDM). Over and above all other management practices, how can MIS play a vital role in disaster management? In spite of having all kind of resources, technology and will, sometimes we fail to manage natural disasters.

At the time of disaster, better and efficient MIS is of immense value and help whether the country is poor or rich. Considering the fact that any country facing disaster situation has to suffer heavily due to such occurrences, it is necessary to have pre and post disaster control measures through proper MIS, which can minimize the damages to property, agriculture, industrial sectors, and loss of lives. In the information era, any situation can be handled if a better and efficient MIS can be implemented. In this context, it was thought to focus on development of better MIS, which is very important for state governments in disaster management.

The study encompasses nature and size of the problem, global context of problem, natural scenario, state level arrangement and what kind of natural events gujarat had experienced, general characteristics and causes of main natural disasters like floods, earthquake, cyclones and drought etc. Various stakeholders of disaster management like taluka level officers, district level officers, policy makers and experts, representatives of NGOs, community representatives, their views and suggestions were collected, analysed, and studied to develop management information system for natural disaster management for the state of gujarat.

4.2 Objectives

The objective of this study, is to develop an efficient, effective and flexible disaster management information system for various operations during various stages of disaster management cycle particularly for natural disasters like floods, earthquakes, cyclones, and drought for Gujarat.

1 To study the general characteristics of various natural disasters like cyclone, earthquake, flood, drought and prevention of them up to certain extent with natural resources management
2 To study existing systems for natural disaster management (NDM) in Gujarat. Also to review the criteria, methods and standards for monitoring of natural disasters (cyclone, earthquake, flood and drought) of the state.
3 To find out the difference between existing system of NDM in the state and other states of the country.
4 To study the role of media and the reasons for non- participation of people and possibilities of people's participation through creating community awareness and capacity building for NDM.
5 To study the use of technology (Remote Sensing Technology, Geographic Information System, Global Positioning System) for hazard, vulnerability and risk assessment as well as effective early warning systems.
6 To develop and suggest an effective Management Information System for rescue and relief operations in NDM.

4.3 Scope

This study has covered application of management information system in natural disaster management and is limited to Gujarat. Views and suggestions on the basis of their experiences and knowledge from various stakeholders like policy makers and experts, district level officers, tehsil level officers, NGO representatives, community representatives have been considered.

This study has covered rapid on set disasters that the state faces and that are the results of natural phenomena. Disasters that are not natural phenomenon but arise due to human errors, industrial hazards, riots and epidemics are not covered in this study. Earthquake, Cyclones, Floods and Drought are focused in this study.

The study was undertaken during the period of December 1999 to February 2003.

4.4 Methodology

Intrinsic to the successful development of DMIS model is a holistic view of the entire process of disaster management starting from mitigation, prevention, preparedness, response, rescue, relief, rehabilitation, reconstruction, recovery and development. Systematic approach has been adopted for understanding the complex relationships between various factors. Extensive efforts have been put on the methodologies and techniques to blend together knowledge, understanding and rich experiences of Government officials of various levels (State, District, Tehsil etc.)and experts on one hand and non-governmental organizations (NGO) and community representative's wisdom on the other.

The study required a comprehensive methodology, which included field studies, review of documents and literature, group discussions, focus group interviews etc.

The structured means of organizing data was undertaken through questionnaires. The questionnaire was administered as follows:
Government officials at various levels:

1.	State level – policy makers and experts	20
2.	District level – officers of District Administration (Implementers and nodal officers)	40
3.	Tehsil level – officers of Tehsil Administration	100
	Total	160
	Other stakeholders.	
1.	Non Government organization (NGOs)	40
2.	Community Representatives	60
	Total	100
	Grand Total	**260**

Graph : 4.1

Details regarding the present system of Disaster Management in the state for major natural disasters like flood, earthquake, cyclone and drought etc., experiences of difficulties faced during management of various disasters because of present system and views or suggestions for better management, suggestions for best disaster management information system on the basis of their experiences and knowledge were asked in the open ended structured questionnaire and partial interviews was also taken in detail for state level senior policy makers and experts from various sectors like administration, health, industries, information, rural, technology, metrology etc. to determine the gap between the existing system of disaster management and the proposed disaster management information system.

To collect details and find out the problems of implementers, executives in monitoring and control of Disaster Management at district level for various activates like information collection, dissemination, control room, response, control mechanism, activities during/ pre/ post disaster situation, relief, rehabilitation, means of information, predictability, various components of MIS in

present the system and suggestions / views for betterment of disaster management information system etc. were asked with the help of structured and unstructured questionnaires.

A combination of structured and unstructured questionnaires was administered to tehsil level officers for various activities of tehsil level. Officers of different disciplines like revenue, panchayat, agriculture, animal husbandry, health, police, fire, information, engineering, horticulture, irrigation, forest, etc were contacted. Group interviews were also conducted with some of them to obtain their broader views for betterment of system and grassroot level problems.

To make the proposed system more effective and useful it should be acceptable also by all stakeholders. First and foremost user group is community people those who are at risk. So another questionnaire was administered to 60 community representatives of different districts, which are prone to one or more disasters. It will help to make the system more need based and participatory. It would be useful also in establishing down-top approach in the system. The questionnaire contained questions regarding details of communication facilities at local level, type of response and time taken, response of government and non-government organizations; problems at local level, suggestions, traditional knowledge for mechanism of prevention or / and immediate response and opinion about various components of disaster management information system, etc.

Another questionnaire was administered to 60 representatives of NGOs who are involved directly or indirectly in the works of disaster management. This questionnaire was also a combination of structured and unstructured questions. To collect details of their area of specialization, their network, their collaboration with Government and other NGOs, their strengths and weaknesses, and their resources at different levels. The intention behind this was to supplement the whole system and mechanism of disaster management with the synergic effects of NGO support.

The questionnaire were administered through stratified random sampling. It was not focused on present posting of the officer but more weightage was given to the experiences they were having of particular areas and type of work/ disaster.

Data collected with the help of questionnaire of different types, interviews, group interviews and discussions has been supported by secondary data whenever relevant and applicable.

Chapter V

Study of The Government Sector

This chapter discusses the basic characteristics of selected government functionaries working at different levels. It includes functionaries working at policy and policy level planning and/or as experts for the particular segment, district, and taluka level functionaries.

The collected information from these functionaries is given in Tables 5.1 to 5.57

Introduction

This chapter deals with. State, District and Taluka level officers who are connected with policy level decision, district level decision, and taluka level management of disaster situations respectively. We selected 20 policy makers and experts at state level, which include Director of Relief, Commissioner of Rural Development, Conservator of Forest, Director of Information, Director of Industries, Director of Meteorology, Director of State Institute of Rural Development, Additional Director General of Police, Fire Expert, Expert for Health Management, Professor of Animal Husbandry, Chief Engineer, GSDMA, Director (Emergency Communication), GSDMA, Director of Gujarat Institute of Development Research, Director of Soil Conservation, etc.

At district level 50 officers were selected for their responses on decision-making and management of disaster situations. At the district level the officers which we have selected include Deputy Collector, Special Land Acquition officer, Assistant Commissioner, Deputy District Development Officer, Additional Collector, Chief District Health Officer, Asst. Health Officer, Police Inspector, Police Sub Inspector, Deputy Director of Agriculture, Deputy Director of Animal Husbandry, Veterinary Officer, Deputy Director of Horticulture, Deputy Director of Information, Executive Engineer, Deputy Executive Engineer, Chief Fire Officer, Taluka Development Officer, etc.

At the taluka level, 100 officers were selected who implemented / carried out instructions/ orders for state/ district level officers. These officers were from different government department like Revenue, Panchayat, Police, Home, State Reserve Police Force, Fire, Health, Agriculture, Horticulture, Animal Husbandry, Forest, Irrigation, Engineering, and Information.

5.1 Policy Makers and Experts - State Level

The state has different departments with branches at district and taluka level. When a natural disaster occurs, the affected departmental head, in consultation with other relevant department has to frame common policy to manage the disaster situation. So it becomes necessary to know how these officers decide policy and disaster managing strategy. Specially designed questionnaires were canvassed directly to those involved in managing disaster situation. The collected information is processed and presented in this part.

5.1.1 Educational Level, Department, Experience Level

Out of responded twenty policy makers / experts, three are doctors/ Ph.D, six post graduates, five from special services (IAS, IPS, IFS), four graduate with technical degrees and two are graduates. This is shown in Table 5.1 given below.

Table : 5.1 Educational Level of selected officers at District level.

Designation	Ph.D/ Doctor	Post Graduate	Graduate	Spl. Quli. IAS,IPS	Technical Degree	Total
Professor	1	1	0	0	0	02
Director	1	4	1	4	1	11
Joint Director	1	1	1	0	2	05
Retired Officers	0	0	0	1	0	01
Others	0	0	0	0	1	01
Total	3	6	2	5	4	20

These officers are from different departments like Revenue (2) IAS (4), Forest, Rural Development, Animal Husbandry, Soil Conservation and Agriculture (7), Police, Fire (2), Health (1), Engineering / Industries (4). See Table 5.2 below.

Table : 5.2 Distribution of Officers according to their departments.

Designation	Revenue	IAS	Forest/ Rural etc.	SRPF/ Fire	Health	Eng./In dustries	Total
Professor	0	0	1	0	1	0	02
Director	2	3	3	1	0	2	11
Joint Director	0	0	3	0	0	2	05
Retired Officers	0	1	0	0	0	0	01
Others	0	0	0	1	0	0	01
Total	2	4	7	2	1	4	20

We tried to cover more departments and more officers at state level but due to their pre-occupation they could not respond in time.

Most of the officers are having sufficient experience in different government departments and have managed various kind of disasters. There are seven officers having more then 15 years but less then 25 years of experience, which is followed by 10 officers having more than 25 but less then 40 years of experience. There are only three officers who possess more than 40 years of experience. It is seen from Table 5.3 below.

Table : 5.3 Work Experience.

Designation	15 to 25	25 to 40	40 <	Total
Professor	0	1	1	02
Director	4	7	0	11
Joint Director	2	2	1	05
Retired Officers	0	0	1	01
Others	1	0	0	01
Total	7	10	3	20

These state level officers / policy makers and experts have very long experience in their services. To know how many natural disasters they have handled, a question was asked. The responses of this question reveals that out of twenty state level officers 50 per cent have handled more than five disaster situations. About eight officers responded that they have handled three to four various disaster situations. Only two officers have experience of handling two or less than two disaster situations.

Table : 5.4 Number of Natural Disasters Handled by the selected State level officers

Designation	Less then 2	3 to 4	5 & More then 5	Total
Professor	0	1	1	02
Director	1	3	7	11
Joint Director	1	4	0	05
Retired Officers	0	0	1	01
Others	0	0	1	01
Total	2	8	10	20

5.1.2 Present Disaster Management System in the State

For major natural disasters like flood, earthquake, cyclone and drought, we wanted to know the present system of management. Surprisingly out of 20 officers 50 per cent did not answer this question at all. Out of rest 50 per cent, 20 per cent have avoided by saying that they are not part of that and 30 per cent officers have responded. Responses are sketchy and do not create a clear picture of the present system. Responses reveal that the present system is

1 There is no defined "Disaster Management System"
2 It works eventually
3 Permanent action plans/ Master plans are prepared at district level
4 Start control rooms
5 Warning and forecasting systems are there
6 Database of equipments is available
7 Not proper.

5.1.3 Difficulties

The state level officers are very senior and responsible. Many of them have participated in managing natural disasters so it was thought to know the difficulties they have faced during managing the disasters. The officers are from different departments/ institutions hence were unable to give specific responses about various disaster situations. Their responses were collected and listed below.

1 Dealing with anxious media/ Hostile media, which discourages dedicated workers.
2 Dealing with elected ill informed representatives / Interference. Politicizing.
3 Facing the unrealistic demands of people, staff, managers (e.g. mask to all), very high expectation of people.
4 Disrupted communication / transport/ restoration of communication.
5 Unprepared Government / Non Government health care set up.
6 More duty hours (up to 16), without facilities.
7 Lack of trained and skilled staff./ Inadequate resources. Minimum backup – no quick replacement of staff.
8 Communication Gap.
9 Delegation of Power(Decision taken on the spot were approved after delay-difficulties)Delay in sanction from all levels.
10 Lacking in financial provision.
11 Administrative difficulties / less preparedness.
12 Lacking in information system.
13 Linkages problem among Government, line Departments, NGOs./ Co-ordination.
14 Relief material distribution system.
15 Necessary forms /Government Resolutions.
16 No uniformity.
17 Lack of modern equipments / planning / mapping/ technical capabilities
18 Rumors and panic.
19 Apathy and indifference of government establishment at district level /unfair practices.

5.1.4 Suggestions and views

The state level officers have narrated their difficulties in management of disaster situations. They are not specific in giving suggestions/ views. Their responses on this question were collected and are listed below.

1 A well-defined State Cell.
2 A clearly identified District network.
3 Multi-disciplinary Board at each level of management.
4 Preparedness in Quantity and Quality.
5 Set up working modern communication system/solid.
6 Organize rescue operations within 30-60 minutes of event/multipurpose disaster management teams at 2-3 places at alert to rush.
7 Organize relief from day 1 to day 30.
8 Plan rehabilitation and implement with a clear objective to strengthen communities' capacity and make it less vulnerable.
9 Document for lessons learnt.
10 Gujarat needs a professional Disaster Management institute. It should be autonomous outside day-to-day Government control/ regular practice training for senior executives / pre disaster training to all officers/ staff. / Training of local Government.
11 Start civil defense for all citizens.
12 Community based and community oriented Drought proofing/ mitigation/ watershed management/ fodder banks at village level.
13 Creating and developing local drinking water resources.
14 Forecasting and warning systems development/ dense network of hydro meteorological observatories to make flood forecast more effective and accurate/ more seismological observatories in national network./ warning messages should reach to disaster manager in shortest possible time.
15 Restricted entries at event place (Media, Politicians, people) minimum visits of VIPs/ Political interference should be avoided.
16 Media cultivation.
17 Community awareness/ training for disaster specific including Home guards, SRPs, NCC etc.,/ social training.
18 Written communication for delegation of powers/ free hand for staff selection / no frequent transfer or ban on transfer and quick replacement/ proper postings
19 Stringent implementation of IS codes for constructions.
20 There should be an act for disaster management norms and manual should be prepared for all levels.
21 Damage assessment forms and all other forms should be available.
22 Communication facilities to be updated at 24 hrs. Central control room with details and way of contacting key Administration People.
23 Success depends upon the integrity, dedication, commitment, speed of action taking bonafide, genuine and objective decisions by the persons who work at Disaster Management.
24 Check malpractices.
25 Co-ordination with NGOs/ line depts.
26 Specific and detailed pre-planning with allotment of responsibilities.
27 Dissemination of information.
a) To the person concern in the organization.
b) To the general public through media.
28 More rational approach rather than emotional approach to avoid wasteful use of resources reducing efficiency.
29 Information technology should be strengthening at all levels.
30 Separate financial provision should be kept at all levels.

5.1.5 Means of information

The state level officers sometimes know about disaster situation either from local level or district level. We collected data on how they received information about different disasters under study. The collected information from these officers is presented in Table 5.5.

Table : 5.5 Means of information for getting information of disasters.

Types of Disasters	Phone/ Fax	HAM/ Wireless	Satellite Phone	Media	Total
Flood	18	2	0	16	36
Earthquake	18	2	0	17	37
Cyclone	18	1	0	16	35
Drought	09	0	0	12	21

The data reveals that for flood situation phone/fax (18) and media (16) are the main sources of information for these officers. In case of earthquake also phone/ fax (18) and media (17) played an important role in receiving the information of the disaster. In the case of cyclone, information reaches state level officers through phone/fax (18) and media (16). These two means are very important for passing information. In case of drought some officers have not responded to our question. This is may be because the occurrence of such type of situation is slow and gradual. But here also whatever the data and information received by state officers is through phone/fax (9), and media (12).

The analysis of data reveals that in all four-disaster situations phone/ fax and media remain an important medium of information.

5.1.6 Action Taken

The state level officers received information through different sources of information. To know what type of action officers took after receiving the information, a specific question was asked and their responses were collected for different disasters. The collected information is presented in Table 5.6.

Table : 5.6 Action taken by state level officers after receiving the information of disasters.

Action taken	Response	Response (%)
Rush to the place to manage	17	85
Rush to the location to get information	11	55
Gave direction to subordinates at a time	16	80
Called a meeting	10	50
Approached superiors to get orders	06	30
Tried to co-ordinate line depts., NGOs, Experts. etc.	13	65
Left for location after arranging contact point	09	45
Total	82	-

The analysis of data reveals that 85 per cent of the officers rushed to the place to manage the disaster situation. As the next immediate step, 80 per cent of officers have given direction to their subordinates immediately for necessary action. It is followed by 65 per cent of the officers who tried their best to coordinate line department, NGO, and other experts. Some of the officers (50 per cent) called a department meeting for discussions to handle the situation. At state level the officers are suppose to give information to concerned people and other stakeholders. So such officers (45 per cent) instead of immediately rushing to the affected location made some arrangements for a contact point at state level and then left for the location.

5.1.7 Views on Disaster Management Information System

At state level, those officers who are directly or indirectly participating in managing disaster situation were asked about present DMIS. The collected responses of these state level officers are presented in Table 5.7.

Table : 5.7 Responses on present DMIS by State level officers

Designation	No	Yes
Professor	02	0
Director	11	0
Joint Director	03	2
Retired Officers	01	0
Others	01	0
Total	18	2

The collected responses of state level officers are very negative. Most of the officers (90%) are not satisfied with the present system of disaster management information. In the continuation of this question suggestions for improvement of the system were invited from the same officers for all the natural disasters under study. The suggestions are as follows.

1 Advocacy/ awareness of Politicians/ Bureaucrats.
2 Training to all.
3 HAM Radio-proper propagation and spreader numbers required.
4 Control deforestation/ control encroachment on riverbed.
5 Cyclones community centers – training to community and engineers.
6 Separate and modern MIS, where speed and accuracy are balanced.
7 New indicators for monitoring and evaluation should be developed and they should be an integral part of the MIS for drought management.
8 Proper planning for smooth and effective flow of information.
9 To decide the various levels for the flow of information from downwards to upward and upwards to down wards.
10 To bring uniformity in the system appropriate checklist to be devised.
11 System to be devised to acquaint the staff with various technical inputs to be received from outside → i.e. signal system during the monsoon.
12 An effective approach for the accurate dissemination of information to the public for
   a) Awareness.
   b) Necessary required preparedness.
13 Weak links of the chain should be identified and remedial measures should be initiated.
14 Key role players to be identified well in advance and they should be linked with quick communication network.
15 Role clarity with adequate authority well in advance.
16 System / well established channels for proper and quick communication.

5.2 District level functionaries

5.2.1 Introduction

The study was carried out at different level of functionaries. After discussing data on policy makers and/or experts this part of the chapter looks into basic data on their educational level, organization and experience. Information and/or views of district level officers on different disaster management activities were collected through structured questionnaire. These officers are receiving

orders/instructions from their higher up authorities and by adding their information on the disaster they order/instruct the taluka level officers /implementing agencies. For our study we have selected 50 district officers, as mentioned earlier.

A. Education: The educational level of these selected officers is shown as under:

Table : 5.8 Educational level of selected District level Officers

Designation	Ph.D/ Doctor	Post Graduate	Graduate	Double Graduate	Technical Degree	Total
Taluka Dev.Officer	0	1	1	0	1	03
Deputy Collector	0	3	8	5	1	17
Dy. D.D.O.	1	3	3	1	4	12
Police Inspector/PSI	0	0	2	0	1	03
Assistant Director	0	1	0	0	2	03
Medical Officer	0	0	0	0	2	02
Ind./Fire Officer	0	0	0	0	1	01
Others	0	2	6	1	0	09
Total	1	10	20	7	12	50

Of these selected 50 district level officers, 20 per cent have studied up to postgraduate level; 40 per cent up to graduate level; 14 per cent having double graduate degrees, and 24 per cent are technical graduates. Only one person (2 per cent) a medical degree. This data reveals that district level officers are well educated.

B Organization: Selected district level 50 officers for our study are belongs to different Government Departments. Out of total 50 officers 40 falls in the district headquarter officers. Among these 17 are from Revenue Department (Deputy Collector), 12 from Revenue (but now working with Panchayat Department), 4 from Police Department, Medical Officers and 7 from other Departments. The 2 officers are selected from Health Department; 4 from Panchayat, and rest 4 officers are from municipal corporations.

C Experience: It is important to know the experience of these officers to administer natural disasters. Data on experience of these officers are presented in Table 5.9.

Table : 5.9 Work experience

Designation	8<	5 to 8	3 to 5	3 to 1	Total
Taluka Dev. Officer	00	0	1	2	03
Deputy Collector	12	3	1	1	17
Dy. District Dev Officer	09	1	0	2	12
Police Inspector/PSI	03	0	0	0	03
Assistant Director	03	0	0	0	03
Medical Officer	02	0	0	0	02
Industries /Fire Officer	01	0	0	0	01
Others	08	0	0	1	09
Total	38	4	2	6	50

Of these 50 officers, 38 officers are having more than 8-year experience, 4 officers have experience between 5 and 8 years, while 6 officers are having experience of 3 years. The table shows that most of the officers who handling disaster situations are well experienced.

5.2.2 Medium and Route of Information

To know through which information system these officers are getting information on occurrence of disaster. For more specific information the specific question on through which level they are getting information was also collected from district level officers. The collected information presented in table.

Table : 5.10 Sources of Information.

Designation	State level	District	Taluka	Village	Total
Taluka Dev. Officer	0	2	1	0	03
Deputy Collector	9	6	8	6	29
Dy. District Dev Officer	6	6	3	3	18
Police Inspector/PSI	2	2	0	0	04
Assistant Director	2	1	0	0	03
Medical Officer	1	1	0	1	03
Industries /Fire Officer	0	1	0	0	01
Others	1	0	7	2	10
Total	21	19	19	12	71

The responses are multiple. Most of the officers mentioned that they are getting information from all the 3 levels; state, district and taluka level almost equally. Some of these officers have also received information directly from village level (12). The analysis of data reveals that district level officers are receiving information from all the levels, which helps them in disaster management.

The information about disaster occurrence comes through different departments/ persons. To know the route of this information, the selected district officers requested to give response the question in the given questionnaire. The responses received are multiple in natures. The collected information presented in Table 5.11.

Table : 5.11 Route of Information flow during Disaster Situation

Designation	Police Dept.	TDO	Mamlat dar	Sarpanch	MP / MLA	NGO	Others	Total
Taluka Dev. Officer	0	1	00	0	0	0	2	03
Deputy Collector	3	3	10	4	5	1	0	26
Dy. District Dev Officer	2	5	02	1	2	1	5	18
Police Inspector/PSI	2	0	00	0	0	0	2	04
Assistant Director	1	1	01	0	1	0	0	04
Medical Officer	1	0	02	1	1	0	0	05
Industries /Fire Officer	0	0	00	0	0	0	1	01
Others	0	1	07	2	0	0	0	10
Total	9	11	22	8	9	2	10	71

The data show that most of the information comes from Mamlatdars (44 per cent), followed by TDO (22 per cent), 18 per cent from Police and political leaders each and 16 per cent from village Sarpanches. Very few come from other sources. The analysis of data reveals that Mamlatdar/TDO plays vital role in collecting and passing information through district level officer.

After knowing the department/ persons passing information to district officers it is important to know through which communication system this information passes. The district level officers were requested to give by which means they are receiving / getting information. The responses given by these officers are presented in Table 5.12.

Table : 5.12 Use of different communication means to receive disaster related information.

Designation	Phone/Fax/ Mobile	Wireless System	Personal Massage	Media	Total
Taluka Dev. Officer	03	2	0	0	05
Deputy Collector	12	5	6	7	30
Dy. District Dev Officer	09	1	5	8	23
Police Inspector/PSI	02	4	0	1	07
Assistant Director	03	0	0	2	05
Medical Officer	03	1	1	2	07
Industries /Fire Officer	01	0	0	0	01
Others	07	1	1	0	09
Total	40	14	13	20	87

Responses are more than one. Most of the officers are getting information (40) through phone/ fax/mobile. It followed by media (20), wireless (14) and personal messages (13). The analysis of data shows that phone / fax and media are very important means of communication.

5.2.3 Control Room Facilities

The selected district level officers were asked whether their department/ district had a control room/cell. In reply to this question most of the district level officer answered positively that they had a control room/cell at each and every district / department. This cell has different level officers/ staff to work for disaster control. Not all control room/ cells are equipped with full strength of staff and equipment. Not only that, these control rooms are not working all hours of the day round the year, which is necessary.

5.2.4 Response / Action time

The district officers were requested to furnish the detailed information about the time they took for responding to it. Their responses are presented in Table 5.13.

Table : 5.13 Response or action time for responding the disaster situation

Particulars	Responses
Immediately	44
One Day	06
Two / Three Days	00
Week	00
Fortnight	00
Total	50

District officers took immediate action after receiving information about natural disasters. Government machinery at district level reacts very promptly and takes appropriate measures limited to their means.

5.2.5 Monitoring and control

It is interesting to know how district officers monitor and control administration during a natural calamity. The views of district officers were sought on this point.

Table : 5.14 Monitoring and control measures taken by district level officers.

Particulars	Responses
Personal visit at site and first hand report.	06
Effective communication by one, Mobile Phone, Walky-talky. Information through various media. Wireless set at police station and at vehicle	25
Control Room for 24 hours and 365 days at state, district, Taluka, and at Place of event, linked with line depts..	10
Co-ordination with other line departments, NGOs, CBOs, and Local community.	16
District level Disaster Management committee headed by collector. Formation of teams as per demand of situation and disasters.	05
Action Plan for effective implementation.	16
Total	78

The responses of the district officers show that effective communication (25) plays an important role in control mechanism, this is followed by co-ordination with other line departments, NGOs, CBOs, and local community and action plan for effective implementation (16 each). Control room instructions are also vital for monitoring and control. This shows that proper and meaningful communication is very important in administering natural calamity.

5.2.6 Mitigation Measures

We next wanted to know the mitigation measures taken at district level for disaster management. The responses received are presented in Table 5.15.

Table : 5.15 Mitigation Measures taken by District level officers.

Particulars	Responses
Regarding Mapping of prone zones	28
Regarding improvement in predictability	09
Regarding improvement in forecasting systems	14
Regarding improvement in warning systems	18
Disaster preparedness plans	38
Land use zoning	07
Public / community Awareness program through IEC	21
Total	135

The analysis shows that district level officers have given more importance to disaster preparedness plan (38) followed by mapping of disaster prone zones (28) and community awareness (21). There is less hope for improvement in disaster predictability and land use zoning. This shows that, for mitigating disasters, advance planning and mapping of prone zones are very important. So it is better to concentrate on these two aspects as long-term measures.

5.2.7 Pre disaster situation

The district level officers were requested to give responses based on their experiences what measures had been taken in pre-disaster situations. Their responses are presented in Table 5.16.

Table : 5.16 Measures taken for Pre-disasters situation by the District level officers.

Particulars	Responses
Long term / short term planning	42
Community participation and awareness programmes	23
Information Organisation and dissemination	20
HAMs co-ordination	10
Co-ordination and NGO networking	26
Alternate communication systems	14
Stock piling : Area / locations / commodities / instruments	20
Transport arrangement	23
Warning to the people	25
Constant communication with state level and event place.	30
Keeping health support system alert	28
Total	261

Most of the officers have responded that they have planned for short/long term measures (42). It is also equally important that they are remaining in constant touch with state level authorities (30). The next measure is keeping health support system ready (25), they also planned for alternative communication system in case the present one fails (14). The district level officer also responded that coordination between government departments and with NGO was very important (26). These are the main measures generally taken by district officers in pre disaster situations. This analysis shows that district level officers, by their experience, always keep themselves up-to-date before any disaster occurs.

5.2.8 During Disaster

The occurrence of disasters is not so often hence the district level machinery is not equipped with it. As such, when any natural disaster occurs, officers at the district level manage it by either of their experience or getting instructions from state level authorities/higher ups. It is interesting to know that how these district level functionaries take immediate measures during a disaster situation. District level officers' responses are presented in Table 5.17.

Table : 5.17 Actions taken during disaster situation by District officers.

Particulars	Responses
Search and rescue	40
Evacuation and shifting	39
Clearance of debris / dead bodies etc.	36
Shelter to victims	35
Health and casualty	32
Sanitation	26
Livestock management	23
Security for property.	23
Total	254

During a disaster situation, first priority is given to search, and rescue operations, followed by evacuation and shifting. Clearance of debris and giving shelter to victims is given second priority. Health and causalities operations and shifting of livestock is given third priority. Rest of the measures to manage

disaster situation are equally important but work on that requires less priority. District level officers have to work generally as per directives given by state level authorities hence their liberty to choose immediate different measures is very low.

5.2.9 Post-Disaster Situation

After disaster different measures are required to be taken to help the community as well as repairing damages. The district level officers were requested what type of post disaster situation measures they had undertaken while managing disasters. Some options were given to them for their responses. Their responses are presented in Table 5.18.

Table : 5.18 Measures taken in Post-disasters situation by District officers.

Particulars	Responses
Relief: Drinking Water/ Food packets/Medicinal help	45
Survey of damages occurred.	38
Preventive measures for diseases	35
Rehabilitation	29
Total	147

District officers give first priority to carry out relief measures like supplying of drinking water, food packets, medical help, etc. After that they have given importance to know the damages caused by the disaster which is followed by preventive measures for diseases and, if required, rehabilitation also.

Officers at district level function under state level authorities and as per the instructions or as per the assessment of the situation they request for the any of the above four measures.

5.2.10 Monitoring and control at district level

We wanted to know how district level officers monitor and control disaster relief activities and what medium they are using to collect information for better administration.

Table : 5.19 Means used to monitor and control the Disaster Relief activities by District level officers.

Particulars	Responses
Telephone	40
Wireless system	37
Radio/T.V.	36
Telex/Fax	27
Mobil Phone	14
Walki-taki	13
Information leaflets	11
E-mail	06
Information ads	06
HAM Radio	03
Total	193

The responses given by the district officers show that telephone, wireless and radio play an important role in collecting information and on the basis of this information appropriate decisions to manage the situation are taken immediately. It reduces the time leg between information collection and proper decision being taken. The second line of information collection is through mobile, walkie-talkie, and information leaflets. District level officers receive information by using given media and accordingly take prompt action and monitor disaster administration. For any efficient administration inflow of proper information is a key factor. District officers are using this system for quick and effective administration.

5.2.11 Level of predictability

To know the level of predictability of natural disaster occurrence, we requested district level officers to give information from their experiences at different ranges. Collected responses for all these four natural disasters are given in Table 5.20.

Table : 5.20 Level of predictability of natural disasters according to district officers.

Disaster	100%	75-100%	50-75%	25-50%	<25% or unpredictable	Total
Floods	23	14	06	2	00	50
Earthquake	01	00	05	0	44	50
Cyclone	21	11	04	5	09	50
Drought	26	10	03	1	10	50

Flood: In case of flood most of the officers (46 per cent) is of the opinion that flood can be predicted 100 per cent well in advance, while 28 per cent of the opinion that it is predictable upto 75 per cent.

Earthquake: Natural disasters like earthquake occurs rarely, sometimes may be once in half a century or more. So, it is difficult to predict. So 88 per cent of the district level officers answer that it is not predictable.

Cyclone: For another disaster, cyclone, the responses of district level (42 per cent) officers' show it is 100 per cent predictable, while 22 per cent officers said it is difficult to predict a (75 per cent) cyclone.

Drought: The last but not least is drought, which also damages economy. So to know its predictability from these officers to give their responses on the basis of their experiences. More than 52 per cent district officers responded that it is 100 per cent predictable while 20 per cent said it is 75 per cent predictable. Only 20 per cent responded that drought is totally unpredictable.

The analysis of responses given by district officers more than 45 per cent district officers said that flood, cyclone and drought are predictable 100 per cent. For earthquake almost 90 per cent of the officers are of the opinion that it is totally unpredictable.

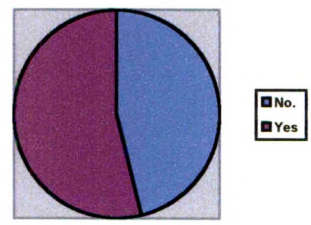
5.2.12 Present MIS

The present MIS helpful to manage and take decision quickly is upto the level or not? To know the reaction of district level officers, this question was asked and responses are presented in Table 5.21.

Table : 5.21 Responses on Efficiency of Present MIS.

Designation	No.	Yes	Total
Taluka Dev.Officer	0	3	03
Deputy Collector	9	8	17
Dy. District Dev Officer	4	8	12
Police Inspector/PSI	3	1	04
Assistant Director	0	3	03
Medical Officer	0	3	03
Industries /Fire Officer	0	1	01
Others	7	0	07
Total	23	27	50

Graph : 5.1



The responses reveal that almost 50 per cent officers are not happy with the present MIS, while rest of them responded that it was working satisfactorily. Those officers who have given the answer positively were requested to explain how it was or in what way it was satisfactory. The responses to this question were almost negligible, so we have not discussed them.

5.2.13 Views /Suggestions for DMIS

During our study we have interviewed district level officers. The officers were requested to give their views and suggestions for betterment of DMIS for Flood, Earthquake, Cyclone and Drought.

Table : 5.22 District officers' views / suggestions on betterment of DMIS.

Disaster	Public Awareness Programme	Moak drills	Control Room	Plann -ing	Warning System	Timely Communi cation	Record Maintenance for Relief
Floods	09	4	6	13	02	09	14
Earthquake	17	3	4	04	01	03	17
Cyclone	10	6	3	-	17	13	18
Drought	-	-	-	18	-	11	17

Flood: District officers suggested that relief record should be maintained property (14), which is followed by campaign for public awareness (09) and timely communication (09). They have also suggested proper long term planning to manage floods (13).

Earthquake: In case of earthquake, maintenance of relief record and generating public awareness are equally important (17 each). Proper planning, appropriate building construction act, strictly monitoring and control are important (4 each).

Cyclone: The officers suggested that in a disaster like cyclone, details of whatever relief is being given should be maintained properly (18). They also suggested that in cyclone like situation proper warning (17) and forecasting should be given to community. Timely communication (13) to public and concerned officers is also necessary. Generating public awareness to face the cyclone follows this.

Drought: When monsoon fails and/or is less than required, drought situation occurs. In India rainfall is totally unpredictable. Sometimes high or less rain creates drought situation. For such situation the district officers were requested to give their suggestions. They are of the opinion that proper advance planning and relief measures record should be kept properly. Which helps to take the appropriate decision and to fight the situation of drought.

5.2.14 Comments for Systems

The district level officers were requested to give their comments on nine systems, which is presently in operation for disaster management. Their views are ranked accordingly *very good, good, fair* and *poor*. The collected comments are presented in Table 5.23.

Table : 5.23 Comments for Various Systems by Selected District Officers.

System	Comments			
	Very Good	Good	Fair	Poor
Forecasting System	3	6	3	38
Warning System	1	8	4	37
Information collection system	1	7	7	35
Information dissemination system	1	7	5	37
Information channels. Up-down.	1	5	7	37
Public awareness system	1	5	6	38
Computerization of various activities	3	5	6	36
Software : GIS, GPS	1	5	6	38
Information networking system	1	10	2	37

The analysis shows a very negative picture. As per district officers responses almost all systems are functioning poorly. Most of the officers' opinions vary between 70 per cent and 76 per cent. There is a wide scope in improvement of these systems, which will enable district officers to manage disasters, in a better way.

5.3 Taluka Level Functionaries.

For our study, total 100 functionaries working/worked at taluka level during the different disasters were selected. Their educational level, departments and experiences are mentioned in Table 5.24.

5.3.1 Educational Level

Table : 5.24 Literacy level of selected Taluka level functionaries.

Designation	Post Graduate	Graduate	Double Graduate	Technical Degree	S.S.C./ H.S.C.	Total
Mamlatdar	02	14	3	1	4	24
Taluka Dev.Officer	05	09	2	0	2	18
Deputy Collector	10	05	0	0	0	15
Dy. District Dev Officer	02	01	0	0	0	03
Police Inspector/PSI	02	11	1	1	1	16
Assistant Director	00	14	0	0	1	15
Medical Officer	01	02	0	0	0	03
Industries /Fire Officer	02	00	0	2	0	04
Others	02	00	0	0	0	02
Total	26	56	6	4	8	100

Data shows the education level of the selected functionaries. The functionaries include Mamlatdar, Taluka Development Officer, Deputy Collector, Deputy District Development Officer, Police Inspector/Police Sub Inspector, Assistant Director, Medical Officer, Industries/Fire Officer, and others. In all 100 functionaries were selected as sample. Out of 100 functionaries 56 are graduates, 26 post graduate, and 8 are educated up to HSC/SSC. Among these functionaries the highest number are Mamlatdars (24) followed by Taluka Development Officers (18), Police Inspectors/PSI (16), Deputy Collectors (15) and Assistant Directors (15). The table reveals that most of the selected functionaries have education up to college level and a small number have studied up to postgraduate level.

5.3.2 Department

Table : 5.25 Number of Functionaries Selected at Taluka Level

Designation	Revenue	Panchayat	Police / Fire/ Health	Agril..& Allied	Enginee ring	Informa tion.	Total
Mamlatdar	24	00	00	00	0	0	24
Taluka Dev.Officer	00	18	00	00	0	0	18
Deputy Collector	15	00	00	00	0	0	15
Dy. District Dev Officer	00	02	00	01	0	0	03
Police Inspector/PSI	00	00	16	00	0	0	16
Assistant Director	00	01	00	12	1	1	15
Medical Officer	00	00	03	00	0	0	03
Industries /Fire Officer	00	00	02	02	0	0	04
Others	00	00	00	01	1	0	02
Total	39	21	21	16	2	1	100

This table shows the different departments from which functionaries were selected for our study. There are six different departments namely Revenue, Panchayat, Police/Health/fire, Agriculture/ Animal Husbandry/ Horticulture/Allied, Engineering and Information. Of the total functionaries highest from Revenue department i.e. Mamlatdar (24) and Deputy Collector (15) there are 21 functionaries each from Panchayat and police/fire/health. Here again

highest functionaries are from police department (16). There are 16 functionaries from agriculture and allied departments. Only two are from engineering and one is from information department. Though we have sent questionnaires proportionately to these officers, we got responses as described in the table above.

5.3.3 Experience

Table : 5.26 Experience of Taluka Functionaries in Their Services.

Year of Experience	No. of Functionaries
0 to 3	19
4 to 8	25
9 to 15	20
15 to 20	13
above 20	23
Total	100

From the received response of our questionnaires we have tried to put them as per their years of experience. The categories are those having experiences up to 3 years, 4 to 8 years, 9 to 15 years, 15 to 20 years and 20 years above. The number of functionaries in each category is 19, 25, 20, 13 and 23 respectively. This shows that the highest number of functionaries (25) long experience of 4 to 8 years this is followed by 20 years and above where the number is 23. In the category of 0 to 3 years and 9 to 15 years experience, the number is almost equal.

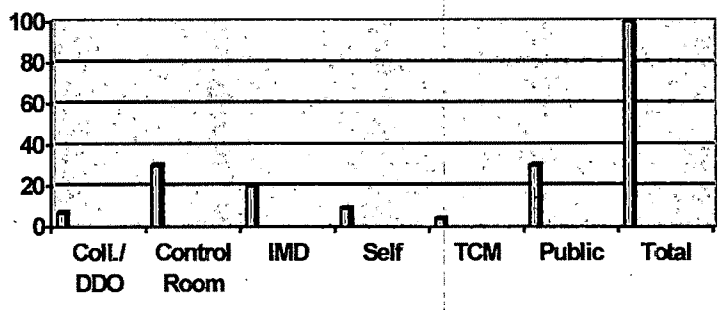
5.3.4 Information and Media for Disaster:

Flood

a. Sources of Information: –

Table: 5.27 Sources of Information on Floods.

Designation	Coll./ DDO	Control Room	IMD	Self	TCM	Public	Total
Mamlatdar	1	8	1	4	1	14	29
Taluka Dev. Officer	2	5	1	0	1	10	19
Deputy Collector	2	3	1	1	0	04	11
Dy. District Dev Officer	0	1	1	0	0	00	02
Police Inspector/PSI	1	6	7	1	0	00	15
Assistant Director	0	4	4	3	2	01	14
Medical Officer	0	0	2	0	0	00	02
Industries /Fire Officer	0	3	1	0	0	00	04
Others	1	0	2	0	0	01	04
Total	7	30	20	9	4	30	100



Graph : 5.2

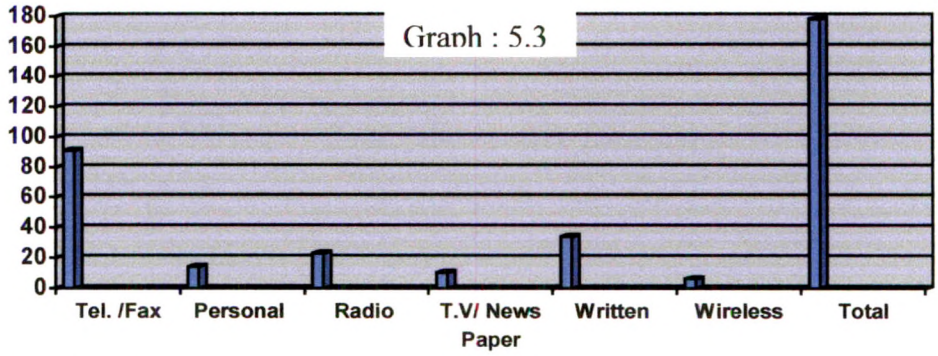
This section deals with the information given to taluka level officer by different sources. Table 5.27 shows the information of flood given to taluka level functionaries, under study. Some functionaries got information through more than one media. It is reflected in their responses on who informs about flood. The collected data show that taluka level functionaries receive information through control room (30%), public (30%) and IMD (20%). Rest of the information came through collector office, Talati cum Mantri, Self and others. It is observed that information about flood is given to subordinate officers by control rooms and public representatives.

b. Means of Information:

The information about floods flows from both levels i.e. top to bottom and bottom to top. The state control room informs the district level control room and the district control room informs at the taluka level functionary and viceversa. It was thought to how this information or by which means information flows from one level to another. How information is passed out is presented in Table 5.28.

Table: 5.28 Means of Information for Flood

Designation	Tel. /Fax	Personal	Radio	T.V/ News Paper	Written	Wireless	Total
Mamlatdar	22	6	8	2	08	1	47
Taluka Dev. Officer	17	2	7	0	02	2	30
Deputy Collector	12	1	3	0	05	0	21
Dy. District Dev Officer	01	1	0	2	01	0	05
Police Inspector/PSI	13	1	2	0	10	0	26
Assistant Director	13	0	2	6	00	3	24
Medical Officer	03	3	1	0	00	0	04
Industries /Fire Officer	08	0	0	0	01	0	12
Others	02	0	0	0	07	0	09
Total	91	14	23	10	34	6	178



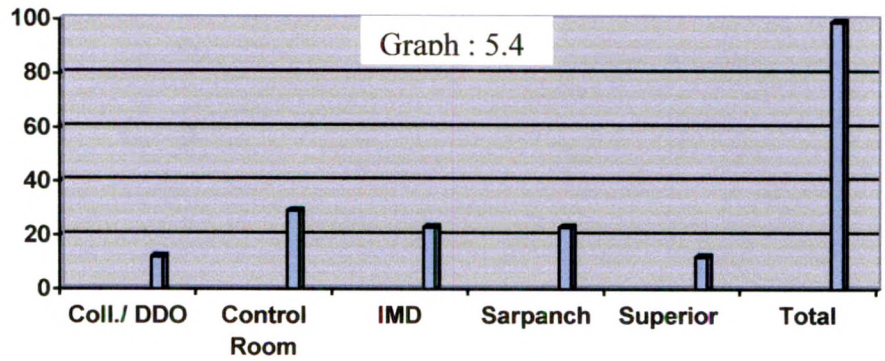
According to taluka level functionaries, they got this information through fax and telephones (91) followed by written message from higher ups (34) and through radio (23). So from above analysis it is concluded that Fax/Telephone plays vital role as a means of information for taluka level functionaries.

Earthquake

a. Sources of Information: Earthquake is also a natural disaster. It does not occur often in our state. To know who gives information about this disaster to taluka level functionaries, we collected data.

Table : 5.29 Sources of Information for Earthquake.

Designation	Coll./ DDO	Control Room	IMD	Sarpanch	Superior	Total
Mamlatdar	2	11	6	2	3	24
Taluka Dev. Officer	2	08	3	2	3	18
Deputy Collector	4	01	0	8	2	15
Dy. District Dev Officer	1	01	0	0	1	03
Police Inspector/PSI	1	06	5	2	1	15
Assistant Director	1	01	3	8	2	15
Medical Officer	0	00	3	0	0	03
Industries /Fire Officer	0	01	2	1	0	04
Others	1	00	1	0	0	02
Total	12	29	23	23	12	99

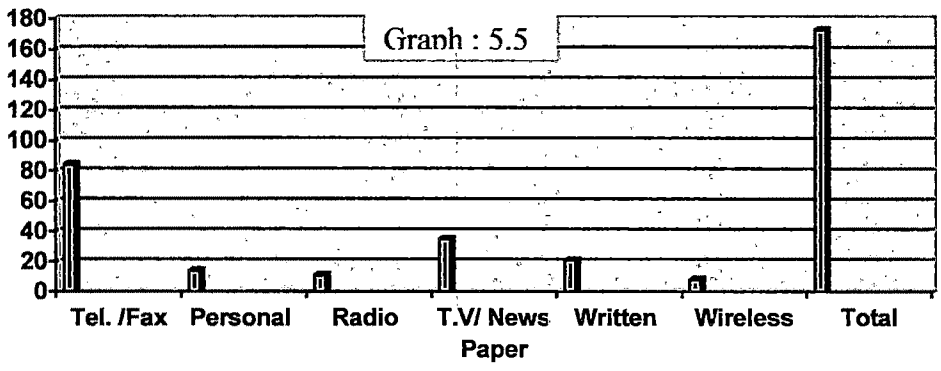


There are about ten mediums through which this information goes to taluka level functionaries. The analysis of data show that control room informs (29) taluka functionaries followed by IMD (23) and village sarpanch (23). There is no other vital medium playing the role of informants. It is observed from the table that the control room is playing a very important role in informing to taluka officers. The other two, IMD and village sarpanch are also equally important as immediate informants.

b. Means of Information: Some natural calamities are not occurring often hence the medium used to inform to taluka functionaries is not multifaceted. Messages are passed to concern functionaries through routine media. For earthquake also it was studied that how this message goes to taluka level. The data on this aspect are presented in Table 5.30.

Table : 5.30 Means of Information for Earthquake.

Designation	Tel. /Fax	Personal	Radio	T.V/ News Paper	Written	Wireless	Total
Mamlatdar	23	6	0	15	7	1	52
Taluka Dev. Officer	16	3	4	10	2	3	38
Deputy Collector	14	2	1	00	1	0	18
Dy. District Dev Officer	01	1	0	02	1	0	05
Police Inspector/PSI	12	0	3	00	9	0	24
Assistant Director	10	0	2	06	0	4	22
Medical Officer	03	0	1	00	0	0	04
Industries /Fire Officer	03	2	0	02	1	0	08
Others	02	0	0	00	0	0	02
Total	84	14	11	35	21	8	173



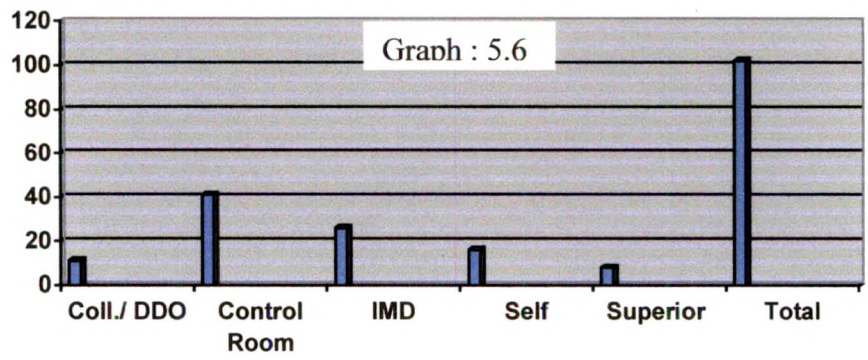
The responses given by taluka officers are multiple. The data show that the message of earthquake reached taluka functionaries through using Fax/ telephone (84). The medium of wireless system is at lowest of use. The information through written and newspaper/TV comes second. It is observed from the analysis of the data that telecommunication is very important to contact taluka level officers.

Cyclone:

a. Sources of Information: Cyclone is comparatively less disastrous and its occurrence also very less particularly in the state. It is our objective to know that who informs taluka functionaries about this calamity. This is shown in Table 5.31

Table: 5.31 Sources of Information for Cyclone.

Designation	Coll./ District Developme nt Officer	Control Room	IMD	Self	Superior	Total
Mamlatdar	1	13	3	6	2	25
Taluka Dev. Officer	2	12	4	0	0	18
Deputy Collector	6	4	1	3	2	16
Dy. District Dev Officer	0	1	1	0	1	03
Police Inspector/PSI	1	6	6	2	1	16
Assistant Director	0	3	5	5	2	15
Medical Officer	0	0	3	0	0	03
Industries /Fire Officer	0	2	2	0	0	04
Others	1	0	1	0	0	02
Total	11	41	26	16	8	102

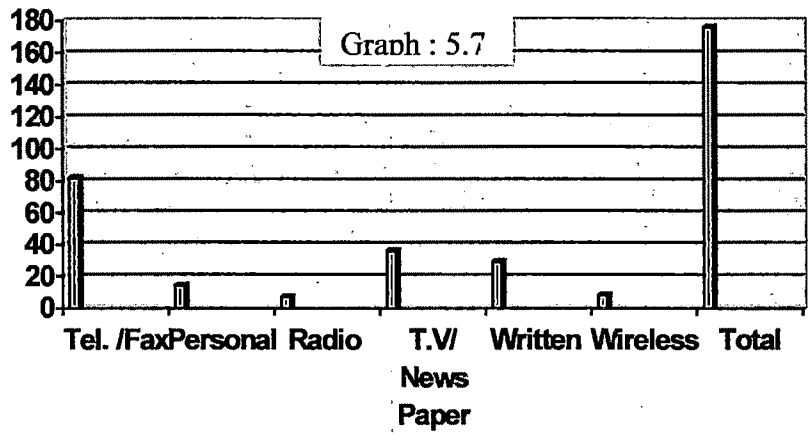


There are about ten different sources of information. Taluka level functionaries got information mainly through the control room (41), followed by IMD (26) and self (16). It is observed from the table that here again the control room is playing a vital role in passing information to taluka functionaries.

b. Means of information: Information about calamity reaches to the taluka functionaries through the control room and other media. The question asked to the taluka level officers that how information/ through which means reaches to their offices. These officers have given their responses and it is presented in Table 5.32.

Table: 5.32 Means of Information for Cyclone.

Designation	Tel. /Fax	Personal	Radio	T.V/ News Paper	Written	Wireless	Total
Mamlatdar	21	7	0	14	07	2	51
Taluka Dev. Officer	17	2	3	12	04	2	40
Deputy Collector	13	2	0	00	05	0	20
Dy. District Dev Officer	01	1	0	02	01	0	05
Police Inspector/PSI	12	0	2	00	10	0	24
Assistant Director	10	0	1	06	00	4	21
Medical Officer	03	0	1	00	00	0	04
Industries /Fire Officer	03	2	0	02	01	0	08
Others	02	0	0	00	01	0	03
Total	82	14	7	36	29	8	176



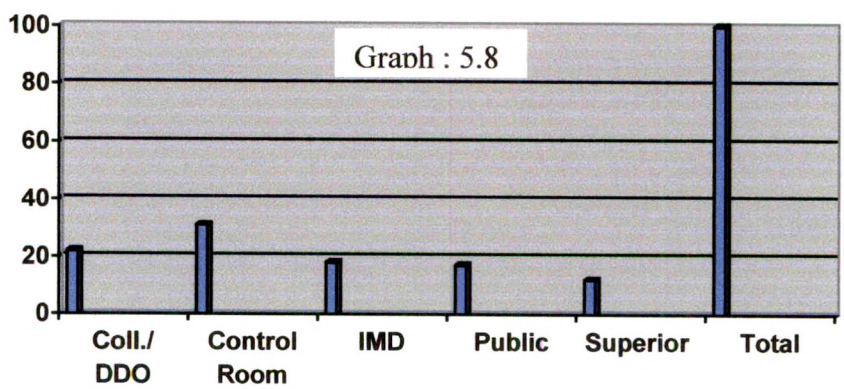
There are about nine alternative means of information. Most of the officers responded that they were informed through fax/telephone (82). They also receive information in writing (29) from other different sources. TV and newspapers (36) also played significant roles in informing taluka level officers. It is observed from this table again that telecommunication played a very important role.

Drought:

Regarding receiving of information about drought, at taluka level, the taluka level officers were asked about sources of information. Their responses are presented Table: 5.33.

Table: 5.33 Sources of Information for Drought.

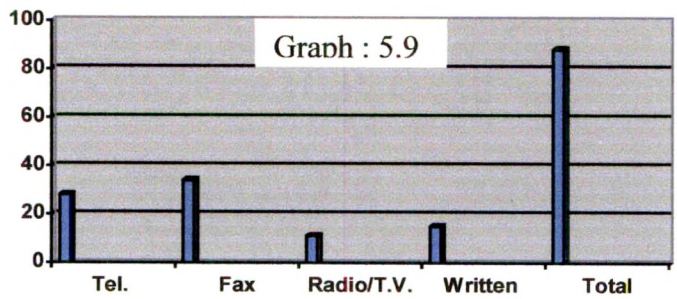
Designation	Coll./ DDO	Control Room	IMD	Public	Superior	Total
Mamlatdar	1	6	3	9	5	24
Taluka Dev. Officer	5	5	0	7	1	18
Deputy Collector	9	3	0	1	2	15
Dy. District Dev Officer	1	1	1	0	0	03
Police Inspector/PSI	1	7	6	0	2	16
Assistant Director	4	7	2	0	2	15
Medical Officer	0	0	3	0	0	03
Industries /Fire Officer	0	2	2	0	0	04
Others	1	0	1	0	0	02
Total	22	31	18	17	12	100



The responses shows that most of the information comes through the control room (31); followed by Collectorate/DDO (22), IMD (18) and public (17). These four sources play a vital role in passing information. These officers were further asked that through which means this information were received. The responses given by taluka officers are presented Table 5.34.

Table: 5.34 Means of Information for Drought.

Designation	Tel.	Fax	Radio/T.V.	Written	Total
Mamlatdar	5	5	0	4	14
Taluka Dev. Officer	5	4	3	0	12
Deputy Collector	8	4	2	1	12
Dy. District Dev Officer	1	1	0	0	02
Police Inspector/PSI	3	8	2	9	22
Assistant Director	4	6	2	0	12
Medical Officer	0	3	1	0	04
Industries /Fire Officer	1	2	1	0	04
Others	1	1	0	1	03
Total	28	34	11	15	88



Fax (34) topped the best followed by telephone (28), written notes (15) and radio/TV (11).

5.3.5 Responses on Disaster Administration

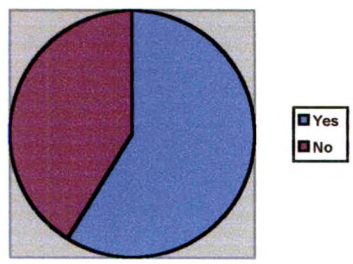
This section of the study analyses the data collected on control room facilities, strength of functionaries, means of monitoring and control and views on present system of disaster administration. The responses given by taluka level functionaries are presented and discussed.

a. Control Room: To know the facilities of administering natural calamity, taluka level functionaries were asked whether they have separate cells or control rooms for natural calamity. The collected responses are presented in Table 5.35.

Table: 5.35 Control Room Facilities at Taluka Level

Designation	Yes	No.	Total
Mamlatdar	20	04	24
Taluka Dev. Officer	04	14	18
Deputy Collector	09	06	15
Dy. District Dev Officer	01	02	03
Police Inspector/PSI	08	08	16
Assistant Director	09	06	15
Medical Officer	03	00	03
Industries /Fire Officer	04	00	04
Others	01	01	02
Total	59	41	100

Graph : 5.10



Out of 100 functionaries 60% have replied positively. In relation to this, how much functionaries are working in this control room was asked? From the collected responses, it is found that there are on an average 5 functionaries. This data is limited to revenue administration only. Further, the data on their assigned duties are also collected. The responses on this are multiple. The responses of this information are presented in table. The major duties assigned are as under as per its importance.

Table : 5.36 Duties at Control Room at Taluka Level

Sr.No	Duties	Responses
1	To attend telephone/Collect data and Information.	109
2	To collect information / Messages from subordinates	069
3	To receive direction/guidance/suggestions from superior	036
4	To give instructions/guidance/direction to subordinates	027
5	Record keeping	026
6	To supply information/Messages to superiors – H.O.	025
	Total	292

The analysis of the responses shows that attending telephone and collecting data and information on disasters is very important. This helps taluka level functionaries in taking proper decision and actions.

b. Constraints: We were wanted to know the major constraints faced by the taluka level functionaries in performing their duties. Responses are presented in Table 5.37

Table: 5.37 Constraints in Performance of duties of Taluka Level Officers

Constrains	Responses
For shift duty more staff required – shortage of staff	71
Small office space	19
Shortage of instruments / funds	06
Not separate and permanent arrangement except calamity	02
Total	98

The major constraints faced by taluka level officers are inadequate staff (71) followed by space for office (19) and funds (6). The major constraints even in the staff and office are staff for shift duties, shortage of instruments and untrained manpower and lack of job specifications/ instructions. We also asked taluka level officers about their requirement of staff. The responses received from the officers' shows that they require more supervisory cadre staff (Mamlatdar (79), Dy. Mamlatdar (12) and less or equal staff like clerk (19) and drivers (18). See Table 5.38.

Table: 5.38 Requirement of Staff at Taluka Level Control Room

Designation	Mamlatdar	Dy. Mamlatdar	Clerk	Driver	Total
Mamlatdar	09	6	15	15	45
Taluka Dev. Officer	17	1	00	00	18
Deputy Collector	11	4	04	03	22
Dy. District Dev Officer	03	0	00	00	03
Police Inspector/PSI	15	1	00	00	16
Assistant Director	15	0	00	00	15
Medical Officer	03	0	00	00	03
Industries /Fire Officer	04	0	00	00	04
Others	02	0	00	00	02
Total	79	12	19	18	128

At taluka level for implementation of district/ state level instructions; senior staff is more necessary than supporting staff.

c. Monitoring and control: In any natural calamity or manmade disaster, monitoring and control plays a vital role. As such information on how monitoring and control is done by taluka level officers was collected. Which is presented in Table 5.39 .

Table: 5.39 Monitoring & Control of Taluka Level Through Different Means.

Sr. No.	Medium	Responses
1	Telex/Fax/Telephone	86
2	Announcement through public address system	81
3	Personal visits	77
4	Radio/T.V.	73
5	Daily Written Reports	63
6	Pamphlets/leaflets	59
	Total	439

The responses are multiple as number of means and equipments used by the taluka level officers for administering disasters are more than one. From the table, it is observed that different means like public address system (81), personal visits (77), Reports (63), pamphlets (59), radio and TV (73), telephone and telex (86) were used for monitoring and control. It shows that telephone / telex, Radio / TV and public announcement system as well as personal visits have played a very important role in proper administration.

d. Present System: To know the efficiency of present system of disaster management, the opinion of taluka officers were sought. The collected information classified in major four assessment criteria. Data are presented in Table 5.40.

Table: 5.40 Efficiency of Present Disaster Management System at Taluka Level

Designation	Excellent	Very Good	Good	Fair	Total
Mamlatdar	4	2	9	09	24
Taluka Dev. Officer	1	2	0	15	18
Deputy Collector	0	2	3	10	15
Dy. District Dev Officer	1	0	0	02	03
Police Inspector/PSI	0	0	2	14	16
Assistant Director	1	3	4	07	15
Medical Officer	0	0	0	03	03
Industries /Fire Officer	0	1	1	02	04
Others	1	0	0	01	02
Total	8	10	19	63	100

The responses of taluka level officers show that the present system is not adequate (63). Most of the officers are of the opinion of improving the system. These same officers were requested to give their views/suggestions for improvement of the present disaster management system. Their views and suggestions were collected and presented in Table 5.41.

Table : 5.41 Views/Suggestions for Improvement of Disaster Management System

Sr. No	Views/Suggestions	Responses
1	Planning: Action Planning- identification of area, zonation, mapping, who, when, what, where, and why all details in plan. / shelter, evacuation, relief/ capacity of NGOs, blood banks, doctors etc. / updating of plan at regular interval (3 months.)	69
2	Co-ordination and community participation/ capacity building through gram sabhas/ rescue teams at village, taluka level.	39
3	Public awareness programmes: for public, GO (all departments), NGO, VO, CBO, schools, colleges, NCC, civil defense etc./ compulsory/mock drills/ trainings/ AV Programs/ frequently.	33
4	Act and law: implementation of law/ separate wing at state level/ easy and understandable system.	24
5	Facilities to government functionaries: Staff, skilled staff, best staff, interested staff, staff in full strength/ separate establishment for DM/ Technical support/mobile phone & latest scientific instruments/ vehicles/ fund or budget/ powers at all levels / responsibilities and specific assignment of duties and its implementation, powers to controlroom State to local/ appreciation, incentives to staff.	21
6	Effective communication system: use of traditional system/ use of existing systems, structures like bus service etc.	20
7	Equipments at all level – community/local, tehsil, district, special task forces and regular check up of it.	15
8	Training to concerns: dealing persons, seniors, technical persons, at all levels.	09

These suggestions / views reveal that there is a big scope for improvement, which will help them in management of disasters more effectively and efficiently.

5.3.6 Disaster Mitigation Measures

Natural Disasters like floods, earthquake, cyclone and drought occur in different part of the state. It affects all the three sectors of the economy. It ruins agriculture, industrial, and service sectors. When they occur often, they affect the overall growth of the state. So it is useful to plan in advance to face disasters and minimize damages. To minimize this damages what mitigation measures are being taken for pre disaster situation, during disaster and post disaster situation by taluka level officers are presented in tables below.

a. Mitigation Measures: To know what mitigation measures are being taken presently specific questions were asked. Responses are as under.

Table : 5.42 Mitigation Measures Taken by Taluka Level Officers

Actions	Responses
Land use zoning	47
Disaster preparedness plans	40
Regarding improvement in predictability	37
Regarding improvement in warning systems	36
Regarding Mapping of prone zones	31
Regarding improvement in forecasting systems	21
Public / community Awareness program through IEC	17
Total	229

The analysis of data shows that land use zoning, disaster preparedness plans, improvement in predictability and warning play a vital role in mitigation measures.

b. Pre Disaster Situation: It is always better to plan for pre-disasters situation. Keeping this thing in mind, are there any measures being taken by taluka level officers? . The responses of these officers are presented in Table 5.43.

Table: 5.43 Measures Taken for Pre-disaster Situation

Actions	Responses
Long term / short term planning	52
Community participation and awareness programmes	49
Constant communication with state level and event place.	49
Warning to the people	46
Keeping health support system alert	40
Information organisation and dissemination	36
Alternate communication systems	36
Stock piling: Area / locations / commodities / instruments	30
HAMs co-ordination	28
Transport arrangement	28
Co-ordination and NGO networking	27
Total	421

It is observed from the responses that taluka level officers have taken appropriate measures as found fit for pre disaster situation, though these may not be sufficient to mitigate disaster damages.

c. During Disaster Situation: The taluka level officers have to take immediate remedial measures during the natural calamity. They have to take immediate action as per the instruction from their higher authority. The data on the measures taken by these officers are collected and shown in Table 5.44.

Table: 5.44 Measures Taken During Disaster Situation

Actions	Responses
Evacuation and shifting	55
Shelter to victims	51
Search and rescue	46
Clearance of debris / dead bodies etc.	43
Security for property.	40
Health and casualty	37
Livestock management	36
Sanitation	36
Total	344

Measures taken are immediate and appropriate as per the need of hour. The taluka level officers have their own limitations.

d. Post Disaster Situation: To give relief and plan for rehabilitation certain information is required. To know what type of information to be collected and how government functionaries have acted after post disaster situation is important. The data on post disaster measures taken by the taluka level officers were collected and are given in Table: 5.45.

Table: 5.45 Measures Taken During Post Disasters Situations

Actions	Responses
Relief	65
Survey of damages occurred.	52
Rehabilitation	48
Preventive measures for diseases	45
Total	210

Relief work and survey of damages are of prime importance. This is followed by rehabilitation and disease control measures. In the post-disaster situation these are the main and important measures to be carried out.

5.3.7 Adequacy of Present Information System

After discussing measures taken in the situation like pre-disaster, during disaster and post disaster, it would be better to know whether the present information system of monitoring and controlling is adequate. The responses collected from taluka level officers' show that a large number of officers are of the opinion that the present system is adequate (62). But some of them are not happy with the present system and responded negatively (38). These responses are presented in table below.

Table: 5.46 Adequacy of Present DMIS

Designation	Yes	No.	Total
Mamlatdar	16	8	24
Taluka Dev. Officer	14	4	18
Deputy Collector	08	7	15
Dy. District Dev Officer	02	1	03
Police Inspector/PSI	12	4	16
Assistant Director	06	9	15
Medical Officer	02	1	03
Industries /Fire Officer	02	2	04
Others	00	2	02
Total	62	38	100

As seen above that some taluka level officers are of the opinion that additional support for all three conditions of disasters are necessary.

Their main requirements for floods are as under.

Table: 5.47 Additional Supports Required for Flood Situation

Situations	Additional Support Required	Responses
Pre	Training to all/ Trained Manpower	13
	Sufficient Machinery	08
	Public awareness system	09
During	Use of Remote Sensing Technology at all levels	09
	Sufficient technical equipments	08
	Better communication system – HAM	04
	Training to all/ Trained Manpower	11
Post	Trained Staff	12
	Relief and Rehabilitation	05
	Use of Remote Sensing Technology at all levels	04

Regarding earthquake situations their demand additional support as under for all three conditions of earthquake disaster.

Table: 5.48 Additional Supports Required for Earthquake Situation

Situations	Additional Support Required	Responses
Pre	Training to all/ Trained Manpower	13
	Sufficient Machinery	07
	Public awareness system	09
	Use of Remote Sensing Technology at all levels	05
	Better communication system – HAM	05
During	Use of Remote Sensing Technology at all levels	04
	Sufficient technical equipments	08
	Better communication system – HAM	04
	More Manpower/ staff	04
Post	Trained Staff	11
	Relief and Rehabilitation	06
	Use of Remote Sensing Technology at all levels	04

The taluka level officers' responses for additional support requirement for cyclone for all three situations are as under.

Table: 5.49 Additional Supports Required for Cyclone Situation

Situations	Additional Support Required	Responses
Pre	Training to all/ Trained Manpower	12
	Sufficient Machinery	07
	Public awareness system	09
	Better communication system – HAM	08
During	Use of Remote Sensing Technology at all levels	04
	Sufficient technical equipments	08
	Better communication system – HAM	05
	More Manpower/ staff	09
Post	Trained Staff	12
	Relief and Rehabilitation	05
	Use of Remote Sensing Technology at all levels	04

To minimize the impact of drought, the taluka level officers have asked for additional support. Support required as in different situations is shown in Table 5.50.

Table : 5.50 Additional Supports Required for Drought Situation

Situations	Additional Support Required	Responses
Pre	Training to all/ Trained Manpower	13
	Planning – Action Plan – Master Plan	04
	Public awareness system	07
	Use of Remote Sensing Technology at all levels	04
	Better communication system – HAM	06
During	Use of Remote Sensing Technology at all levels	04
	Sufficient technical equipments	07
	Better communication system – HAM	03
	More Manpower/ staff	09
Post	Trained Staff	11
	Relief and Rehabilitation	05
	Use of Remote Sensing Technology at all levels	04

5.3.8 Communication Impact

The taluka level officers were asked about whether they possess any equipment for fast communication and decision-making process which are very much required. They were also asked whether they had trained staff to use this equipment. Further we also enquired whether they believed in help of information technology for betterment of taking decisions to manage disasters. Responses to these questions are given below.

Facilities In The Office: The Taluka Level officers responses are analysed as under.

Table: 5.51 Availability of Communication Equipment Facilities at Taluka Level

Sr.No.	Facilities	Responses
1	Phone	96
2	Fax	68
3	Wireless Set	42
4	Mobile Phone	35
5	Media (Print,T.V.,Radio)	22
	Total	263

Taluka level offices are equipped with phone and fax and wireless facilities, which are very important in communicating, taking decisions, and implementing during disaster management activities.

The taluka level offices possess trained staff to utilize IT equipments for communication facilities? Answers to this question are presented in Table 5.52.

Table : 5.52 Information on Trained Staff for Equipment of IT at Taluka Level

Designation	Yes	No.	Total
Mamlatdar	2	22	24
Taluka Dev. Officer	2	16	18
Deputy Collector	4	11	15
Dy. District Dev Officer	1	02	03
Police Inspector/PSI	9	07	16
Assistant Director	7	08	15
Medical Officer	0	03	03
Industries /Fire Officer	2	02	04
Others	2	00	02
Total	29	71	100

The response of the taluka level officers shows that out of hundred officers. 71 have said that they don't have trained staff with them. Rest of them 29 officers responded positively. This information reveals that though taluka officers have IT equipment, but due to lack of trained staff, they are unable to utilize available facilities.

In such circumstances they do send staff for training at different places. In certain cases they take work either from their own skilled staff or take the help from head office. In this way they manage their requirements.

The responses on whether information technology will help them managing natural calamity better way. The responses given by the taluka level officers that all of them are positive in this regard they responded 100% for this question.

5.3.9 Suggestions for DMIS

The taluka level officers are managing the DMIS as such they must have gain good practical experience to prevent/ minimize damages. To know their suggestions the question was asked. These officers' responses are gathered and displayed in tables below for floods, earthquakes cyclone and drought.

Floods : in case of floods, their views / suggestions are as follows

Table : 5.53 Suggestions to Minimize / Prevent for the Floods

Floods	Responses
Efficient forecasting and warning system	17
Public awareness system.	17
Communication should be timely and effective – HAM	15
Evacuation and fast transport at the time.	13
Preparedness by rescue teams	09
Monitoring of dams/ check dams / river basins/ nala / drainage	09

This shows that forecasting and warning system plays a vital role followed by public awareness system, Communication should be timely and effective – HAM and evacuation and fast transport at the time. To prevent floods some of the officers have suggested for construction of dams and proper co-ordination of disaster management activities.

Earthquake : Regarding earthquake the officers of taluka level have suggested following measures to prevent damages.

Table : 5.54 Suggestions to Minimize / Prevent for the Earthquake

Earthquake	Responses
Public Awareness Programme	20
Improve building codes, resistant design & implement it.	14
Quick rescue teams with ready equipments	12
Forecasting and warning technology should be developed.	09
Planning – action plans at all levels	08
Total	63

Taluka officers give importance to educating masses for earthquakes and measures to be carried out. This is very important situation. They also give more stress on improving building codes / acts and equally development of earthquake resistant designs and its strict implementation. When earthquake occurs, quick rescue teams with well-equipped equipments should be kept ready.

Cyclone: Cyclones damages buildings and infrastructure and agriculture. To prevent taluka level officers suggest following measures.

Table : 5.55 Suggestions to Minimize / Prevent for the Cyclone

Sr.No.	Cyclone	Responses
1	Proper forecasting and effective warning system should be developed	28
2	Public Awareness System	20
3	Timely and effective communication	08
	Total	56

They give more importance to forecasting and warning system followed by generating people's awareness. Better communication facilities are also very important according to these officers.

Drought: When monsoon fails, drought situation arises. Impact of drought situations is generally on agriculture and drinking water supply. It is very important to minimize the effects of drought in a region or a state. Suggestions by taluka level officers are given in Table 5.56.

Table : 5.56 Suggestions to Minimize / Prevent for the Drought

Sr. No.	Drought	Responses
1	Storage of – Food, Grass, water, rain water and supply.	15
2	Watershed Management / Resource Management / Land use / Water use/ cropping pattern / Plantation etc. Long term measures/ Drought resistant species.	12
3	Employment generation	04
	Total	31

The suggestions are:(1) proper storage of rain/ runoff water for future consumption. (2) watershed management and (3) constructions of small check dams that generate employment too. The officers say that watershed management programmes are best suited for preventing drought damages.

5.3.10 Information System's Efficiency

To know which information system is more efficient to handle disasters, the taluka level officers were asked certain questions. Their responses for each system are given in Table 5.57.

Table : 5.57 Comments on Efficiency of Various Information Systems

System	Very Good	Good	Fair	Poor	Not Mentioned	Total
Forecasting System	1	26	3	45	25	100
Warning System	1	30	5	42	22	100
Information collection system	3	21	3	47	26	100
Information dissemination system	0	24	4	37	35	100
Public awareness system	0	22	7	47	24	100
Computerization of various activities	0	26	5	41	28	100
Information networking system	1	22	5	42	30	100

1. Forecasting system: Taluka level officers say that the forecasting system is not working efficiently.
2. Warning System: The warning system is also not working properly. The responses are; poor (42), good (30) , fair (5) ,and not responded (22).
3. The information Collection System: Basic data, which help in quick decision-making, are very important. Collections of data on different sectors help in planning disaster situations before and after. In the opinion of these officers, this system also not functioning well. The responses are: poor (47), good (21) , fair/ very good (3) each.
4. Information dissemination system: The collected data on disaster, if they did not reached the proper decision making authority, have no value. So it is very important that collected information should be disseminated for further action. It must also reach the implementing agencies timely. The opinion of taluka level officers on this subject was collected. Their responses show that dissemination of information is not done properly. The responses are: poor (37), good (24), fair (4), very good (0),and not responded (35) .

5. Public Awareness System: It is better to educate community about disasters, its impact, and mitigation measures and what to do and what not to do, and co-operate with authority. Written and/or oral information should be made available to the community. Public awareness is very important and can be disseminated through any media. Data reveal that present public awareness system is very inefficient (47), followed by satisfactory level (22). The responses of the taluka level officers lead to the conclusion that there is a lot of scope for improvement in the present public awareness system.

6 Computerization of various activities: The use of computer technologies for analysis of collected information and its use for disaster management is vital for quick decision-making. Most of the officers are of the opinion of that use of this technology and instruments is very poor (41%). Some officers (28%) are of the opinion that it works reasonably well. This opinion analysis of taluka level officers shows that there is a good scope for improvement in this system also.

7 Information Networking System: It is always better that taluka level officers have information about availability of means at different places and sources. This helps them in procuring required equipment/ information for better and quicker administering of disasters. Networking of information is the need of hour. If a taluka level officer know what is available, where it is available, whom to contact, how to procure and how much time will it take and other related information, he can take quick decision and minimize the damages. The present networking information system is not much useful (42). But some officers (22) are of the opinion that it is useful up to certain extent. The analysis of data reveals that if such networking information system is made available to taluka level officers, it will help in disaster administration. There is excellent scope for proper networking of information system up to grass root level.

Chapter VI

Study of The NGO and Community

This chapter deals with the work carried out by NGO/VO in collaboration with community people. To know their experiences to handling natural disasters, about 40 representatives of NGO/VOs and 60 community representatives were selected for our in-depth study. Their views and suggestions were also studied.

The first part of the chapter looks into the working of NGO/VOs and their views and suggestions on disaster management and information system. The second part discusses the information given by community representatives and their efforts, difficulties faced, and suggestions.

6.1 NGO/VO

In the development of any region / state, some grassroots level working organizations are required. It is equally true that in natural calamities like floods, earthquake, cyclone, drought, etc. their help is required. These organizations have played a vital role in relief and rehabilitation work in past. We have selected a few organizations to understand the role they have played in rehabilitation work. For this purpose forty (40) representatives of NGO/VOs were selected randomly. The responses of these NGOs grassroots' level workers are analysed below.

6.1.1 Literacy Level

We have selected 40 representatives of NGO/VOs. They are having designations like field worker (15), project coordinator (11), consultant (4), and supervisor (7) , office assistant (3). Their educational levels are shown below.

Table : 6.1 Literacy level of selected Representatives of NGO/VOs

Literacy Level	Numbers
Graduate	11
Post Graduate	16
S.S.C./ H.S.C.	04
Technical Course	09
Total	40

Most of the representatives are well qualified and some of them have technical knowledge. Only 4 representatives have studied up to HSC/SSC. This shows that NGO/VOs are very much conscious of their work and responsibility.

Experience: There are 14 representatives having experience of up to two years, 11 having experience of 3 to 4 years and 15 are having experience of 5 years and above. This shows that selected representatives of NGO/VOs are well versed with disaster management. About 12 are engaged in training, education, and awareness creation, 8 in rehabilitation work, 7 in technical support and supervision, and the rest in relief and watershed management activities.

Table : 6.2 Specific Field of Activities of Representatives of NGO/VOs.

Activities	Responses
Research	02
Training-Educations –Awareness	12
Relief	06
Rehabilitation	08
Technical Support-supervision	07
Watershed Management	05
Total	40

There are 28 representatives who have handled 2 numbers of disaster works, while 12 have handled 3 to 4 numbers of disaster work.

6.1.2 Source of Information

The question about How did these representatives receive information of disaster? The responses show that phone/ fax (37) and media (print, T.V., and radio) (39) are the main sources of information followed by personal messages (28).

Table : 6.3 Source of Information for Disasters.

Source of Information for Disaster	Responses
Phone/ Fax	37
Media (print, TV, Radio)	39
Personal message	28
Total	104

It is seen from the analysis of data that phone/media plays vital role in passing the information to community as well as representatives of NGO/Vos.

6.1.3 Involvement of NGO/VOs and Community

We next sought the involvement of NGO/VOs in natural disaster management work. The responses show that 22 representatives were of the opinion that involvement was very good while 12 said that it was excellent.

Table : 6.4 NGOs Involvement in NDM

Level of Involvement	Responses
None	00
Seldom	00
Week	06
Ok	22
Strong	12
Total	40

The data show that voluntary agencies have played a very important role during and after disasters.

Regarding community participation, the responses (18) show that their involvement is satisfactory. Some responses (16) show that community participation is not up to the mark.

Table : 6.5 Community Participation Level.

Community participation level	Responses
Complete	02
Considerable	18
Feeble	16
None	04
Total	40

This shows that the participation level of community in disaster management is not satisfactory.

6.1.4 NGO/VOs Collaboration

Majority (29) of NGO/VOs are working in collaboration with state or central government while 11 VO/NGOs are working either independently or taking help from other agencies.

Table : 6.6 Collaboration with State/ Central Government.

Collaboration with State/ Central Govt.	Responses
Yes	29
No	11
Total	40

It is reveal from the collected responses that most of the representatives of NGO/VOs work in collaboration with state / central government.

6.1.5 Information Equipments

We asked the representative what type of equipments they had to collect and disseminate information for better management of disasters. The collected responses show that all the agencies are equipped with information technology instruments. these instruments include telephone (40), computer (25), media (22), fax (10), and mobile phone (12).

Table : 6.7 Information Technology Equipments with NGO/VOs

Information Technology Equipment	Responses
Telephone	40
Fax	10
Mobile Phone	12
Computer	25
Media (print, T.V., Radio)	22
Total	109

6.1.6 Information Management and Impact

The representatives were asked whether proper and timely information helped in taking appropriate decision in disaster administration. All 40 of them were of the opinion that timely information was essential.

We further asked them whether preventive and timely information would help minimize the effect / damages of disasters." The responses are as follows.

Table : 6.8 What kind of preventive and timely information helps in NDM

Suggestions	Responses
Warning	29
Pre- planning	29
Government rules / regulations (Do's & Don't)	22
Basic information about disasters	20
Total	100

Advance warning and preplanning help minimize damages due to disasters. This is followed by government rules and regulations, dos and donts, and basic information about different disaster.

When any disaster occurs and if you have proper information, relief and rehabilitation work can be speeded up. Keeping this in mind we asked them what type of information can help speed up disaster management work. Their responses are presented below.

Table: 6.9 What kind of Information can help speed up the disaster management work

Suggestions	Responses
List of resources	28
Lest of inventory with GO, NGO, Public & Corporate Sector,	24
Facilities available at various levels	21
Type of human resources and their capabilities to handle various disasters	22
Media cultivation	15
Total	110

The data presented in the table above reveal that the list of resources for help and list of inventory with government, NGOs, public and corporate sectors play a very important role. It is followed by availability of human resources and their capabilities to handle various disasters and facilities available at various levels, i.e. taluka, district, and local level. Information about these facilities helps speed up disaster management work.

6.1.7 Views and Suggestions for DMIS

The representatives were requested to give their views and suggestions about type of information technology to be adopted for disaster management. On the basis of their experiences in disaster management they have given following suggestions.

Table: 6.10 Views and suggestions for DMIS

Suggestions	Responses
Vulnerability reduction through public awareness creation	28
Development of forecasting and warning system for all land of disaster and dissemination upto end unit must be organized	22
Community based and community oriented DMIS should be developed	24
Proper planning for smooth and effective flow of information	20
Information networking from state to villages across all stakeholders like Government, NGO, Corporate sector, Community etc.	14
Total	108

6.1.8 Predictability

The question of predictability level of disasters under study was asked to these representatives and their responses are presented below.

Table: 6.11 Predictability level in view of NGO/VOs.

Disaster	100%	75-100%	50-75%	25-50%	<25% or unpredictable	Total
Floods	15	22	01	01	01	40
Earthquake	00	00	00	00	40	40
Cyclone	16	21	03	00	00	40
Drought	11	21	07	01	00	40

Most of the disasters are predictable at 75 to 100 per cent level except earthquake. Earthquakes are totally unpredictable. In the case of flood, cyclone, and drought, they are always predictable. But some of the representatives are of opinion that even flood (15), cyclone (16), and drought (11) are 100% predictable. In such cases one can take precautions, which will help in reducing the damages.

6.1.9 Present Information System's Evaluation

We wanted to know the efficiency of the present information system with regard to disasters, representatives asked to evaluate the system as *Very good, Good, Fair and Poor*. The responses are presented below.

Table : 6.12 Efficiency of Various Information Systems by Representatives of NGO/VOs

System	Comments				
	Very Good	Good	Fair	Poor	Total
Forecasting System	01	20	10	09	40
Warning System	01	20	10	09	40
Information collection system	02	15	12	11	40
Information dissemination system	01	12	14	13	40
Information Channels Up-Down	01	12	15	12	40
Public awareness system	01	12	15	12	40
Computerization of various activities	01	15	08	16	40
Software : GIS,GPS	01	15	07	17	40
Information networking system	01	15	08	16	40

Data presented in the table above indicate that forecasting and warning system ranks very important and that the systems are good. Other systems like information collection, computerization of various activities, use of modern computer softwares like GIS and information networking activities occupy the second position. This does not mean that other systems like information dissemination, information channels-up and down, and public awareness system are not important, but they occupy the third position.

The responses lead to the conclusion that present systems are very important but are not working up to the required efficiency level.

6.1.10 Role of NOG/VOs in DMIS

NGO/VOs are playing a vital and important role in DMIS. But the specific roles played by them are not known; the responses of the representatives are presented below.

Table : 6.13 Activities of NOG/VOs in DMIS.

Activities	Responses
Post disaster relief	23
Civil construction/ Tech. Support-supervision	14
Distribution of Relief	13
Hydrological works/ watershed management	17
Rehabilitation	15
Research	14
Training, education, and awareness	18
Health	07
Total	121

Most of the NGOs are engaged in mainly in post-disaster relief work combined with other related activates. Some NGOs (18) are engaged in awareness creation and educating people about different disasters. Some of them also colink their activity in hydrological works like supplying drinking water (17). Some NGOs have also interlinking their activities with civil construction work supervision as part of rehabilitation work (14). Only a few NGO/VOs have taken up health as a link activity (7). This shows that important activates like health are not properly taken care of.

6.2 Community Representatives

Natural disasters are not a regular feature but many community representatives have come across different disasters. They also help each other to face disaster situations. Looking into this aspect we decided to collect data on management information system for disaster management. We selected 60 community representatives for a detailed study as mentioned in Chapter 4. These selected community representatives are as under.

Table 6.14 Selected Community Representatives.

Sarpanch	37
Secretary, President Co-op. Soc.	07
Social Worker	04
Common man/ Farmer	08
Member – Panchayat	03
Member Local Organisation	01

This selected community representatives are engaged in different occupations. Their occupations are as under.

Table 6.15 Occupations of Community Representatives.

Farmer	39
Farming and Animal Husbandry	11
Business	04
Service	03
Retired / Others	03

Most of the community representatives are engaged in farming and animal husbandry (50). There are only a few engaged in business and services.

Age, Sex and Experience:

Age: The selected community members are mature and adult. Most of them are between 20 and 60 years of age. There are 22 members in the age group of 20 to 40 years, while 34 are between 40 to 60 years of age.

Sex: Most of the community representatives are male (49); there are 11 female members. Though care has been taken we failed to attract more female members to respond our questionnaires. All those who have responded our questionnaires (11) are sarpanch.

Experience: The selected community representatives have experienced different kind of disasters. To know how many of selected community representatives have this type of experience, a question was asked and responses are as under

Table 6.16 Representatives Experience of facing various disasters.

Yes	60
No	00

This shows that all the community representatives have come across different disaster situations and participated in managing them.

6.1.1 Village Information System

The villages are scattered and not directly connected with taluka headquarters or not interconnected with other villages. The community representatives are facing difficulties in conveying important messages on disasters. What is the present arrangement in the village to inform taluka / district machinery about natural disasters? The responses of the representatives for different disasters are given below.

Table : 6.17 Facilities for informing Taluka/ District Machinery about different Disaster

Disaster type	Personally	Telephone	Panchayat Messenger	Group Representation	Political Leader
Flood	33	54	15	08	10
Cyclone	33	51	16	08	11
Earth quake	33	51	16	09	11
Drought	32	49	15	10	11

The table shows that in flood situations telephone message (54) and as personal contact (33) were used to inform taluka / district machinery. Other like sending a panchayat messenger, group representations at taluka / district level, and generating pressure through political leader are not of much use. In the case of cyclone also, village community representatives have used personal visit and telephone to inform taluka / district administration. The same systems are used for earthquake and drought situations. The community representatives have not used or do not depend on other means or systems to convey information about disaster situations to taluka / district machinery.

6.2.2 Communication facilities

Disaster management requires basic communication facilities, which give information and help in updating information to take appropriate decisions. We wanted to know the communication and other information facilities available in the villages. Data obtained from community representatives are tabulated in Table 6.18.

Table : 6.18 Number of telephone and T.V. Sets owned by Individual and village panchayat for information

Communication facilities	Yes	No
Telephone facility at village	51	09
Own telephone	38	22
Telephone at panchayat office	28	32
Panchayat telephone remain in order	15	13
Television sets at village panchayat	14	46
Panchayat TV sets in order	09	05
Own T.V. Sets	44	16
Usefulness of T.V. sets and Telephone in disasters	60	00

Most of the villages have telephone facilities either owned by the individual or some village organization. Out of 60 community representatives 38 have their own telephone facility and 22 community representatives do not have it. Out of 60 village panchayats, 28 have telephone facility in their office, while 32 village panchayats still lacking this facility. This shows that less than 50% village panchayats lack this important means of communication. Though 28 village panchayat offices have telephone connection, about 50% (13) are not in working condition. This is also an obstacle.

In many villages government supplies TV sets. To know how many villages under the study have panchayat TV sets, the data was collected through community representatives. The data reveals that out of 60 villages only 14 have panchayat TV sets. Only 9 village panchayat sets were in working condition. Out of 60 community representatives, 44 have their own TV sets, and help others watch it.

We asked the selected community representatives about the usefulness of TV and telephone in better management of disaster situations. All the responses were affirmative. Both facilities are very important for quick decision-making. How helpful these are to disaster situations are given in Table 6.19.

Table : 6.19 Usefulness of Television set and telephones in disaster management.

Usefulness	Responses
News for other places/ educational purpose	48
Quick information, Quick communication, Quick contact	44
It gives warning / forecasting for weather	25
Can take advantage of Government schemes/ packages.	21
Create awareness about various measures to be taken	16
Contact for help taking and giving	14
Total	168

TV and telephone are very useful for connectivity to other places in the context of disasters. They give quick information for proper and appropriate decision making. It helps in co-ordination and instructing relevant departments for implementation of relief measures. It also helps in getting and sending necessary help / relief.

6.2.3 Government Help

During and after any natural disaster affected people receive different types of help from community, caste organizations, national and international organizations, NGOs and government. To know what type of help they have received for particular disasters, a specific question was put to them in this respect. Data collected from community representatives are presented below.

Table : 6.20 Responses about type of help community received.

Help Received	Responses
Cash doles	57
Relief Work	51
Medicine	50
Kind	47
Equipment	11
Any other system	02

The affected community got relief in the form of cash doles, relief works, medicine, and in kind.

Table : 6.21 Responses about timely government help.

Community representatives	Yes	No.	Total
Sarpanch	35	02	37
Secretary, President Co-op. Soc.	05	02	07
Social Worker	04	00	04
Common man/ Farmer	07	01	08
Member – Panchayat	03	00	03
Member Local Organisation	01	00	01
Total	55	05	60

Most of the sufferers received government help in time. Very few said that the help was not in time but took two to three days.

6.2.4 Agency's Help Promptly

The selected community representatives were asked, which agencies (GO, NGO) helped disaster affected villages promptly. The responses are shown below.

Table : 6.22 Responses about prompt help from various agencies.

Agency	Responses
Local level	01
Taluka Level	26
District level	51
Social organization	28
NGO	21
Religious organization	40
Others	08
Total	175

The district level authority acted promptly, followed by religious organizations (40), social organizations (28), taluka level authorities (26), and NGOs (21).

Help received from government / district / taluka level was not adequate and timely. The community representatives have specifically responded to this question. They suggested the following measures.

Table : 6.23 Suggested long term measures for providing prompt help.

Suggestions	Responses
Permanent actions for drought proofing	09
Immediate action for relief, shelter, evacuation	11
Employment generation	09
Education / awareness to public	10
Timely action for all kind of disasters	11
Total	50

6.2.5 Present Information System

The selected community representatives were asked weather the present information system of sending information to government is good or bad. The responses show that the present information system is very reliable but inadequate. Only 9 are not satisfied with the present system. They have suggested the following measures.

Table : 6.24 Suggested measures to strengthen present information system.

Suggested Measures	Responses
Telephone facility should be at all villages	08
Latest wireless facility	09
Long distance telephone services should be made cheaper	08
Equipments should be ready with battery.	09
Total	34

6.2.6 Post Disaster Monitoring and Control Suggestions

The community representatives were requested to give their suggestions for proper monitoring and control activities after disasters. These community representatives have given, the following suggestions.

Table : 6.25 Suggestion for post-disaster monitoring and control activities.

Suggestions	Responses
Take enough care and use proper design and raw material for buildings	12
Strict implementation of Government norms	26
Complaint to Government for wrong doers	25
Strengthening Gram samitis as watch agencies.	24
Total	87

The community representatives are very much concerned about post- disaster activities; hence they have strongly suggested government norms for construction of buildings. Their suggestions for measures to avoid damages are given in Table 6.26.

Table : 6.26 Suggestions for measures to avoid damages.

Suggestions	Responses
Creation of awareness	38
Proper warning system.	35
Earthquake proof buildings	23
Pre planning	17
Development of water	07
Total	120

Most of the community representatives are of the opinion that proper awareness (38) should be created among communities. They have also suggested disaster warning systems (35) should be strengthened so that proper arrangements can be made and damages can be controlled. They suggest that in villages disaster proof buildings should be constructed and old structures should be strengthened.

6.2.7 Community Representatives Opinion About Various Systems of Disaster Management

The selected community representatives were requested to give their comments about given nine systems of disaster management. Their comments were classified into four degrees, namely very good, good, fair, and poor. The collected responses are presented below.

Table : 6.27 Comments on various sys Total items of disaster management.

System	Very Good	Good	Fair	Poor	Not mentioned	Total
Forecasting System	00	05	42	04	09	60
Warning System	00	04	42	05	09	60
Information collection system	00	06	42	03	09	60
Information dissemination system	00	04	43	04	09	60
Information channels. Up-down	00	04	42	05	09	60
Public awareness system	00	06	42	03	09	60
Computerization of various activities	00	05	42	04	09	60
Software : GIS, GPS	00	06	42	03	09	60
Information networking system	00	05	42	04	09	60

None of the community representatives are in favour of the present systems, which can be considered as very good. Most of them have responded that all the systems mentioned in the questionnaire are fair. Some of them were of the opinion that very few systems are good. The overall analysis shows that the present system of disaster management is fair.

6.2.8 Community Participation

The selected community representatives were asked to give their responses on the level of community participation. Their responses are shown below.

Table : 6.28 Community participation in natural disaster management activities.

Community Participation	Responses
Complete	16
Considerable	16
Feeble	28
None	00
Total	60

Community participation is very meager (28), is or complete/ considerable (16). This shows that in disaster situations the level of community participation is very poor, this shows that they are dependant on government relief/ help.

Chapter VII

Major Findings

7.1 General Characteristics of Natural Disasters of Gujarat

The study is based mainly on natural disasters. As seen in Chapter II, *Literature Review* the main characteristics of natural disasters in Gujarat are as follows.

7.1.1 Earthquakes

(1) It is found that the Kutch region is more prone to earthquakes.

(2) There is no systematic occurrence of earthquakes in Gujarat and therefore no specific trend is found.

(3) Majority of the earthquakes excluding the July 1956 and the January 2001 quakes, were not much disastrous.

(4) It is found from the data that the frequency of occurrence of earthquakes has gone down.

(5) Movement of tectonic plates and restructuring remain is active even in the last two centuries.

7.1.2 Cyclones

Gujarat has the longest coastline of about 1600 km. in India. Most of the cyclones that affected Gujarat have originated in the Arabian Sea. Their main features are as follows.

(1) May, June, October, and November are the months when cyclones formed in the Arabian Sea.

(2) It is seen that Junagadh / Veraval, Jamnagar and Kutch are the districts that suffered most during the last century.

(3) Cyclones have considerably damaged agriculture and human and cattle lives.

(4) Cyclones are predictable well in advance (72 hours) but it is very difficult to predict its path and hence the devastation is huge.

(5) It is found that there are clear zones for formation of cyclones, especially the region between 60-70 degrees East and 15-25 degrees north in the Arabian Sea.

7.1.3 Floods

(1) The Narmada, Sabarmati, Tapti, and Mahi basins frequently experience rolling river floods.

(2) Problems associated with principal rivers are mainly inundation of areas owing to spilling over of riverbanks and inadequate drainage at places and erosion of banks.

(3) Floods damage mainly agriculture and hutments on the riverbanks.

(4) Saurashtra and north Gujarat experience very limited flood effects.

(5) Though floods damage agriculture and partly industry, they are equally helpful to agriculture as floodwater increases the fertility of land in some cases.

7.1.4 Droughts

The occurrence of droughts is mainly because of erratic and scanty rainfall. Gujarat can be divided into four regions: South Gujarat, North Gujarat, Saurashtra, and Kutch. Generally Kutch and Saurashtra face drought often. The tribal belt of north Gujarat and the eastern part of Gujarat also face droughts often.

(1) Occurrence of drought is very often in Gujarat. Of the last 40 years, 23 years were drought years.

(2) It is found from the data that every seventh year is a severe drought year.

(3) The Kutch region is very much prone to drought in comparison to other regions of the state.

(4) The intensity of damages by drought has been brought dwon considerably over a period of time.

(5) Droughts affect agriculture and cattle herds the most. They also affect human settlements and result in mass migration of cattle and human beings.

(6) Drought creates drinking water problems in rural and urban areas of the drought prone regions.

7.2 Communication Facilities and Role of Media in the State

1. According to 90 per cent (18 responses out of 20) policy makers and experts, in situations of disasters phone/fax and media remain important media of information. As such both these tools need to be strengthened.
2. Phone/fax (according to 80 per cent responses) and media (according to 40 per cent responses) are very important means of communication at district level according to district level officers.
3. Taluka level officers (82 to 91 per cent) felt that telephone/fax is a very important means of communication to contact taluka level officers in disaster situations.
4. 95 per cent representatives of NGO/VOs (38 responses out of 40) said that telephone and media (print, television, radio) play a vital role in passing information to communities as well as representatives of NGO/VOs.
5. Proper and meaningful communication is very important in administering natural calamities at district level according to 50 per cent district level officers. (25 responses out of 50)
6. District level officers (80 per cent responses) say that they receive information through telephone and accordingly take prompt action and monitor disaster administration.
7. According to 35 per cent taluka level officers control rooms are playing a vital role in passing information to taluka functionaries in the case of disasters.

8. Telephone, radio / TV, and public announcement system as well as personal visits have played a very important role in timely administration, say taluka level officers (73 to 86 per cent responses).
9. Taluka level offices say that they are equipped with phone (96 per cent responses), fax (68 per cent responses) and wireless facility (92 per cent responses), which are very important in communicating, taking decisions, and implementing process during disaster management activities.
10. According to representatives of NGO/VOs most of NGO/VOs are equipped with telephone (100 per cent responses), computer (63 per cent responses), media (newspaper, television, radio), fax and mobile phones.

7.3 Possibilities of People's Participation in NDM

1. Information collection, dissemination, and networking systems are functioning poorly status according to (75 per cent responses) district level officers.
2. As per taluka level officers (65 per cent responses) information collection, dissemination and networking systems are functioning poorly.
3. Representatives of NGO/VOs say (70 per cent responses) that information collection, dissemination, and networking systems are functioning poorly.
4. Information collection, dissemination, and networking systems are functioning poorly, say 75 per cent community representatives.
5. Participation level of communities in disaster management activities is found inadequate and lacking enthusiasm according to50 percent representatives of NGO/VOs.
6. 75 per cent community representatives confess that in disaster situations the level of community participation is very poor, which shows that they are dependent on government help/ relief.
7. Awareness programmes and community participation are the compelling needs in pre-disaster situations according to50 percent taluka level officers.
8. Representatives of NGO/VOs say (75 per cent responses) that most of them work in collaboration with either state or central government.

9. Involvement of NGO/VOs is very important in disaster management work (55 per cent say very good and 30 per cent excellent) according to representatives of NGO/VOs.

7.4 Community Awareness and Capacity Building

1. Public awareness system is in poor status according to (75 per cent responses) district level officers.
2. As per 60 per cent taluka level officers public awareness system is in poor status.
3. 68 per cent representatives of NGO/VOs are of the opinion that public awareness system is in poor status.
4. Public awareness system is in poor status, say (75 per cent responses) community representatives.
5. District level officers feel that advance planning (76 per cent) and mapping of disaster prone zones (58 per cent) are very important for mitigating the effects of disasters.
6. Campaign for generating public awareness for disaster management is of prime importance for better management according to (35 percent majority) district officers.
7. Community representatives say that they are using only two means-telephone (85 per cent) or personal contacts (55 per cent)-to inform and get help from taluka / district administration.
8. 100 per cent community people experienced that television sets and telephones are very useful for connectivity to other places in the context of disasters and help in quick decision-making provided they remain in order.
9. 60 per cent district level officers, by their previous experience; always keep themselves up-to-date and remain in touch with state level authorities in pre-disaster situations.

7.5 Use of Technology

1. Computerization of various activities, use of softwares like geographical information system, use of instruments like global positioning system, and use of technologies like remote sensing are in very poor state according to75 per cent district level officers.
2. According to, 61 per cent taluka level officers computerization of various activities, use of softwares like geographical information system, use of instruments like global positioning system, and use of technologies like remote sensing are in poor status.
3. Representatives of NGO/VOs (68 per cent responses) felt that computerization of various activities, use of softwares like geographical information system, use of instruments like global positioning system, and use of technologies like remote sensing are in poor state.
4. Computerization of various activities, use of softwares like geographical information system, use of instruments like global positioning system, and use of technologies like remote sensing are in poor state according to75 per cent community representatives.
5. Taluka level officers say that use of remote sensing technology at all levels in the present MIS will make it more efficient in all three situations: pre, post, and during disasters.
6. Taluka level officers (100 per cent responses) believe that information technology will definitely help them in managing natural calamities better.

7.6 Effectiveness of Forecasting and Warning Systems

1. Forecasting and warning systems are in a poor state according to75 per cent district level officers.
2. 60 per cent taluka level officers are of the opinion that forecasting and warning systems are not up to the mark.
3. Forecasting and warning systems are above satisfactory level according to55 per cent representatives of NGO/VOs.

4. Forecasting and warning systems are fair, that is the feeling 75 per cent of community representatives.
5. More than 45 per cent district officers said that floods, cyclones and drought are predictable 100 per cent, almost 90 per cent of officers are of the opinion that earthquakes are totally unpredictable.
6. Flood, cyclone, and drought are predictable at level of 75 to 100 per cent (above 50 per cent say) and earthquakes are totally unpredictable according to 100 per cent representatives of NGO/VOs.
7. Land use zoning, disaster preparedness plans, improvement in predictability and warning systems play a vital role as mitigation measures according to 40 per cent taluka level officers.
8. Prevention and timely information like early warnings and pre-planning will help minimize damages according to75 per cent representatives of NGO/VOs.

7.7 Development of MIS for NDM

1. Most of the officers those who are policy makers and experts (90 per cent responses) are not satisfied with the present system of disaster management information.
2. 40 per cent district level officers say that they receive information from all levels (state, district, taluka, and village), which helps them in disaster management.
3. According to district level officers, mamlatdar (44 per cent responses) and taluka development officers (22 per cent responses) plays vital role in collecting and passing information to district level officers.
4. District level officers (90 per cent responses) having control rooms but they are not equipped with full strength of staff and equipment and do not work all hours of the day and round the year.
5. According to 88 percent district level officers government machinery at district level reacts very promptly and takes appropriate measures limited to their means.

6. People felt that affected community gets relief in the form of cash dole, relief work, medicine, and in kind (78 to 95 per cent responses). Most of them received government help in time (92 per cent responses). In comparison to others district level authority acted promptly (85 per cent responses).
7. During a disaster, first priority is given to search and rescue operations, followed by evacuation and shifting, according to 80 percent district level officers.
8. During a disaster, first priority is given to evacuation and shifting operations, followed by search and rescue, according to 55 percent taluka level officers.
9. District officers function under the instructions of state level authorities and as per their assessment of the situation they make for any of the relief measures (90 per cent responses).
10. Taluka officers functions under district level authorities and as per the instructions or as per the assessment of the situation they adopt any of the relief measures (65 per cent responses).
11. According to70 to 76 per cent district level officers, all systems are in poor state.
12. All systems are functioning poorly according to 60 per cent taluka level officers.
13. Most of the taluka level officers (63 per cent responses) are of the opinion of improving the present system of disaster management.
14. NGO/VOs (100 per cent responses) believe that proper and timely information helps in taking appropriate decisions to administer the disasters.
15. Community representatives (85 per cent responses) felt that the present information system is very reliable but inadequate.

7.8 General Findings

The findings are based on field studies, review of documents and literature, group discussions, and focus group interviews by researcher.

1. Gujarat is the only and leading state to have a setup like Director, Non-Government organizations co-ordination; but it is not found effective.
2. State control rooms are really of a state of art level in terms of hardware but still there is a room for development in terms of software.
3. Control rooms at district and tehsil levels are not up to the mark. Shortage of staff (trained staff), equipment and vehicle effect their operations. Duplication of control rooms and activities there owing to lack of coordination among various departments.
4. The existing disaster related legislations are insufficient; moreover, they do not place enough emphasis on mitigation. Even the proposed National calamity Management act and the state calamity management act deal with the authority and responsibilities only, and do not cover other related legislations.
5. The needs of relief are met better than rehabilitation since society takes relief as a collective responsibility, while rehabilitation as responsibility of government.
6. Networking and proper co-ordination mechanisms are required among different levels of government, different departments of government, private sector and NGOs, and international agencies.
7. Periodical practice and updatation of district level disaster management plans do not take place.
8. Standard operating procedures (SOPs), formats and field manuals are not available, particularly for assessment, relief, and rescue operations.
9. Documentation of various disastrous events is poor.

Chapter VIII

Recommendations and Conclusions

8.1 Recommendations for Increasing the Effectiveness of Disaster Management Information System

1. Government at all levels should have pro-active policies for making available technologies and information exchange, including the Internet, satellite networks, and others.

2. Government should consider regular funding or contributions to Disaster Management Information System (DMIS) via appropriate departments and agencies and through their participation in state bodies. So that it works more efficiently and effectively which in turn will help public at a large. Additional funding should come from private industry and communities too.

3. Telecommunications service providers should increase their involvement in DMIS by participating in the evaluation of user needs, setting up and maintaining special pricing, enabling simple and easy access to experts, practitioners and local communities, and passing on benefits of improved technologies and decreasing costs.

4. Private industry should continue and increase their contribution to developers and users of Disaster Management Information System (DMIS) as industry benefits too. Many corporations are already actively contributing their knowledge and skills. Ways should be found to increase their participation.

5. Disaster mitigation organizations at all levels should interact with the DMIS developers and suppliers by sharing knowledge and helping to standardize the information to increase the information systems' effectiveness.

6. DMIS developers should find an effective mechanism for notifying the widest number of practitioners of the availability and capabilities of a DMIS and of any new developments. They should strengthen links among themselves to share the knowledge, skills and possibly resources, and strive to avoid duplication, and wasting scarce resources.

7. End users should be educated to the fullest extent on the use of available DMIS, using available material, seminars and training. Users should provide feedback to suppliers and developers freely and frequently to maintain the relevance and quality of information.

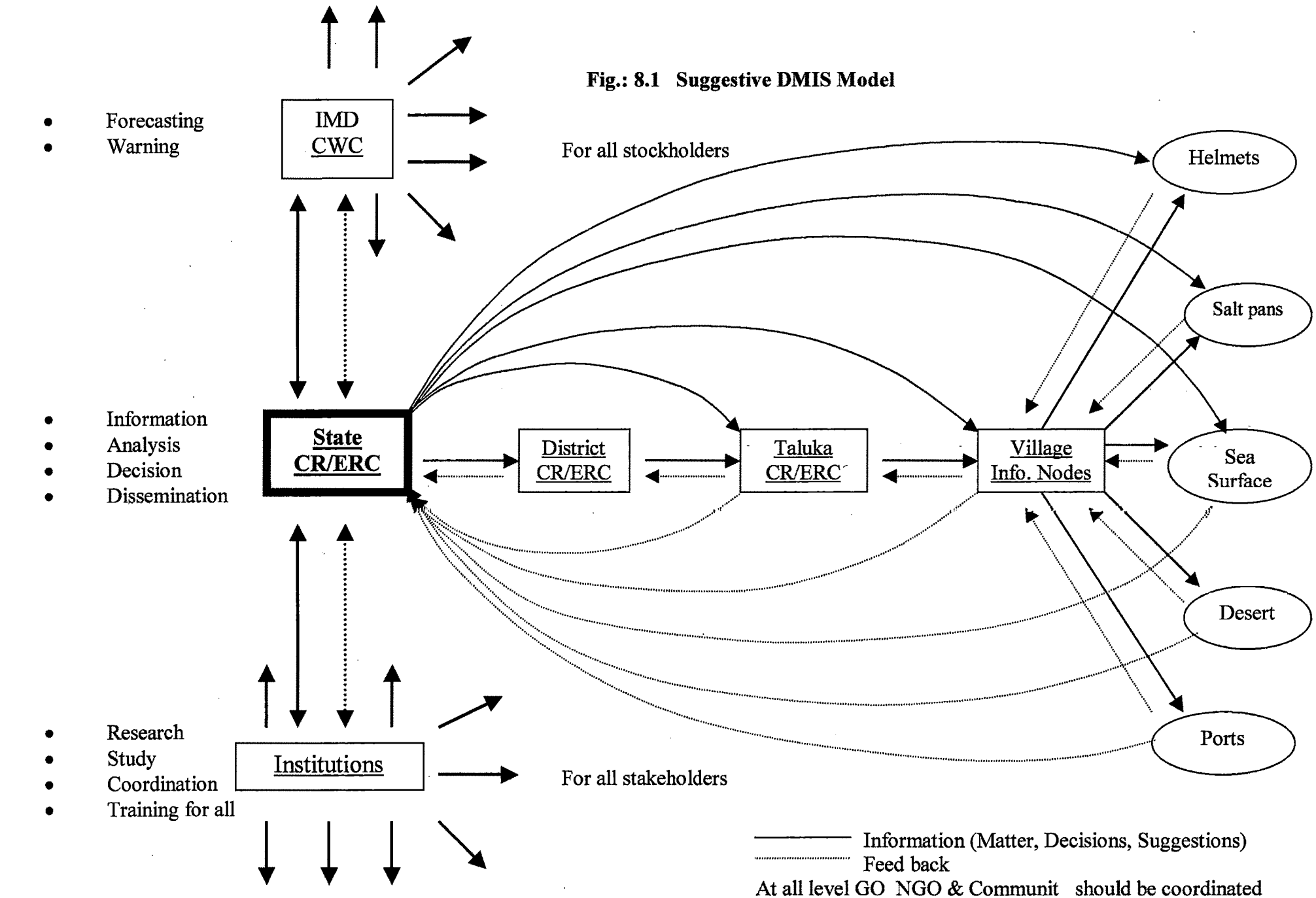
8. The state should maintain the already achieved momentum and direction on a local, district, state, national, regional and international scale. Coordinating and initiating roles as well as involvement in international seminars are important to develop, testify, and familiarize new concepts.

9. The state community at large should support conferences to reaffirm strategies for further evolution of disaster management information systems for disaster preparedness and mitigation and to generate support for this important endeavour.

8.2 Suggestive Disaster Management Information System Model

The primary support feature of any proposed disaster response mechanism needs to be an efficient disaster management information system that would not only support coordination of emergency response operations, but also provide the information flow infrastructure for support activities during pre disaster situations. A suggestive such DMIS model is presented in figure: 8.1.The working of this system will be as follows;

Fig.: 8.1 Suggestive DMIS Model



1. GIS based DSS and DMIS having a complete database of all the spatial and non-spatial data of the state, interlinked with hazard mapping and risk assessment for all regions under consideration. The regions are formed by the criteria of geographical location, similar vulnerability, agro-climatic conditions, ecology, and demography of the region. The decision support system works on simulation models of rapid onset of disasters such as earthquakes, cyclones and floods. If necessary simulation models can be developed for other hazards also.
2. As part of the multi-hazard response plans, maps of the districts with taluka-wise and village-wise details should be developed for a comprehensive (GIS) based DMIS with flexibility to respond to user queries to village specific details of availability of infrastructure.
3. DMIS includes spatial data on natural resources like slope, soils, geology, land use, land cover, drainage network, surface reservoirs, hydro geomorphology, geophysical data and data on climate like rainfall pattern, temperature, wind, humidity, etc. Non-spatial data consist of administrative setup, human resources, socio-economic and demographic profile of the population, water resource, irrigation, health facilities, education infrastructure, animal husbandry, agriculture, power, infrastructure, industry fisheries, public distribution system, tourism, etc. Villages in the State should be assessed for the availability of various facilities listed above and their infrastructure capability should be mapped and included in the database to permit querying.

8.2.1. Control Room/Emergency Response Centre – CR/ERC

The Control Room/Emergency Response Centre (CR/ERC) provides a secure location to coordinate actions and make critical decisions at the time of emergencies and disaster situations. Control Room/Emergency Response Centre is heart of the response mechanism. It would include the following components:

1. CR is the main room where all disaster management operations are planned, managed and executed and would have LAN networked computers, servers, digitized maps, emergency response plans, etc. It will be the convergence point for all inter-agency coordination. The state CR/ERC should have facilities such as conference room, pressroom, analysis room, information center, workstations for various support functions, network control room, etc.
2. CR Analysis room is meant for analyzing information received from the district level control room by GIS experts, statisticians and data analysts so as to come up with a revised disaster management plan that could ensure speedy relief and recovery of the affected areas. A reference library will contain research material to support the staff and personnel at the CR particularly in the analysis room.
3. Information Centre (IC) is meant for collection and dissemination of disaster related information to the media and general public. It would be equipped with good telephone network and computers.
4. The WAN (Wide Area Network) connected room will be in contact with various centers of distribution of relief material such as backup transport systems, food and other materials, shelters in the area under the CR, medical aid centers and list of hospitals and doctors through its special units that deal with these functions.
5. Support Functions (SFs): Support functions are how emergency management accomplishes many of the tasks of responding to an emergency. These SFs form an integral part of the CR and each SF should coordinate its activities from the allocated CR. Extension teams and workers of each SF will be required to coordinate. Each SF is headed by a primary agency, which has been selected based on its authority, resource and capabilities to support the functional area.

   Support functions are communication, public health and sanitation, power, transport, donation, search and rescue, public works and engineering, food, information and planning, relief supplies, drinking water, shelter, media, and helplines

6. Responsible Departments: These are agriculture, defense, surface transport, power, health and family welfare, water resources, animal husbandry, urban development and poverty alleviation, planning and programme implementation, home affairs, rural development, information technology, information and broadcasting, communication, heavy industries, social justice and empowerment, civil aviation, non-conventional energy resources, petroleum and natural gas, finance, external affairs, commerce and industry, science and technology, labour, consumer affairs and public distribution, etc.
7. State, district and taluka level CR should use communication means such as the Internet, telephone, radio (UHF, VHF, HF, Low Band, and Amateur radio frequencies broadband access to streaming audio video network for video-conferencing and complete computer support), fax, etc.
8. District control room/shadow control rooms, State control room/Shadow control room need to be set up and appropriately located.
9. Ham radios to be used as a backup emergency communication system in the eventuality of a disaster and integrated with the district community response plan.
10. Communication at the CR to be duplicated. Alternatives through messengers on foot and vehicles should be maintained.

8.2.2 Information Database

A sound information database is the backbone of any system. It facilitates strategic planning, and quick response with prioritization of activities and optimization of resources. A database of all areas/regions giving land use, demographic, socioeconomic data, infrastructure (like road, rail network, hospital etc.), geography, etc should maintained at state, district, taluka and local levels. Resource inventories of governmental and non-governmental systems, personnel, and equipment should be networked.

1. Creating a state register of resource persons and institutions for disaster management.

2. Generate standardized formats for assessment, relief, and compensation.

3. Generate location specific data, which can provide reliable decision support to emergency managers.

4 Establish information centers (help lines) at predestinated locations for giving details of disasters and answering public queries. Telephone numbers of all such information centers should be given wide publicity through electronic media.

5. Organization of integrated spatial and non-spatial databases using GIS tools in a systematic manner. Integration or synthesis of spatial and non-spatial information within the framework of a coherent data model and linkages between the different datasets are vital. This would involve diverse information from variety of sources, and requires effective matching of similar entities and demands information consistency across datasets.

6. Generation of spatial outputs, supported by tables/charts to help in developmental planning and decision-making.

8.2.3 Communication links, forecasting, and warning

1. It is essential to modernize the computerized weather forecasting system of IMD by introducing very fine resolution numerical models for tropical cyclone predictions. This may require ocean-atmosphere coupled models with suitable parameterization schemes to comprehend intense precipitation, strong winds and storm surges well in advance. This would essentially need upgrading of the computing facility in IMD.

2. The rain-gauge network is too coarse to provide variations of rainfall within districts. An adequate network of rain gauges should cover the entire state, especially known hazardous areas and locations.

3. Deployment and networking of adequate number of doppler radars would facilitate improvement in analysis and prediction of cyclones.

4. There is need to improve design of tide-gauges to capture storm surges and augmentation of their network along west coast.

5. There is a definite need to strengthen the network of micro-seismic monitoring. Round the clock earthquake monitoring through strong motion seismographs and VSAT based digital telemetry systems should be encouraged to generate and disseminate, earthquake related information in real time.

6. A network of automatic weather stations should be established.

7. Community level communication should be given due emphasis so that people can be in touch with concerned relatives.

8. Forecasting and warning should reach endusers and feedback mechanism must be developed for appropriate actions.

8.3 Suggestions/Conclusions

1. Proper *coordination* mechanisms should be incorporated for government, different departments, private sector, NGOs and international agencies.

2. Government and its agencies alone cannot completely address disasters in terms of prevention, mitigation, and rehabilitation. Each and every individual has to play a role. Community participation and capacity building is a must through *public awareness campaigns.*

3. Detailed *Disaster Management Plans* must be prepared for various levels starting from state to village (local) level with the help of GIS based DSS and DMIS.

4. Impacts of disasters can be reduced with the help of accurate and qualitative *forecasting* along with timely and area specific *warnings* to endusers by encouraging research and development.

5. Well-equipped *control room and information network* throughout the state with information nodes at village level is necessary. Duplication of work and control rooms of various departments should be avoided by proper coordination among various departments.

6. *Training for all*: State level professional and autonomous disaster management institute should be established to impart training for different segments of state human resources. Senior executives to cutting edge level, technical, non-technical, local government, community etc.

7. *Civil defence* for majority of the citizens.

8. Armed forces should be included in any knowledge network to make use of their experience in handling disasters and their command, control, and communication facilities.

9. Gujarat has a tradition of wisdom in coping mechanisms for disaster prevention and mitigation. There is a need to study these and develop a compendium of such knowledge.

10. Promoting *amateur radio clubs* in schools and colleges to propagate Ham radios in remote areas.

11. Framing standard relief procedures, standards of relief, manuals and SOPs for emergency.

12. Regular updation of plans and periodical rehearsals and mock drills especially before the season of cyclones and floods and on regular basis for earthquakes. Periodical checking and maintenance of equipment and machinery.

13. Forming task forces and allotting responsibilities for providing immediate relief and operating relief camps. (civil defense corps, home guards (operational control), citizens' councils, in city ward wise identified key persons, corporators, ex-corporators, mohalla samities, existing village committees, ex defence personnel, panchayat members, eminent women leaders, youth clubs, mahila manadals.)

BIBLIOGRAPHY

1. Albala-Bertrand J M
   Political Econmy Of Large Natural Disasters. 1993, Clarendon Press, Oxford.

2. Alexander David
   Natural Disasters.1993, Resarch Press, New Delhi.

3. Anderson M B
   Rising From The Ashes : Development Strategies In Times Of Disaster.1989, Westview Press, Boulder.

4. Canning John
   Great Disasters.1991, Prentice Hall, New Jersey.

5. Cashman J R
   Management Of Hazardous Waste .1986, Technomic Pub. Co. Inc. Lancaster.

6. Cheremisinoff P N
   Industrial Noise Control Handbook. 1978 ,Ann Arbor Science Pub. Inc,Michigan.

7. Clark J I
   Population And Disaster.1989, Basic Blackwell ,Oxford.

8. Davis Lee
   Encyclopeadia Of Natural Disasters.1992,Headlinebook Pub. Co. London.

9. Davis Lee
   Natural Disasters.1992, Factson File , New York.
   Acc No : 22586

10. Geipel Robert
    Disaster And Reconstruction.1982, George Allen & Unwin , London.

11. Gokhberg M B
    Earthquake Prediction. 1995 , Gordon And Breach Pub. Australia.

12. Nternational Labour Office
    Prevention Of Major Industrial Accidents. 1991, I.L.O, Geneva.

13. Jadhav H V
Encyclopaedia Of Hazardous Chemical And Medical Management. 1993 , Himalaya Pub. House,New Delhi.

14. Kingston J
Catastrophe And Crisis : Natural And Man - Made Disaster That Shook The World.1979, Bloomsury Books, London

15. Kletz T
Lessons From Disaster.1993,Institution Of Chamical Engineers, Warwickshire.

16. Kreps G
Social Structure And Disaster.1989, Uni. Of Delaware Press, London.

18. Marriott J
Disaster At Sea. 1987,Ian Allan Ltd. England.

19. Mishra V K
Environment Disasters And The Law. 1994, Ashish Pub. House, New Delhi.

20. Misra G K
Natural Disaster Reduction. 1993, Reliance Pub. House, New Delhi.

21. Myers K N
Total Contingency Planning For Disasters.1993, John Wiley & Sons Inc, New York.

22. Perry R W
Evacuation Planning In Emergency Anagement.1981 Lexington Books, Toronto.

23. Proctor N H
Chemical Hazards Of The Workplace.1978, Van Nostrand Reinhold, New York.

24. Newburn Tim
Disaster And After.1993, Jessicaking Sley Pub. London.
Acc No : 22588

25. Qed Information Science Inc.
Disaster Recovery.1985, Cgalingo Pub. Co. New York.

26. Ramlu M A
Mine Disasters And Mine Rescue.1992, Qed Information Science ,Inc Massachusetts.

27. Singh R B
Disasters Environment And Development.1996, Oxford & Ibh Pub. Co. Pvt.Ltd. New Delhi.

28. Varley Ann
Disasters Development And Environment.1994,Wiley & Sons, Chichester.

29. Vickery D J
School Buildings and Disasters.1982, Unesco, Washington.

30. Mannion, A.M. and Bewlby,S.R.
(1992) Environmental issues in the 1990s. Chichester: John Wiley & Sons Ltd. (ISBN 0-471-933260)

31. Pickering, K.T. and Owen, L.A.
(1994) An introduction to Global Environmental Issues. London : Routealge. (ISBN 0-415-10228-6: 16.00)

32. Parsuraman S., Unnikrishnan P.V. (ed),
India Disaster Report : Towards a Policy Initiative (New Delhi : Oxford University Press, 2000)

33. Mehrotra Nirmita,
National Conference on Disaster and Technology (Ministry of Information Technology, Government of India, 1998)

34. Sharma, Vinod K, (ed),
Disaster Management, (National Centre for Disaster Management, Indian Institute of Public Administration, New Delhi, 1997)

35. Prakash Singh, William W. Mendel, Graham H. Turbiville,JR
Disaster Response in INDIA, (The Center of Excellence in Disaster Management and Humanitarian Assistance & The Foreign Military Studies Office, 2000)

36. M.C.Gupta, Vinod K. Sharma, L.C.Gupta, B.K. Tamini (ed),
Manual on Natural Disaster Management in India, (National Centre for Disaster Management, IIPA, New Delhi, 2001)

37. L.C.Gupta, Vinod K. Sharma,
Drought in Gujarat 1999-2000 &2000-2001. (National Centre for Disaster Management, IIPA, New Delhi, 2001)

38. L.C.Gupta, Vinod K. Sharma,
Drought in Rajasthan 1999-2000 &2000-2001. (National Centre for Disaster Management, IIPA, New Delhi, 2000)

39. Memorandum to the Government of India on the Cyclone in Gujarat, June 1998.
(Revenue Department, Government of Gujarat, Gandhinagar, 1998)

40. Report on Drought in Gujarat for Scarcity 1993-94,
(Revenue Department, Government of Gujarat, Gandhinagar, 1993-94)

41. Annual Administrative Report on Scarcity for 1982-83,
(Revenue Department, Government of Gujarat, Gandhinagar, 1982-83)

42. Memorandum on Flood Situation in Gujarat State, Monsoon 1994,
(Revenue Department, Government of Gujarat, Gandhinagar, 1994)

43. Annual Administrative Report on Scarcity for 1986-87,
(Revenue Department, Government of Gujarat, Gandhinagar.1986-87)

44. Gujarat Relief Manual,
(Revenue Department, Government of Gujarat, Gandhinagar.)

45. Singh R.B.
Disaster Environment & Development, (Oxford & IBM) 1996

46. Alexander David,
Natural Disasters, 1993

47. Davis Lee,
Natural Disasters, 1992

48. Kletz T,
Lessons from Disaster, 1993.

49. Girish K. Mishra, G.C. Mathur,
Natural Disaster Reduction, New Delhi.

50. Ronanld W. Perry, Michael K. Lindell, Marjorie R.
Greene America. Evacuation Planning in Emergency Management.

51 Model Action Plan for Disaster Preparedness for Floods,
(Department of Agriculture & Co-operation, Government of India, New Delhi.)

52. Stop Disasters, (ISSN - 1018-0850 * Number 32.11/1997.)1997.

53 B ROLL
- United Nations "Prevention Begins With Information" (World Disaster Reduction Campaign, IDNDR) http://www.unog.ch 1998.

54. Reading Material Natural Disaster Management Cell,
Sardar Patel Institute of Public Administration, Ahmedabad. Imperatives in Natural Disaster Reduction, 18-21

55. Prakash, Indu,
Disaster Management, Rashtra Prahari Prakashn, Ghaziabad, 1995,p-36.

56. Study Material of Certificate in Disaster Management
by Indira Gandhi National Open University, New Delhi, CDM – 01, Block-1, Unit – 1. Page

57 Charaksanhita,
(Vimansthanam - Chapter III) which is derived from Atharvaveda.

58 Gujarat Earthquake recovery Programme,
ADB and World Bank Joint Assessment Report, Gujarat Earthquake-A Rapid Environmental Appraisal, Gujarat Institute of Desert Ecology.

59 Shah Jolly,
State Environmental Action Programme(SEAP), (Report for GEC, Vadodara) Ahmedabad.

60 Hirway Indira,
Mahadevia Darshini, Gujarat Human Development Report 1999, Mahatma Gandhi Labour Institute Ahmedabad 1999.

61 Vyas Shailesh,
Presentation of Drought Proofing Programme in Kutch, Sahjeevan, 2002

62 Mishra Usha,
Exploring Drought Relief Policy and Practice: A Consultation with Government and NGOS, Oxfam (India) Trust

63 BMTPC,
Gujarat: Vulnerability Atlas of India, Ministry of Urban Development, New Delhi, 1997

64 Merh S.S.,
Role of active tectonism in evolution of Kutch Landscape

65 Kumar Santosh,
Disaster Management, Analysing Vulnerability, Disaster Mitigation: Experiences and Reflection.

66. Buch, V.B.
Vice Chairman, Sardar Sarovar Narmada Nigam Ltd. (SSNNL),"Meeting the Challenge of Development.

FURTHER WEB REFERENCES

IDNDR
http://www.onewrold.org/idndr/index.html

Human Rights links:
http:/www.igc.org/igc/issues/hr/

Humanitarian Practice Network:
http://www.odihpn.org/

Human Development Reports:
http://www.undp.org/hdro/

Hazard Reduction and Recovery Center
http://hrrc.tamu.edu/hrrc/

Guardian online, Ben Wisner:
http://www.quardianunlimited.co.uk/Archive/Article/0,4273,4128181,00.html

The Guardian
http://www.guardianunlimited.co.uk/

GeoHarards:
http://www.geohaz.org/home.htm

Gender and Disaster Network:
http://www.anglia.ac.uk/geography/gdn

Environmental Justice Resource Center
http://www.ejrc.cau.edu/

Earthquakes and Megacities Initiative:
http://www.megacities.physik.uni-karisruhe.de/

Duryog Niravan
http://www.adpc.ait.ac.th/duryog/duryog.html

Disaster Mitigation for Sustainable Livelihoods Programme, University of Cape Town (Periperi is there):
http://www.egs.uct.ac.za/dimp/

Disaster and Social Crisis Research Network (D&SCRN):
http://www.anglia.ac.uk/geography/d&scm

Disaster Diplomacy:
http://www.arct.cam.ac.uk/disasterdiplomacy/

DesInventar:
www.desinventar.org/terremoto

CRID (Centro Regional Sobre la informacion de Desasters)
http://www.crid.or.cr/

Comission Nacional de Emergencias de EI Salvador
www.coensv.50megs.com/mapas

CISPES (Committee in Solidarity with the People of EI Salvador
http://www.cispes.org/

Cepredenac:
http://www.cepredenac.org/

Centre for Science and Environment:
http://www.cseindia.org/index.html

Centre for Research on the Epidemiology of Disaster (CRED)
http://www..cred.be/

ASCE World Congress on Disaster Reduction:
www.asce.org/conferencees/disasters2001/

Asian Disaster Prevention Centre
http://www.adpc.ait.ac.th/

Asian Urban Disaster Mitigation Programme:
http://www.adpc.ait.ac.th/audmp/audmp.html

Bilham, Roger: Global Urbanization and Lncreased Seismic Risk:
http://cires.colorado.edu/~bilham/globalEQfatalities.html

Coordinadora Civil para la Emergencia y la Reconstruccion – CCER Nicaragua
http://www.ccer-nic.org/

Center for Public Health and Disaster Relief
http://www.ph.ucla.edu/cphdr/

World Resources 1996-7: The urban Environment:
http://www.wri.org/wri/wri/wr/96-97-/96tocful.html

World Assembly of Urban Inhabitants:
http://www.laneta.apc.org/hic-al/

WHO Healthy Cities Program:
http://www.wits.ac.za/fac/med/comhealth/healthy.htm

Vulnerability Assessment Techniques and Applications (National Oceanic & Atmospheric Administration and organization of American States, Unit for Sustainable Development and Environment).
http://www.csc.noaa.gov/vata/

Urban Development/ World Bank:
http://www.worldbank.org/html/fpd/urban/

United Nations Institute for Social Research:
http://www.unrisd.org/index.htm

UNDP Emergency Response Division:
http://www.undp.org/erd/

United Nations Centre for Human Settlement (Habitat):
http://www.unchs.org/

SEEDS (The Sustainable Environment and Ecological Development Society):
http://www.seedsindia.org/

Salud y Desasters en Centroamerica:
http://www.disaster.infor.desasters.net/saludca/desastersCR/

Relief Web:
http://www.reliefweb.int/w/rwo.nsf

Pan American Health Organsization (PAHO):
http://www.paho.org.

Oscar Romero University (named for slain Salvadoran priest, Oscar Romero):
http://www.mnm.kent.edu/~umoar/index.html

Natural Hazards Information Center:
http://www.Colorado.EDU/hazards.

Multidisciplinary Center for Earthquake Engineering Research (MCEER)
http://mceer.buffalo.edu/

La Red:
http://www.desenredando.org/

Intermediate Technology Development Group (ITDG)
http://www.oneworld.org/itdg/

ISDR (United Nations International Strategy for Disaster Reduction)\
http://www.unisdr.org/

IIED's Human Settlements Program:
http://www.oneworld.org/iied/human/

IDNDR Urban Earthquake Risk Reduction program (RADIUS):
http://www.geohaz.org/radius/

Code-A

"APPLICATION OF MANAGEMENT INFORMATION SYSTEM IN NATURAL DISASTER MANAGEMENT"

QUESTIONNAIRE

1. Name : _____
2. Designation : _____
3. Qualification : _____
4. Speciality/Faculty/
   Department : _____
5. Organisation : _____
6. Working on Current
   Position since : _____
7. Total experience in the
   Specified field : Executive _____
   Trainer _____
   Other _____ Total Years_____
8. What is the present system of Disaster Management in the State for the following:
   (a) Floods :
   (b) Earthquake :
   (c) Cyclone :
   (d) Drought :
9. How many Natural Disasters you have handled during your service period.

	Type of disaster	Year of event	Role played
1.			
2.			
3.			
4.			
5.			

10. Difficulties faced by you in managing Natural Disaster. Please describe

(a) Floods :

(b) Earthquake :

(c) Cyclone :

(d) Drought :

11. Your views and suggestions in management of Natural Disaster.

(a) Floods :

(e) Earthquake :

(f) Cyclone :

(g) Drought :

12. How did you received information about Disaster from below level ? Please (✓) any.
(Local Level, Taluka Level, District Level)

	Type of Disaster		Information System
(a)	Floods	:	Phone/Fax/E-mail/HAM/Mobile Phone/Walki-talki Personal Massage/Media(Print,T.V.,Radio)/Satellite Phone/Wireless System/any other please specify
(b)	Earthquake	:	Phone/Fax/E-mail/HAM/Mobile Phone/Walki-talki Personal Massage/Media(Print,T.V.,Radio)/Satellite Phone/Wireless System/ any other please specify
(c)	Cyclone	:	Phone/Fax/E-mail/HAM/Mobile Phone/Walki-talki Personal Massage/Media(Print,T.V.,Radio)/Satellite Phone/Wireless System/ any other please specify
(d)	Drought	:	Phone/Fax/E-mail/HAM/Mobile Phone/Walki-talki Personal Massage/Media(Print,T.V.,Radio)/Satellite Phone/Wireless System/ any other please specify

13. Your action after receiving information : (Tick any)

Sr No	Action Taken	Flood	Earthquake	Cyclone	Drought
1.	Rush to the place to manage				
2.	Rush to the location to get information				
3.	Gave direction to subordinates at a time				
4.	Called a meeting				
5.	Approached superiors to get orders				
6.	Tried to co-ordinate line depts., NGOs, Experts. Etc.				
7.	Left for location after arranging contact point				
8.	Any other please specify				

14. In your views present Disaster Management Information System (DMIS) is satisfactory ?

Yes/No.

15 Your general views/suggestions for betterment of Disaster Management Information
System. (DMIS)

(a) Floods :

(b) Earthquake :

(c) Cyclone :

(d) Drought :

Place : _____ (Investigator)
Date : _____

Survey for doctorate programme on **MIS in NDM.**

Code-B

"APPLICATION OF MANAGEMENT INFORMATION SYSTEM IN NATURAL DISASTER MANAGEMENT"

QUESTIONNAIRE

1. Name : _____

2. Designation : _____

3. Qualification : _____

4. Specialty/Faculty/ Department : _____

5. Organisation : _____

6. Working on Current position since : _____

7. Total experience in the specified field :
   Executive _____
   Trainer _____
   Other _____ Total Years_____

8. What is the information system available to know about Occurrence of Disaster? (Please ✓ any)

   (a) Through which level ? : State level functionary/ District/ Taluka/ Village/ Any other please specify.

   (b) Through person or Dept. ? : Police Dept./ TDO/Mamladtdar/Political Leader/ M.P./MLA/ Sarpanch/NGO representative/ Personal visit/ Any other please specify.

   (c) Through which communication System : Phone/Fax/E-mail/HAM/Mobile Phone/Walki-talki/Personal Massage/ Media (Print, T.V. ,Radio)/Satellite Phone/Wireless System/ any other please specify

9. Do you have Disaster Management Department/Cell/Control Room at District level?

Yes / No.

If "YES" please give details of it.
1.
2.

If "NO" please give constraints of it :
1.
2.
3.
4.

10. How much response time it takes for action in case of natural severe calamity ? (Please ✓ any)

(1) Immediately (2) One Day (3) Two/Three days

(4) Week (5) Fortnight

11. What is your control mechanism to administer this type of event? Please give details.

12. What **mitigation (Long term + short term)** measures are being taken at this level for Disaster Management (District level) (Please ✓ any)

1. Regarding Mapping of prone zones
2. Regarding improvement in predictability
3. Regarding improvement in forecasting systems
4. Regarding improvement in warning systems
5. Disaster preparedness plans
6. Land use zoning
7. Public / community Awareness program through IEC
8. If other, specify

13. What measures before disaster occurs (**pre-disaster situation**) is being taken at this level for Disaster Management. (District level) (Please ✓ any)

1. Long term / short term planning
2. Community participation and awareness programmes
3. Information Organisation and dissemination
4. HAMs co-ordination
5. Co-ordination and NGO networking
6. Alternate communication systems
7. Stock piling : Area / locations / commodities / instruments
8. Transport arrangement
9. Warning to the people
10. Constant communication with state level and event place.
11. Keeping health support system alert
12. If other, specify

14. What measures **during disaster situation** is being taken at this level for management of it. (District level) (Please ✓ any)

1. Evacuation and shifting
2. Search and rescue
3. Shelter to victims
4. Livestock management
5. Clearance of debris / dead bodies etc.
6. Health and casualty
7. Sanitation
8. Security for property.
9. If other, specify

15. What measures for the **post disaster situation** is being taken at this level. (District level) (Please ✓ any)

1. Relief: Drinking Water/ Food packets / Medicinal help / clothes / utensils.
2. Survey of damages occurred.
3. Preventive measures for diseases
4. Rehabilitation : Social / Economical / Agriculture and Irrigation / Housing Reconstruction / Housing retrofitting
5. If other, specify

16. How do you monitor and control the disaster relief activities by using following Information System ? (Please ✓ any)

1. Radio/T.V. 2. Telex/Fax 3. Telephone 4. Wireless system
5. E-mail 6. Mobil Phone 7. Walki-taki 8. Information ads
9. Information leaflets 10. HAM Radio

17. Which of the present following facilities were useful in taking decision quickly to minimize the losses of lives and property ? (Please ✓ any)

1. Radio/T.V. 2. Telex/Fax 3. Telephone 4. Wireless system
5. E-mail 6. Mobil Phone 7. Walki-taki 8. Information ads
9. Information leaflets 10. HAM Radio

18. What is current level of predictability in your system?

Disaster	100%	75-100%	50-75%	25-50%	<25%
Floods					
Earthquake					
Cyclone					
Drought					

19. Is present M.I.S. satisfactory and helpful to manage and take decision quickly ?
Yes/ No.

If "YES" , Please explain How ?
1.
2.
3.

20. Your general views/suggestions for betterment of Disaster Management Information System. (DMIS)

(a) Floods :
(b) Earthquake :
(c) Cyclone :
(d) Drought :

21. Do you want to opine something about various systems like ;

System	Comments
1. Forecasting System	
2. Warning System	
3. Information collection system	
4. Information dissemination system	
5. Information channels. Up-down.	
6. Public awareness system	
7. Computerisation of various activities	
8. Software : GIS, GPS	
9. Information networking system	

Place : _____ (Investigator)
Date : _____

Survey for doctorate programme on **MIS in NDM.**

code-C

"APPLICATION OF MANAGEMENT INFORMATION SYSTEM IN NATURAL DISASTER MANAGEMENT"

QUESTIONNAIRE

1. Name :_____
2. Designation :_____
3. Qualification :_____
5. Speciality/Faculty/ Department :_____
5. Organisation :_____
1. Working on Current position since :_____
7. Total experience in the specified field :
   Executive _____
   Trainer _____
   Other _____

   Total Years _____
8. Who informs you about natural calamity ? How ?

Sr. No.	Natural Calamity	Who	Level	how (communication system)
1.	Floods			
2.	Earthquake			
3.	Cyclone			
4.	Drought			

9. Do you have separate cell/control room to operate such natural calamity. Yes/No.

   (a) If "YES", no. of functionaries and their assigned duties.

   1.
   2.
   3.
   4.

(b) If "NO" please give constraints of it ?

1.
2.
3.
4.

10. Do you think, present strength of functionaries are adequate?

Yes/No.

If "NO", How much more required and in what category?

1.
2.
3.
4.
5.

11. How do you monitor and control Disaster administration ?

(1) Mobil Phone
(2) Radio/
(3) T.V.
(4) Telex/Fax
(5) Telephone
(6) Personal visits
(7) Announcement through public address system
(8) Daily Written Report
(9) Pamphlets/leaflets

12. Is the present system of Disaster administration

Excellent / Very Good / Good / fair (please ✓ any)

13. What are your views/suggestions to improve the present disaster management system. Please give details.

1.
2.
3.
4.
5.

14. What **mitigation (Long term + short term)** measures are being taken at this level for Disaster Management (Please ✓ any)

1. Regarding Mapping of prone zones
2. Regarding improvement in predictability
3. Regarding improvement in forecasting systems
4. Regarding improvement in warning systems
5. Disaster preparedness plans
6. Land use zoning
7. Public / community Awareness program through IEC
8. If other, specify

15. What measures before disaster occurs (**pre-disaster situation**) is being taken at this level for Disaster Management. (Please ✓ any)

1. Long term / short term planning
2. Community participation and awareness programmes
3. Information Organisation and dissemination
4. HAMs co-ordination
5. Co-ordination and NGO networking
6. Alternate communication systems
7. Stock piling : Area / locations / commodities / instruments
8. Transport arrangement
9. Warning to the people
10. Constant communication with state level and event place.
11. Keeping health support system alert
12. If other, specify

16. What measures **during disaster situation** is being taken at this level for management of it. (Please ✓ any)

1. Evacuation and shifting
2. Search and rescue
3. Shelter to victims
4. Livestock management
5. Clearance of debris / dead bodies etc.
6. Health and casualty
7. Sanitation
8. Security for property.
9. If other, specify

17. What measures for the **post disaster situation** is being taken at this level. (Please ✓ any)

1. Relief: Drinking Water/ Food packets / Medicinal help / clothes / utensils.
2 Survey of damages occurred.
3. Preventive measures for diseases
4. Rehabilitation : Social / Economical / Agriculture and Irrigation / Housing Reconstruction / Housing retrofitting
5. If other, specify

18. Is present information system adequate to manage disasters ? Yes/No.

If "NO" what additional support required by you for pre, during and post disaster condition.

	Type	**Pre.**	**During**	**Post**
1.	Floods			
2.	Earthquake			
3.	Cyclone			
4.	Drought			

19 Does your office have following facilities / equipment for fast communication and decision making process for management of disasters ? (please ✓)

Phone/ Fax/ E-mail/ HAM/ Mobile Phone/ Walki-talki/ Media(Print,T.V.,Radio) /Satellite Phone/ Wireless System/ any other please specify

20. Do your office have trained staff to handle with new Information Technology equipment.

Yes / No.

If "NO" how do you manage to work with it ?

21. Do you believe that information technology will help you for better management of such natural calamities ?

Yes/No.

22. With your practical experience, which type of DMIS should be developed to prevent/minimize the damages due to disasters, spell briefly.

1. Floods :

2. Earthquake :

3. Cyclone :

4. Drought :

23. Do you want to opine something about various systems like ;

System	Comments
1. Forecasting System	
2. Warning System	
3. Information collection system	
4. Information dissemination system	
5. Information channels. Up-down.	
6. Public awareness system	
7. Computerisation of various activities	
8. Software : GIS, GPS	
9. Information networking system	

Place : _____ (Investigator)
Date : _____

Survey for doctorate programme on **MIS in NDM.**

code-D

"APPLICATION OF MANAGEMENT INFORMATION SYSTEM IN NATURAL DISASTER MANAGEMENT"

QUESTIONNAIRE

1. Name : _____
2. Designation : _____
3. Qualification : _____
4. Total experience in the specified field : Executive _____
   Trainer_____ Other _____ Total Years _____
5. Name of NGO : _____
6. Address & Phone/Fax : _____
   E-mail : _____
7. Specific Fields of activities : _____

8. Specific districts for the activities : _____

10. How many type of disaster you have handled? When ? Where ?

	Type of Disaster	Year of event	Place	Role Played
1.				
2.				
3.				
4.				
5.				

11. What is your source of information for disaster ?

Sr.	Type of Disaster	Level of Source	Communication System used
1.	Floods		
2.	Earthquake		
3.	Cyclone		
4.	Drought		

12. In general, NGO involvement in Natural Disaster Management is None/ Seldom / week / ok / Strong.

13. What has been the community participation level ?
Complete / Considerable / Feeble / None

14. Have you collaborated with any other agency including State/Central Government?

Yes/ No.

If "YES", Please state ;

	Type of Disasters	Agency	Period
1.	Floods		
2.	Earthquake		
3.	Drought		
4.	Cyclone		

15. Do you possess the following information technology equipment ? Please (✓) any.

Yes/No

Telephone/Fax/E-mail/HAM/Mobile Phone/Walki-talki/ Telex/ Computer/ Media (Print,T.V.,Radio)/Satellite Phone/Wireless System/any other please specify

16. Do you think that proper and timely information helps in taking appropriate decision ?

Yes/ No

17. According to you what kind of preventive and timely information can help to Minimize the effect/Damages due to disaster ?

Sr.	Type	Type of information
1.	Floods	
2.	Earthquake	
3.	Cyclone	
4.	Drought	

18. What type of information can help to speed up the disaster management work ?

Sr.	Type of Disaster	Type of information
1.	Floods	
2.	Earthquake	
3.	Cyclone	
4.	Drought	

19. Give your views and suggestion about what type of information technology should Be adopted for Disaster Management or best suitable DMIS.

20. What is current level of predictability in our system?

Disaster	100%	75-100%	50-75%	25-50%	<25%
Floods					
Earthquake					
Cyclone					
Drought					

21. Any traditional system or mechanism for prediction of Natural disasters in your knowledge ? pleas give details ;

Sr.	Type of Disaster	System or Mechanism
1.	Floods	
2.	Earthquake	
3.	Cyclone	
4.	Drought	

22. Do you want to opine something about various systems like ;

System	Comments
1. Forecasting System	
2. Warning System	
3. Information collection system	
4. Information dissemination system	
5. Information channels. Up-down.	
6. Public awareness system	
7. Computerisation of various activities	
8. Software : GIS, GPS	
9. Information networking system	

23. Your and your organization's role in DMIS ? Which kind of activities and up to What extent ?

Place : _____ (Investigator)
Date : _____

Survey for doctorate programme on **MIS in NDM.**

Code-E-F

"APPLICATION OF MANAGEMENT INFORMATION SYSTEM IN NATURAL DISASTER MANAGEMENT"

QUESTIONNAIRE

1. Name :_____

2. Address & Contact No :_____

   (Telephone/Fax) _____

3. Are you a member of Local / Taluka / District / State legislative body?

   Yes / No

   If "YES"; Designation : _____

4. Working on Current position since: _____

   Occupation : _____

   Age : _____ Sex : _____

5. How many following natural disasters have you come across? Give details :

Sr.	Type of Disaster	When	Where
1.	Flood		
2.	Cyclone		
3.	Earthquake		
4.	Drought		

6. What was the system in the village to inform Taluka/District Machinery about following natural disasters ?

Type	Personally	Telephone	Panchayat Messenger	Group Representation	Political Leader	Any other system
Flood						
Cyclone						
Earthquake						
Drought						

7. Does your village have telephone facility? Yes / No.

8. Do you have your own telephone? Yes / No.

9. Does village Panchayat office have telephone facility? Yes / No.

10. Does your Panchayat telephone remain in order most of the time ? Yes / No.

If "NO", it is out of order – always / most of the time /rarely (Please ✓ any)

11. Does your village Panchayat have T.V. set? Yes / No.

If "YES", when did your Village Panchayat acquired it ? Year _____

12. Is your Panchayat's T.V. set working properly? Yes / No.

If "NO", since when it is out of order? Months/ Year _____

13. Do you have your own T.V. Set? Yes / No.

If "YES", When did you purchase it? Year _____

14. Do you think that T.V. and Telephone are very useful in the time of Natural Disaster?

Yes / No.

If "YES" how? Please explain.

1.
2.
3.
4.
5.

15. What Government help generally do you receive for the following natural disaster?

Type of Disaster	Cash	Relief work	Medicine	Kind	Any other system	Equipment
Flood						
Cyclone						
Earthquake						
Drought						

16. Have your village received Government help in time? Yes / No.

If "NO", please give details

Type	Immediately	Hours			Days			Week		> Two Weeks
		3	6	12	1	2	3	1	2	
Flood										
Cyclone										
Earthquake										
Drought										

17. Which of the following agencies generally helped your village promptly?

Type of Disaster	Local level	Taluka level	District level	Social Org.	N.G.O.	Religious Org.	Others
Flood							
Cyclone							
Earthquake							
Drought							

18. Are the actions taken by government adequate and timely ? Yes / No.

If "NO", in your opinion what action would have been more appropriate?

Sr.	Type of Disaster	Action
1.	Flood	
2.	Cyclone	
3.	Earth Quick	
4.	Drought	

19. Are you satisfied with the present information system of informing higher authority ?

Yes / No

If "NO" please give your suggestions.

1.
2.
3.
4.

20. Do you think that disasters are preventable ?

If "YES"; How ?

1.
2.
3.
4.
5.

If "NO" ; why ?

1.
2.
3.
4.
5.

21. How do you monitor and control the post disaster activities ?

1.
2.
3.
4.

22. What measures/suggestions do you suggest to minimize/ avoid disaster damages ?

1.
2.
3.
4.
5.

23. Do you want to opine something about various systems like;

System	Comments
1. Forecasting System	
2. Warning System	
3. Information collection system	
4. Information dissemination system	
5. Information channels. Up-down.	
6. Public awareness system	
7. Computerisation of various activities	
8. Software : GIS, GPS	
9. Information networking system	

24. What has been the community participation level ? (Please ✓ any)
Complete / Considerable / Feeble / None

25. Do you know about any traditional system or mechanism for prediction of Natural disasters ? please give details ;

Sr.	Type of Disaster	System or Mechanism
1.	Floods	
2.	Earthquake	
3.	Cyclone	
4.	Drought	

Place : _____ (Investigator)
Date : _____

Survey for doctorate programme on **MIS in NDM.**